

เอกสารสอบเทียบความถูกต้องของเครื่องมือตรวจวัดคุณภาพสิ่งแวดล้อม

ลำดับที่ 1 คุณภาพอากาศในบรรยากาศ

ลำดับที่ 2 ระดับเสียงในบรรยากาศ

ลำดับที่ 3 คุณภาพน้ำ

ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม

| รายการตรวจวิเคราะห์ | เครื่องมือเก็บตัวอย่าง | เครื่องมือตรวจวิเคราะห์ |
|---|--|---|
| | ชื่อเครื่องมือ | ชื่อเครื่องมือ |
| 1. คุณภาพอากาศในบรรยากาศ | | |
| TSP | High Volume Air Sampler No. R02, R05, R06, R07 | Digital Balance |
| PM ₁₀ | High Volume PM ₁₀ Air Sampler No. R02, R08, R10, R13 | Digital Balance |
| SO ₂ | SO ₂ Analyzer No. R01, R02, R04, R10 | SO ₂ Analyzer No. R01, R02, R04, R10 |
| NO ₂ | NO _x Analyzer No. R01, R05, R07, R11 | NO _x Analyzer No. R01, R05, R07, R11 |
| CO | CO Analyzer No. B04, R01, R02, R03 | CO Analyzer No. B04, R01, R02, R03 |
| Total VOC | Personal pump SKC No. B71, R26, R32, R40 Rotameter No. R05 | VOC Analyzer No. R01 |
| 2. ระดับเสียงในบรรยากาศ L _{eq} 24 hr, L _{eq} 1 hr, L _{eq} 5 min, L _{max} , L ₉₀ 1 hr, L ₉₀ 5 min, เสียงรบกวน | Acoustic Calibrator Sound Level Meter No. CR-B01, B04, B06, B09 Sound Level Meter No. ACO-R15, R18, R19, R25 | - |
| 3. คุณภาพน้ำ | | |
| pH | - | pH meter |
| Temperature | - | Thermometer |
| Turbidity | - | Turbidity meter |
| Salinity | - | Conductivity meter |
| Total Suspended Solids | - | Digital Balance |
| Total Dissolved Solids | - | Digital Balance |
| Dissolved Oxygen | - | DO meter |
| BOD ₅ | - | DO meter |
| COD | - | COD Reactor |
| Phosphate-Phosphorus | - | Spectrophotometer |
| Cyanide | - | Spectrophotometer |
| Free Chlorine | - | Spectrophotometer |
| Fluoride | - | Spectrophotometer |
| Arsenic | - | AAS |
| Barium | - | ICP |
| Cyanide | - | Spectrophotometer |
| Nickel | - | AAS |
| | | ICP |
| Zinc | - | AAS |
| | | ICP |
| Manganese | - | AAS |
| | | ICP |
| Copper | - | AAS |
| | | ICP |
| Cadmium | - | AAS |
| | | ICP |

ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม (ต่อ)

| รายการตรวจวิเคราะห์ | เครื่องมือเก็บตัวอย่าง | เครื่องมือตรวจวิเคราะห์ |
|---------------------------|------------------------|-------------------------|
| | ชื่อเครื่องมือ | ชื่อเครื่องมือ |
| 3. คุณภาพน้ำ (ต่อ) | | |
| Mercury | - | AAS |
| Total Iron | - | ICP |
| Total Chromium | - | ICP |
| Lead | - | AAS |
| | | ICP |
| Selenium | - | AAS |
| Hexavalent Chromium | - | Spectrophotometer |
| Total Coliform Bacteria | - | Incubator |
| | | Water Bath |
| VOCs | - | GC/MS |
| Formaldehyde | - | Spectrophotometer |

ลำดับที่ 1

คุณภาพอากาศในบรรยากาศ



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High Volume Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

Calibration Data

| High Volume Air Sampler Data | | Calibration Data | | |
|------------------------------|------------|------------------|--|-------|
| Recorder No. | Blower No. | Date | Actual Flowrate (ft^3/min) | R^2 |
| B35 | B35 | 02/02/2024 | $y = 1.188x - 3.435$ | 0.996 |
| B36 | B36 | 01/02/2024 | $y = 1.201x - 4.036$ | 0.999 |
| B37 | B37 | 01/02/2024 | $y = 1.196x - 2.671$ | 0.998 |
| B38 | B38 | 02/02/2024 | $y = 1.232x - 6.552$ | 0.997 |
| B39 | B39 | 03/02/2024 | $y = 1.164x - 0.902$ | 0.997 |
| B40 | B40 | 01/02/2024 | $y = 1.225x - 6.117$ | 0.999 |
| B41 | B41 | 02/02/2024 | $y = 1.265x - 6.140$ | 0.999 |
| B42 | B42 | 02/02/2024 | $y = 1.187x - 3.625$ | 0.999 |
| B43 | B43 | 01/02/2024 | $y = 1.233x - 2.707$ | 0.997 |
| B44 | B44 | 01/02/2024 | $y = 1.202x - 3.263$ | 0.996 |
| R01 | R01 | 01/02/2024 | $y = 1.214x - 4.512$ | 0.999 |
| R02 | R02 | 02/02/2024 | $y = 1.222x - 5.522$ | 0.999 |
| R03 | R03 | 03/02/2024 | $y = 1.204x - 5.785$ | 0.999 |
| R04 | R04 | 01/02/2024 | $y = 1.220x - 5.355$ | 0.999 |
| R05 | R05 | 01/02/2024 | $y = 1.190x - 5.262$ | 0.997 |
| R06 | R06 | 02/02/2024 | $y = 1.223x - 6.383$ | 0.998 |
| R07 | R07 | 02/02/2024 | $y = 1.084x + 0.577$ | 0.999 |
| R08 | R08 | 01/02/2024 | $y = 1.157x - 2.531$ | 0.999 |
| R09 | R09 | 01/02/2024 | $y = 1.194x - 3.227$ | 0.998 |
| R10 | R10 | 02/02/2024 | $y = 1.198x - 4.625$ | 0.998 |
| R11 | R11 | 02/02/2024 | $y = 1.143x - 2.176$ | 1.000 |
| R12 | R12 | 02/02/2024 | $y = 1.165x - 4.124$ | 0.998 |
| R13 | R13 | 03/02/2024 | $y = 1.133x - 1.833$ | 0.997 |
| R14 | R14 | 01/02/2024 | $y = 1.216x - 3.559$ | 0.995 |
| R15 | R15 | 01/02/2024 | $y = 1.183x - 5.143$ | 0.999 |
| R16 | R16 | 01/02/2024 | $y = 1.227x - 7.151$ | 0.999 |
| R17 | R17 | 02/02/2024 | $y = 1.181x - 3.964$ | 0.996 |
| R18 | R18 | 02/02/2024 | $y = 1.195x - 3.915$ | 0.997 |
| R19 | R19 | 03/02/2024 | $y = 1.215x - 6.609$ | 1.000 |
| R20 | R20 | 03/02/2024 | $y = 1.208x - 5.309$ | 0.998 |

Calibrated by :

(Mr. Adul Dangklom)

Approved by :



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High Volume PM-10 Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

Calibration Data

| High Volume PM-10 Data | | Calibration Data | | |
|------------------------|------------|------------------|--|-------|
| Recorder No. | Blower No. | Date | Actual Flowrate (ft^3/min) | R^2 |
| R01 | R01 | 02/02/2024 | $y = 1.206x - 5.952$ | 0.998 |
| R02 | R02 | 02/02/2024 | $y = 1.219x - 3.961$ | 0.997 |
| R03 | R03 | 01/02/2024 | $y = 1.203x - 5.426$ | 0.998 |
| R04 | R04 | 01/02/2024 | $y = 1.191x - 6.027$ | 0.997 |
| R05 | R05 | 01/02/2024 | $y = 1.199x - 5.883$ | 1.000 |
| R06 | R06 | 01/02/2024 | $y = 1.192x - 3.038$ | 0.998 |
| R07 | R07 | 02/02/2024 | $y = 1.169x - 2.670$ | 0.996 |
| R08 | R08 | 02/02/2024 | $y = 1.186x - 4.195$ | 0.997 |
| R09 | R09 | 03/02/2024 | $y = 1.184x - 3.512$ | 1.000 |
| R10 | R10 | 03/02/2024 | $y = 1.179x - 3.695$ | 0.999 |
| R11 | R11 | 03/02/2024 | $y = 1.202x - 2.389$ | 0.997 |
| R12 | R12 | 01/02/2024 | $y = 1.194x - 5.194$ | 0.998 |
| R13 | R13 | 01/02/2024 | $y = 1.173x - 2.754$ | 0.999 |
| R14 | R14 | 01/02/2024 | $y = 1.176x - 2.231$ | 0.997 |
| R15 | R15 | 02/02/2024 | $y = 1.188x - 3.910$ | 0.998 |
| R16 | R16 | 02/02/2024 | $y = 1.180x - 3.568$ | 0.998 |
| R17 | R17 | 02/02/2024 | $y = 1.195x - 3.126$ | 0.996 |
| R18 | R18 | 03/02/2024 | $y = 1.143x - 2.749$ | 1.000 |
| R19 | R19 | 01/02/2024 | $y = 1.154x - 2.002$ | 0.996 |
| R20 | R20 | 01/02/2024 | $y = 1.161x - 4.362$ | 0.998 |

Calibrated by :

(Mr. Adul Dangklom)

Approved by :

(Mr. Pecha Detadom)



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| CALIBRATION REPORT | | | | | |
|--|-----------------------------------|-----------------------------|--------------------------------|--------------------------------|-------|
| SO ₂ FLUORESCENT ANALYZER | | | | | |
| DATE : | 10 March 2024 | BRAND : | API | MODEL : | 100E |
| NO. | SO ₂ -R01 | SERIAL NO. | 3415 | | |
| 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. : A008145K | | | |
| Certified Date : 21 June 2021 | | Expired Date : 21 June 2029 | | Cylinder Conc. : 50.0 ppm | |
| CALIBRATING CONDITION | | | | | |
| Pressure | 1011 | mmbar | Temp. | 24.5 | °C |
| | | % RH | | 48 | |
| 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 | 0.11 | - | 0 | - |
| SO ₂ Span | 400.0 | 399.5 | -0.125 | 400.0 | 1.004 |
| API Model 100E SO ₂ Analyzer Check list | | | | | |
| Test Values | Observed Value | Units | Nominal Range | | |
| RANGE | 500 | PPB | 0-500 | | |
| SAMPLE PRESS | 28.5 | mmHg | 25-35 | | |
| SAMPLE FLOW | 658 | cc/min | 650 ± 10% | | |
| PMT | 103.1 | mV | -20-150 with Zero Air | | |
| LIV LAMP | 3009.6 | mV | 1000-4900 | | |
| STR. LGT | 61.9 | PPB | <100 | | |
| DRK PMT | 63.4 | mV | -50 - 200 | | |
| DRK LMP | 58.2 | mV | -50 - 200 | | |
| UVPS | 674 | V | 550-900 constant | | |
| DCPS | 2527 | mV | 2500 ± 200 | | |
| CELL TEMP | 50.2 | °C | 50 ± 1 | | |
| BOX TEMP | 29.5 | °C | 5-40 | | |
| PMT TEMP | 7.1 | °C | 7 ± 2.0 | | |
| SO ₂ Span Conc. | 400 | PPB | 20-20,000 | | |
| SO ₂ Slope | 1.004 | - | 1.0 ± 0.3 | | |
| SO ₂ Offset | 22.2 | mV | <250 | | |
| Stability at Zero | 0.1 | PPB | <0.2 | | |
| Stability at Span | 0.2 | PPB | 0.5% of reading (above 50 ppb) | | |

Calibrated by :

(Mr.Adul Dangklom)

Approved by :

(Mr.Peera Detudom)



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| CALIBRATION REPORT | | | | | |
|--|-----------------------------------|-----------------------------|--------------------------------|--------------------------------|-------|
| SO ₂ FLUORESCENT ANALYZER | | | | | |
| DATE : | 10 March 2024 | 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. : A008145K | | | |
| Certified Date : 21 June 2021 | | Expired Date : 21 June 2029 | | Cylinder Conc. : 50.0 ppm | |
| CALIBRATING CONDITION | | | | | |
| Pressure | 1011 | mmbar | Temp. | 24.5 | °C |
| | | % RH | | 48 | |
| 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 | 400.4 | 0.100 | 400.0 | 1.004 |
| API Model 100E SO ₂ Analyzer Check list | | | | | |
| Test Values | Observed Value | Units | Nominal Range | | |
| RANGE | 500 | PPB | 0-500 | | |
| SAMPLE PRESS | 28.5 | mmHg | 25-35 | | |
| SAMPLE FLOW | 657 | cc/min | 650 ± 10% | | |
| PMT | 103.8 | mV | -20-150 with Zero Air | | |
| LIV LAMP | 2992.4 | mV | 1000-4900 | | |
| STR. LGT | 61.2 | PPB | <100 | | |
| DRK PMT | 63.1 | mV | -50 - 200 | | |
| DRK LMP | 57.8 | mV | -50 - 200 | | |
| UVPS | 670 | V | 550-900 constant | | |
| DCPS | 2526 | mV | 2500 ± 200 | | |
| CELL 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 | 1.004 | - | 1.0 ± 0.3 | | |
| SO ₂ Offset | 22.1 | mV | <250 | | |
| Stability at Zero | 0.1 | PPB | <0.2 | | |
| Stability at Span | 0.2 | PPB | 0.5% of reading (above 50 ppb) | | |

Calibrated by :

(Mr.Adul Dangklom)

Approved by :

(Mr.Peera Detudom)



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| CALIBRATION REPORT | | | | | |
|--|-----------------------------------|-----------------------------|--------------------------------|--------------------------------|-------|
| SO ₂ FLUORESCENT ANALYZER | | | | | |
| DATE : | 10 March 2024 | BRAND : | API | MODEL : | 100E |
| NO. | SO ₂ -R04 | SERIAL NO. | 3489 | | |
| 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. : A008145K | | | |
| Certified Date : 21 June 2021 | | Expired Date : 21 June 2029 | | Cylinder Conc. : 50.0 ppm | |
| CALIBRATING CONDITION | | | | | |
| Pressure | 1011 | mmbar | Temp. | 24.5 | °C |
| | | % RH | | 48 | |
| 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 | 0.999 |
| API Model 100E SO ₂ Analyzer Check list | | | | | |
| Test Values | Observed Value | Units | Nominal Range | | |
| RANGE | 500 | PPB | 0-500 | | |
| SAMPLE PRESS | 28.5 | mmHg | 25-35 | | |
| SAMPLE FLOW | 655 | cc/min | 650 ± 10% | | |
| PMT | 102.9 | mV | -20-150 with Zero Air | | |
| LIV LAMP | 2950 | mV | 1000-4900 | | |
| STR. LGT | 60.8 | PPB | <100 | | |
| DRK PMT | 62.7 | mV | -50 - 200 | | |
| DRK LMP | 57.8 | mV | -50 - 200 | | |
| UVPS | 670 | V | 550-900 constant | | |
| DCPS | 2515 | mV | 2500 ± 200 | | |
| CELL TEMP | 50.2 | °C | 50 ± 1 | | |
| BOX TEMP | 28.9 | °C | 5-40 | | |
| PMT TEMP | 7.1 | °C | 7 ± 2.0 | | |
| SO ₂ Span Conc. | 400 | PPB | 20-20,000 | | |
| SO ₂ Slope | 0.999 | - | 1.0 ± 0.3 | | |
| SO ₂ Offset | 21.8 | mV | <250 | | |
| Stability at Zero | 0.1 | PPB | <0.2 | | |
| Stability at Span | 0.2 | PPB | 0.5% of reading (above 50 ppb) | | |

Calibrated by :

(Mr.Adul Dangklom)

Approved by :

(Mr.Adul Dangklom)



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| CALIBRATION REPORT | | | | | |
|--|-----------------------------------|-----------------------------|--------------------------------|--------------------------------|-------|
| SO ₂ FLUORESCENT ANALYZER | | | | | |
| DATE : | 10 March 2024 | BRAND : | TELEDYNE | MODEL : | 100E |
| NO. | SO ₂ -R10 | SERIAL NO. | TPS1065 | | |
| 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. : A008145K | | | |
| Certified Date : 21 June 2021 | | Expired Date : 21 June 2029 | | Cylinder Conc. : 50.0 ppm | |
| CALIBRATING CONDITION | | | | | |
| Pressure | 1011 | mmbar | Temp. | 24.5 | °C |
| | | % RH | | 48 | |
| 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 | 399.7 | -0.075 | 400.0 | 1.009 |
| API Model 100E SO ₂ Analyzer Check list | | | | | |
| Test Values | Observed Value | Units | Nominal Range | | |
| RANGE | 500 | PPB | 0-500 | | |
| SAMPLE PRESS | 28.5 | mmHg | 25-35 | | |
| SAMPLE FLOW | 656 | cc/min | 650 ± 10% | | |
| PMT | 103.0 | mV | -20-150 with Zero Air | | |
| LIV LAMP | 3034.2 | mV | 1000-4900 | | |
| STR. LGT | 61.4 | PPB | <100 | | |
| DRK PMT | 63.2 | mV | -50 - 200 | | |
| DRK LMP | 58.1 | mV | -50 - 200 | | |
| UVPS | 670 | V | 550-900 constant | | |
| DCPS | 2528 | mV | 2500 ± 200 | | |
| CELL TEMP | 50.5 | °C | 50 ± 1 | | |
| BOX TEMP | 29.4 | °C | 5-40 | | |
| PMT TEMP | 7.0 | °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 | 21.7 | mV | <250 | | |
| Stability at Zero | 0.1 | PPB | <0.2 | | |
| Stability at Span | 0.2 | PPB | 0.5% of reading (above 50 ppb) | | |

Calibrated by :

(Mr.Adul Dangklom)

Approved by :

(Mr.Adul Dangklom)



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| CALIBRATION REPORT | | | | | |
|--|-----------------------------------|-------------------|----------------------------|--------------------------------|----------|
| CHEMILUMINESCENT NO / NO ₂ / NO _x ANALYZER | | | | | |
| DATE : | 10 March 2024 | BRAND : | API | MODEL : | 200E |
| NO. | NOX-R01 | SERIAL NO. | 769 | | |
| 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 | 48 |
| 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 | 0.11 | - | 0 | - |
| NO Span | 400 | 399.9 | -0.025 | 400.0 | 1.003 |
| NO _x Span | 400 | 400.2 | 0.050 | 400.0 | 1.007 |
| API Model 200E NO _x Analyzer Check List | | | | | |
| Test Values | Observed Value | Units | Nominal Range | | |
| RANGE | 500 | PPB | 500 standard | | |
| STABILITY (Zero Gas) | 0.1 | PPB | < 2 with zero air | | |
| SAMPLE FLOW | 505 | cc/min | 500 ± 50 | | |
| OZONE FLOW | 79 | cc/min | 80 ± 15 | | |
| PMT | 102.9 | mV | 20 ± 150 | | |
| AZERO | 94.1 | mV | 20 ± 150 | | |
| HVPS | 670 | V | 420 - 900 constant | | |
| RCCELL TEMP | 50.2 | °C | 50 ± 1 | | |
| BOX TEMP | 29.1 | °C | 8 - 48 | | |
| PMT TEMP | 7.0 | °C | 7 ± 2 | | |
| MOLY TEMP | 315.1 | °C | 315 ± 5 | | |
| RCCELL PRESS | 8.3 | IN-Hg-A | 2 - 10 constant | | |
| SAMPLE PRESS | 28.5 | IN-Hg-A | 25 - 30 constant | | |
| NO Span Conc | 400 | PPB | 20 - 20,000 | | |
| NO _x Span Conc | 400 | PPB | 20 - 20,000 | | |
| NO Slope | 1.003 | - | 1.0 ± 0.3 | | |
| NO _x Slope | 1.007 | - | 1.0 ± 0.3 | | |
| NO Offset | 1.2 | mV | -20 to +150 | | |
| NO _x Offset | 0.8 | mV | -20 to 150 | | |
| Stability at Zero | 0.1 | PPB | < 0.2 | | |
| Stability at Span | 0.2 | PPB | < 2 ppb @ 400 ppb span gas | | |

Calibrated by :

(Mr.Adul Dangklom)

Approved by :

(Mr.Peera Detakorn)



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| CALIBRATION REPORT | | | | | |
|--|-----------------------------------|-------------------|----------------------------|--------------------------------|----------|
| CHEMILUMINESCENT NO / NO ₂ / NO _x ANALYZER | | | | | |
| DATE : | 10 March 2024 | BRAND : | API | MODEL : | 200E |
| NO. | NOX-R05 | SERIAL NO. | 4413 | | |
| 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 | 48 |
| 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 | - |
| NO Span | 400 | 399.6 | -0.100 | 400.0 | 1.004 |
| NO _x Span | 400 | 400.3 | 0.075 | 400.0 | 1.007 |
| 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 | 507 | cc/min | 500 ± 50 | | |
| OZONE FLOW | 79 | cc/min | 80 ± 15 | | |
| PMT | 103.2 | mV | 20 ± 150 | | |
| AZERO | 93.8 | mV | 20 ± 150 | | |
| HVPS | 670 | V | 420 - 900 constant | | |
| RCCELL TEMP | 50.3 | °C | 50 ± 1 | | |
| BOX TEMP | 29.2 | °C | 8 - 48 | | |
| PMT TEMP | 7.4 | °C | 7 ± 2 | | |
| MOLY TEMP | 315.3 | °C | 315 ± 5 | | |
| RCCELL PRESS | 8.2 | 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 | 1.004 | - | 1.0 ± 0.3 | | |
| NO _x Slope | 1.007 | - | 1.0 ± 0.3 | | |
| NO Offset | 1.1 | mV | -20 to +150 | | |
| NO _x Offset | 0.7 | mV | -20 to 150 | | |
| Stability at Zero | 0.1 | PPB | < 0.2 | | |
| Stability at Span | 0.2 | PPB | < 2 ppb @ 400 ppb span gas | | |

Calibrated by :

(Mr.Adul Dangklom)

Approved by :

(Mr.Peera Detakorn)



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| CALIBRATION REPORT | | | | | |
|--|-----------------------------------|-------------------|----------------------------|--------------------------------|----------|
| CHEMILUMINESCENT NO / NO ₂ / NO _x ANALYZER | | | | | |
| DATE : | 10 March 2024 | 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 | 48 |
| 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 | - |
| NO Span | 400 | 399.9 | -0.025 | 400.0 | 1.002 |
| NO _x Span | 400 | 400.2 | 0.050 | 400.0 | 1.007 |
| 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 | 102.9 | mV | 20 - 150 | | |
| AZERO | 94.1 | mV | 20 - 150 | | |
| HVPS | 670 | V | 420 - 900 constant | | |
| RCELL TEMP | 50.2 | °C | 50 ± 1 | | |
| BOX TEMP | 29.4 | °C | 8 - 48 | | |
| PMT TEMP | 7.1 | °C | 7 ± 2 | | |
| MOLY TEMP | 315.2 | °C | 315 ± 5 | | |
| RCELL PRESS | 8.3 | IN-Hg-A | 2 - 10 constant | | |
| SAMPLE PRESS | 28.5 | IN-Hg-A | 25 - 30 constant | | |
| NO Span Conc | 400 | PPB | 20 - 20,000 | | |
| NO _x Span Conc | 400 | PPB | 20 - 20,000 | | |
| NO Slope | 1.002 | - | 1.0 ± 0.3 | | |
| NO _x Slope | 1.007 | - | 1.0 ± 0.3 | | |
| NO Offset | 0.9 | mV | -20 to +150 | | |
| NO _x Offset | 0.3 | 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 :

[Signature]

Approved by :

[Signature]
(Mr.Peeru Deudom)



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| CALIBRATION REPORT | | | | | |
|--|-----------------------------------|-------------------|----------------------------|--------------------------------|----------|
| CHEMILUMINESCENT NO / NO ₂ / NO _x ANALYZER | | | | | |
| DATE : | 10 March 2024 | BRAND : | API | MODEL : | 200E |
| NO. | NOX-R11 | SERIAL NO. | 2621 | | |
| 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 | 48 |
| 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 | 0.11 | - | 0 | - |
| NO Span | 400 | 400.2 | 0.050 | 400.0 | 1.003 |
| NO _x Span | 400 | 400.4 | 0.100 | 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 | 506 | cc/min | 500 ± 50 | | |
| OZONE FLOW | 79 | cc/min | 80 ± 15 | | |
| PMT | 103.2 | mV | 20 - 150 | | |
| AZERO | 94.1 | mV | 20 - 150 | | |
| HVPS | 671 | V | 420 - 900 constant | | |
| RCELL TEMP | 50.2 | °C | 50 ± 1 | | |
| BOX TEMP | 28.9 | °C | 8 - 48 | | |
| PMT TEMP | 7.1 | °C | 7 ± 2 | | |
| MOLY TEMP | 314.9 | °C | 315 ± 5 | | |
| RCELL PRESS | 8.4 | 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 | 1.003 | - | 1.0 ± 0.3 | | |
| NO _x Slope | 1.008 | - | 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 :

[Signature]
(Mr.Adut Dangkom)

Approved by :

[Signature]
(Mr.Peeru Deudom)



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| CALIBRATION REPORT | | | | | |
|---------------------------------------|------------------------------------|------------------------------|---------------------------------|---------------------------------|------|
| NON-DISPERIVE INFRARED CO ANALYZER | | | | | |
| DATE : | 10 March 2024 | BRAND : | API | MODEL : | 300E |
| NO. | CO-804 | SERIAL NO. | 3089 | | |
| 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. | 26.5 | °C |
| | | % RH | 48 | | |
| 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 | 39.90 | -0.250 | 40.00 | |
| API Model 300E CO Analyzer Check list | | | | | |
| Parameter | Observed Value | Units | Nominal Range | | |
| RANGE | 50 | PPM | 0-1000 ppm | | |
| STABILITY | 0.10 | PPM | ≤ 1 ppm with zero air | | |
| CO MEASURE | 4013.8 | mV | 2500-4800 mV | | |
| CO REFERENCE | 3948.2 | mV | 2500-4800 mV | | |
| MEASURE/REFERENCE RATIO | 1.179 | - | 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 | 48.2 | °C | 48 ± 4 | | |
| BENCH TEMPERATURE | 48.1 | °C | 48 ± 2 | | |
| WHEEL TEMPERATURE | 68.3 | °C | 68 ± 2 | | |
| BOX TEMPERATURE | 30.7 | °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 | | |

Calibrated by :

(Mr.Adul Dangklom)

Approved by :

(Mr.Peera Detudom)



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| CALIBRATION REPORT | | | | | |
|---------------------------------------|------------------------------------|------------------------------|---------------------------------|---------------------------------|------|
| NON-DISPERIVE INFRARED CO ANALYZER | | | | | |
| DATE : | 10 March 2024 | BRAND : | API | MODEL : | 300E |
| NO. | CO-R01 | SERIAL NO. | 704 | | |
| Calibrator (Dilution System) | | | | | |
| Brand : API | | Model : 700 | | | |
| Last Cal. Date : 31 October 2023 | | Serial No. : 421 | | | |
| Reference Standard Gas | | | | | |
| Standard Gas : Carbon Monoxide (CO) | | Cylinder No. : D196045 | | | |
| Certified Date : 16 April 2022 | | Expired Date : 15 April 2024 | | Cylinder Conc. : 4,570 PPM | |
| CALIBRATING CONDITION | | | | | |
| Pressure | 1011 | mmbar | Temp. | 26.5 | °C |
| | | % RH | 48 | | |
| 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 | 39.90 | -0.250 | 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 | 4014.3 | mV | 2500-4800 mV | | |
| CO REFERENCE | 3947.5 | 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 | 808 | cc/min | 800 ± 10% | | |
| SAMPLE TEMPERATURE | 48.2 | °C | 48 ± 4 | | |
| BENCH TEMPERATURE | 48.0 | °C | 48 ± 2 | | |
| WHEEL TEMPERATURE | 68.3 | °C | 68 ± 2 | | |
| BOX TEMPERATURE | 30.6 | °C | Ambient temp ± 7 ± 10 | | |
| PHOTO-DRIVE | 3050.3 | mV | 250 mV to 4750 mV | | |
| SLOPE | 1.017 | - | 1.0 ± 0.3 | | |
| OFFSET | 0.2 | - | 0 ± 0.3 | | |

Calibrated by :

(Mr.Adul Dangklom)

Approved by :

(Mr.Peera Detudom)



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| CALIBRATION REPORT | | | | | |
|---------------------------------------|-----------------------------------|-------------------|---------------------------------|--------------------------------|------|
| NON-DISPERIVE INFRARED CO ANALYZER | | | | | |
| DATE : | 10 March 2024 | BRAND : | API | MODEL : | 300E |
| NO. | CO-R02 | SERIAL NO. | 171-S | | |
| Calibrator (Dilution System) | | | | | |
| Brand | : API | | Model | : 700 | |
| Last Cal. Date | : 31 October 2023 | | Serial No. | : 421 | |
| Reference Standard Gas | | | | | |
| Standard Gas | : Carbon Monoxide (CO) | | Cylinder No. | : D196045 | |
| Certified Date | : 16 April 2022 | | Expired Date | : 15 April 2024 | |
| Cylinder Conc. | | | : 4,570 PPM | | |
| CALIBRATING CONDITION | | | | | |
| Pressure | 1011 | mmbar | Temp. | 24.5 | °C |
| % RH | 48 | | | | |
| 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 | 39.91 | -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 | 4014.5 | mV | 2500-4800 mV | | |
| CO REFERENCE | 3948.7 | mV | 2500-4800 mV | | |
| MEASURE/REFERENCE RATIO | 1.179 | - | 1.1-1.3 w/zero air | | |
| SAMPLE PRESSURE | 28.5 | In+Hg-A | +2" < ambient absolute pressure | | |
| SAMPLE FLOW | 807 | cc/min | 800 ± 10% | | |
| SAMPLE TEMPERATURE | 48.5 | °C | 48 ± 4 | | |
| BENCH TEMPERATURE | 48.2 | °C | 48 ± 2 | | |
| WHEEL TEMPERATURE | 68.3 | °C | 68 ± 2 | | |
| BOX TEMPERATURE | 30.6 | °C | Ambient temp + 7 ± 10 | | |
| PHOTO-DRIVE | 3033.4 | mV | 250 mV to 4750 mV | | |
| SLOPE | 1.017 | - | 1.0 ± 0.3 | | |
| OFFSET | 0.2 | - | 0 ± 0.3 | | |

Calibrated by :

[Signature]

Approved by :

[Signature]



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| CALIBRATION REPORT | | | | | |
|---------------------------------------|-----------------------------------|-------------------|---------------------------------|--------------------------------|------|
| NON-DISPERIVE INFRARED CO ANALYZER | | | | | |
| DATE : | 10 March 2024 | BRAND : | API | MODEL : | 300E |
| NO. | CO-R03 | SERIAL NO. | 1352 | | |
| Calibrator (Dilution System) | | | | | |
| Brand | : API | | Model | : 700 | |
| Last Cal. Date | : 06 September 2022 | | Serial No. | : 421 | |
| Reference Standard Gas | | | | | |
| Standard Gas | : Carbon Monoxide (CO) | | Cylinder No. | : D196045 | |
| Certified Date | : 16 April 2022 | | Expired Date | : 15 April 2024 | |
| Cylinder Conc. | | | : 4,570 PPM | | |
| CALIBRATING CONDITION | | | | | |
| Pressure | 1011 | mmbar | Temp. | 26.5 | °C |
| % RH | 48 | | | | |
| 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 | 39.92 | -0.200 | 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 | 4015.2 | mV | 2500-4800 mV | | |
| CO REFERENCE | 3948.3 | mV | 2500-4800 mV | | |
| MEASURE/REFERENCE RATIO | 1.180 | - | 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 | 48.6 | °C | 48 ± 4 | | |
| BENCH TEMPERATURE | 48.0 | °C | 48 ± 2 | | |
| WHEEL TEMPERATURE | 68.3 | °C | 68 ± 2 | | |
| BOX TEMPERATURE | 30.7 | °C | Ambient temp + 7 ± 10 | | |
| PHOTO-DRIVE | 3012.4 | mV | 250 mV to 4750 mV | | |
| SLOPE | 1.017 | - | 1.0 ± 0.3 | | |
| OFFSET | 0.2 | - | 0 ± 0.3 | | |

Calibrated by :

[Signature]
(Mr.Adul Dangklom)

Approved by :

[Signature]



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
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Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscn.com, www.spscn.com

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-II

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.) | | | y | | |
| | | | | | 1 | 2 | 3 | 1 | 2 | 3 | y | R ² | |
| B41 | SKC | 224-PCXR4 | 612669 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 999 | 1,496 | 1,991 | 0.996x + 1.914 | 1.000 | |
| B42 | SKC | 224-PCXR4 | 626041 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 1,004 | 1,498 | 1,991 | 0.986x + 19.248 | 1.000 | |
| B43 | SKC | 224-PCXR4 | 034636 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 1,000 | 1,501 | 1,992 | 0.991x + 11.682 | 1.000 | |
| B44 | SKC | 224-PCXR8 | 529341 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,502 | 2,002 | 1.004x - 6.860 | 1.000 | |
| B45 | SKC | 224-PCXR8 | 529344 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 1,001 | 1,501 | 1,987 | 0.987x + 16.026 | 1.000 | |
| B46 | SKC | 224-PCXR8 | 566743 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,506 | 2,002 | 1.013x - 27.915 | 0.999 | |
| B47 | SKC | 224-PCXR8 | 566747 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,502 | 2,004 | 1.010x - 21.769 | 0.999 | |
| B48 | SKC | 224-PCXR8 | 566753 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 1,000 | 1,493 | 1,998 | 0.997x + 0.239 | 1.000 | |
| B49 | SKC | 224-PCXR8 | 566780 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 1,003 | 1,502 | 2,006 | 1.011x - 21.550 | 0.999 | |
| B50 | SKC | 224-PCXR8 | 500400 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 1,001 | 1,496 | 2,002 | 1.001x - 2.900 | 1.000 | |
| B51 | SKC | 224-PCXR8 | 500363 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 996 | 1,502 | 2,000 | 1.011x - 25.709 | 0.999 | |
| B52 | SKC | 224-PCXR8 | 093186 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 994 | 1,496 | 1,992 | 0.995x + 1.751 | 1.000 | |
| B53 | SKC | 224-PCXR8 | 707670 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,501 | 2,002 | 1.008x - 16.042 | 0.999 | |
| B54 | SKC | 224-PCXR3 | 509821 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,501 | 2,002 | 1.016x - 32.282 | 0.999 | |
| B55 | SKC | 224-PCXR3 | 510710 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 1,004 | 1,495 | 1,992 | 0.991x + 7.666 | 1.000 | |
| B56 | SKC | 224-PCXR3 | 511450 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,001 | 1.005x - 8.559 | 1.000 | |
| B57 | SKC | 224-PCXR3 | 510798 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,492 | 1,999 | 0.999x - 2.122 | 1.000 | |
| B58 | SKC | 224-PCXR3 | 509852 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 1,000 | 1,500 | 1,999 | 1.007x - 19.073 | 0.999 | |
| B59 | SKC | 224-PCXR3 | 509862 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,503 | 1,995 | 0.996x + 2.118 | 1.000 | |
| B60 | SKC | 224-PCXR8 | 512655 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 1,004 | 1,510 | 2,004 | 1.005x - 6.421 | 0.999 | |
| B61 | SKC | 224-PCXR3 | 503915 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 993 | 1,492 | 1,999 | 1.003x - 11.706 | 1.000 | |
| B62 | SKC | 224-PCXR3 | 505975 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 999 | 1,494 | 1,996 | 0.996x + 0.822 | 1.000 | |
| B63 | SKC | 224-PCXR3 | 511432 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 990 | 1,501 | 2,000 | 1.017x - 36.259 | 0.999 | |
| B64 | SKC | 224-PCXR3 | 508302 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 996 | 1,492 | 1,989 | 0.990x + 10.175 | 1.000 | |
| B65 | SKC | 224-PCXR3 | 508310 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,501 | 2,002 | 1.007x - 13.537 | 1.000 | |
| B66 | SKC | 224-PCXR3 | 509861 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,491 | 1,992 | 0.988x + 13.744 | 1.000 | |
| B67 | SKC | 224-PCXR3 | 506295 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,508 | 2,004 | 1.007x - 12.843 | 1.000 | |
| B68 | SKC | 224-PCXR3 | 505872 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,491 | 1,998 | 0.995x + 4.040 | 1.000 | |
| B69 | SKC | 224-PCXR3 | 508375 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 1,003 | 1,499 | 2,000 | 1.009x + 18.977 | 0.999 | |
| B70 | SKC | 224-PCXR3 | 510623 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 992 | 1,493 | 1,996 | 1.002x - 7.730 | 1.000 | |
| B71 | SKC | 224-PCXR3 | 508367 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 994 | 1,506 | 2,002 | 1.015x - 31.561 | 0.999 | |
| B72 | SKC | 224-PCXR3 | 505977 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 1,003 | 1,499 | 1,994 | 0.991x + 9.042 | 1.000 | |
| B73 | SKC | 224-PCXR3 | 512606 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 1,001 | 1,501 | 2,004 | 1.008x - 14.346 | 1.000 | |
| B74 | SKC | 224-PCXR3 | 505993 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 996 | 1,497 | 1,995 | 1.001x - 7.056 | 1.000 | |
| B75 | SKC | 224-PCXR3 | 509820 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 996 | 1,496 | 1,991 | 0.996x + 1.432 | 1.000 | |
| B76 | SKC | 224-PCXR3 | 509811 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 993 | 1,499 | 1,999 | 1.006x - 14.283 | 1.000 | |
| B77 | SKC | 224-PCXR3 | 508301 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 1,001 | 1,501 | 2,003 | 1.013x - 25.406 | 0.999 | |
| B78 | SKC | 224-PCXR3 | 510877 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,503 | 1,999 | 1.012x - 27.520 | 0.999 | |
| B79 | SKC | 224-PCXR3 | 510920 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 994 | 1,494 | 1,994 | 1.003x - 6.178 | 1.000 | |

Calibrated by :

Approved by :



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Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-II

S/N : 136164

Environmental Conditions

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

| Personal Pump Data | | | | Calibration Data | | | | | | | | | |
|--------------------|-------|-----------|------------|------------------|--------------------|-------|-------|-----------------|-------|-------|------------------------------|----------------|--|
| No. | Brand | Model | Serial No. | Date | Flow Rate (ml/min) | | | | | | Value From Calibration Curve | | |
| | | | | | Setting | | | Actual (Q std.) | | | | | |
| | | | | | 1 | 2 | 3 | 1 | 2 | 3 | y | R ² | |
| R01 | SKC | 224-PCXR8 | 602867 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 992 | 1,508 | 2,005 | 1.008x - 15.012 | 1.000 | |
| R02 | SKC | 224-PCXR4 | 626450 | 04/01/2024 | 1,000 | 2,000 | 3,000 | 998 | 1,499 | 1,990 | 0.989x + 12.189 | 1.000 | |
| R03 | SKC | 224-PCXR4 | 691592 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 1,004 | 1,500 | 2,004 | 1.012x - 22.718 | 0.999 | |
| R04 | SKC | 224-PCXR4 | 691672 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 996 | 1,493 | 1,996 | 0.998x - 2.002 | 1.000 | |
| R05 | SKC | 224-PCXR4 | 798470 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 993 | 1,507 | 1,999 | 1.013x - 29.199 | 0.999 | |
| R06 | SKC | 224-PCXR4 | 798456 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,498 | 1,996 | 1.002x - 8.760 | 1.000 | |
| R07 | SKC | 224-PCXR4 | 798480 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 994 | 1,492 | 1,999 | 1.006x - 16.153 | 1.000 | |
| R08 | SKC | 224-PCXR4 | 883215 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 1,012 | 1,500 | 2,005 | 0.999x + 3.725 | 1.000 | |
| R09 | SKC | 224-PCXR4 | 034650 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 991 | 1,504 | 2,001 | 1.018x - 36.179 | 0.999 | |
| R10 | SKC | 224-PCXR4 | 091765 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,511 | 1,994 | 1.000x + 0.499 | 1.000 | |
| R11 | SKC | 224-PCXR4 | 091763 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 1,000 | 1,499 | 2,002 | 1.012x - 24.042 | 0.999 | |
| R12 | SKC | 224-PCXR4 | 091568 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 996 | 1,500 | 2,000 | 1.003x - 7.698 | 1.000 | |
| R13 | SKC | 224-PCXR8 | 091538 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,501 | 1,991 | 0.989x + 14.781 | 1.000 | |
| R14 | SKC | 224-PCXR4 | 091764 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 996 | 1,503 | 1,999 | 1.014x - 30.292 | 0.999 | |
| R15 | SKC | 224-PCXR8 | 529457 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 1,001 | 1,500 | 2,004 | 1.006x - 12.543 | 1.000 | |
| R16 | SKC | 224-PCXR8 | 529643 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 998 | 1,495 | 1,994 | 0.999x - 3.650 | 1.000 | |
| R17 | SKC | 224-PCXR8 | 529445 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,509 | 2,001 | 1.015x - 30.890 | 0.999 | |
| R18 | SKC | 224-PCXR8 | 566756 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 991 | 1,498 | 1,998 | 1.001x - 8.800 | 1.000 | |
| R19 | SKC | 224-PCXR8 | 566802 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,499 | 2,000 | 1.010x - 20.772 | 0.999 | |
| R20 | SKC | 224-PCXR8 | 529089 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 991 | 1,500 | 2,003 | 1.020x - 39.390 | 0.999 | |
| R21 | SKC | 224-PCXR8 | 665728 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 998 | 1,495 | 1,999 | 1.000x - 3.937 | 1.000 | |
| R22 | SKC | 224-PCXR8 | 707444 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 1,003 | 1,500 | 2,003 | 1.005x - 8.595 | 1.000 | |
| R23 | SKC | 224-PCXR8 | 761067 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 998 | 1,491 | 1,991 | 0.993x + 3.358 | 1.000 | |
| R24 | SKC | 224-PCXR8 | 707893 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 996 | 1,508 | 2,000 | 1.008x - 16.660 | 0.999 | |
| R25 | SKC | 224-PCXR8 | 761052 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 1,010 | 1,496 | 1,995 | 0.985x + 21.199 | 1.000 | |
| R26 | SKC | 224-PCXR8 | 707956 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,500 | 2,005 | 1.010x - 16.732 | 1.000 | |
| R27 | SKC | 224-PCXR8 | 707398 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 996 | 1,500 | 2,002 | 1.007x - 16.201 | 1.000 | |
| R28 | SKC | 224-PCXR8 | 707481 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 1,004 | 1,501 | 2,002 | 1.010x - 19.878 | 0.999 | |
| R29 | SKC | 224-PCXR8 | 707402 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 1,003 | 1,494 | 1,989 | 0.986x + 16.137 | 1.000 | |
| R30 | SKC | 224-PCXR8 | 093811 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 1,000 | 1,493 | 1,993 | 0.995x + 4.371 | 1.000 | |
| R31 | SKC | 224-PCXR8 | 093183 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 1,001 | 1,501 | 2,000 | 1.002x - 4.280 | 1.000 | |
| R32 | SKC | 224-PCXR8 | 671950 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 998 | 1,501 | 1,993 | 0.996x + 2.136 | 1.000 | |
| R33 | SKC | 224-PCXR4 | 626254 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 994 | 1,502 | 2,000 | 1.015x - 32.298 | 0.999 | |
| R34 | SKC | 224-PCXR4 | 626131 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,499 | 2,004 | 1.007x - 12.157 | 1.000 | |
| R35 | SKC | 224-PCXR8 | 707460 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 999 | 1,498 | 1,995 | 0.994x + 6.098 | 1.000 | |
| R36 | SKC | 224-PCXR8 | 707446 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 1,004 | 1,498 | 2,001 | 1.009x - 18.630 | 0.999 | |
| R37 | SKC | 224-PCXR8 | 707432 | 04/01/2024 | 1,000 | 1,500 | 2,000 | 995 | 1,499 | 2,000 | 1.006x - 1.827 | 1.000 | |
| R38 | SKC | 224-PCXR8 | 707349 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 997 | 1,500 | 2,002 | 1.003x - 7.889 | 1.000 | |
| R39 | SKC | 224-PCXR8 | 761095 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 1,001 | 1,497 | 1,998 | 0.998x + 1.193 | 1.000 | |



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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 |
| R00 | SKC | 224-PCXR4 | 612753 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 1,001 | 1,502 | 2,003 | 1.013x - 23.923 | 0.999 |
| R01 | SKC | 224-PCXR4 | 626140 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 992 | 1,509 | 2,001 | 1.016x - 31.995 | 0.999 |
| R02 | SKC | 224-PCXR4 | 626463 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 998 | 1,498 | 1,999 | 1.000x - 2.397 | 1.000 |
| R03 | SKC | 224-PCXR4 | 626129 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 1,003 | 1,501 | 2,005 | 1.012x - 20.899 | 0.999 |
| R04 | SKC | 224-PCXR4 | 602753 | 05/01/2024 | 1,000 | 1,500 | 2,000 | 1,002 | 1,496 | 1,993 | 0.995x + 3.007 | 1.000 |
| R05 | SKC | 224-PCXR4 | 626137 | 03/01/2024 | 1,000 | 1,500 | 2,000 | 992 | 1,505 | 2,002 | 1.019x - 37.144 | 0.999 |

Calibrated by :

Approved by :



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Rotameter Calibration Report (For Personal Pump Low Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

| Rotameter Data | | | | Calibration Data | | | | | | | |
|----------------|-------|--------|------------|---------------------|-----|-----|-----------------|-------|-------|------------------------------|----------------|
| No. | Brand | Model | Date | Flow Rate (ml/min) | | | | | | Value From Calibration Curve | |
| | | | | Flow Rate (Reading) | | | Actual (Q std.) | | | y | R ² |
| | | | | 1 | 2 | 3 | 1 | 2 | 3 | | |
| L-R01 | Dwyer | VFA-21 | 03/01/2024 | 50 | 100 | 200 | 50.8 | 101.0 | 204.3 | 0.982x + 3.092 | 0.999 |
| L-R02 | Dwyer | VFA-21 | 04/01/2024 | 50 | 100 | 200 | 50.1 | 102.0 | 201.4 | 1.006x - 0.501 | 0.999 |
| L-R03 | Dwyer | VFA-21 | 03/01/2024 | 50 | 100 | 200 | 50.1 | 100.2 | 202.3 | 1.013x - 0.675 | 1.000 |
| L-R04 | Dwyer | VFA-21 | 03/01/2024 | 50 | 100 | 200 | 50.2 | 100.9 | 201.2 | 1.007x - 0.709 | 0.999 |
| L-R05 | Dwyer | VFA-21 | 04/01/2024 | 50 | 100 | 200 | 50.2 | 101.0 | 201.4 | 0.995x + 1.253 | 1.000 |
| L-R06 | Dwyer | VFA-21 | 05/01/2024 | 50 | 100 | 200 | 51.0 | 100.2 | 202.3 | 1.001x + 0.832 | 1.000 |

Calibrated by :

(Mr. Abdul Dangklom)

Approved by :



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

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



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 | 50.00000 | 0.00000 | 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



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

| Calibration Report | | | | | |
|---|-------------------------------|-------------------------------|-----------------|----------------------------|---------------|
| Photo-Ionization Detector VOC Analyzer | | | | | |
| Date : | 01 March 2024 | Brand : | Mini RAE System | Model : | Mini RAE 3000 |
| No. | R01 | Serial No. | 592-902403 | | |
| Reference Standard Gas | | | | | |
| Standard Gas : Isobutylene (C ₄ H ₈) | | Cylinder No. : 1496584 | | | |
| Certified Date : 24 June 2021 | | Expired Date : 7 January 2026 | | Cylinder Conc. : 100 ppm | |
| Calibrating Condition | | | | | |
| Pressure 1011 mmbar | | Temp. 24.4 °C | | % RH 49 | |
| Calibration Setting | | | | | |
| Span Set Point | Initial Reading (Before Adj.) | | | Final Reading (After Adj.) | |
| | PPM | | | PPM | |
| | Expected Concentration | Analyzer Response | % Dif | Analyzer Response | |
| | Zero (Fresh Air) | 0 | 0.1 | -0.30 | 0 |
| VOC Span (Isobutylene) | 100 | 99.7 | -0.30 | 100 | |

Calibrated by :

Approved by :

ลำดับที่ 2

ระดับเสียงในบรรยากาศ



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

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.

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

FM.BLMTC.002 Rev.4

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Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

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E-mail : sumalee@tistr.or.th



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 μPa at 1000 Hz

Acoustic Output in dB re 20 μPa , Corrected to Reference Conditions : 101.325 kPa, 23.0 $^\circ\text{C}$ 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 | $\pm 0.40 \text{ dB}$ |

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

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 5 Mar. 2024

Date of Issue : 6 Mar. 2024

Ref : 2011267022200795002

End of Certificate

2 / 2

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

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Amphoe Muang, Changwat Samutprakan 10280, Thailand
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Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

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E-mail : sumalee@tistr.or.th



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอย ฟาโพลโยthin 24, ฟาโพลโยthin Road, จอมพล, Chatuchak, Bangkok 10900
Tel: (662) 514-320-73, Fax: (662) 514-4331, E-mail: sales@sps.com, www.sps.com

Noise R_151-1/24

Sound Level Meter Calibration Report

Acoustic Calibrator Data

| | | | |
|-------------------|----------------|------------------|---------------|
| Brand | CIRCUS | 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-801 | Cirrus | CR1618 | G301393 | 10 March 2024 | 94.0 | 94.0 |
| CR-804 | Cirrus | CR1618 | G301404 | 10 March 2024 | 94.1 | 94.0 |
| CR-806 | Cirrus | CR1618 | G301151 | 10 March 2024 | 94.0 | 94.0 |
| CR-809 | Cirrus | CR1618 | G301401 | 10 March 2024 | 94.0 | 94.0 |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) | | | | | 94.04 ± 0.10 dB | |

Calibrated by :

Approved by :



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL, BP. 109/0366

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 : Ambient Environment
Description : Sound Calibrator Temperature : (23 ± 3) °C
Manufacturer : ACO Relative Humidity : (50 ± 15) %
Model : 2127 Ambient Pressure : (101.325 ± 1.500) kPa
Serial No. : 130006

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 : 27 Mar. 2023

Date of Calibration : 29 Mar. 2023

This results relate only to the item 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.

1/3

FM.BLMTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

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 I |
|-----------------------------|---------------------------------------|------------------------|---------------------|--|
| 1/2 inch Bruel&Kjaer 4180 | 93.94 | -0.06 | ± 0.10 | ± 0.40 dB |

2. Frequency

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

3. Total distortion

| Standard Microphone Type | Measured Total distortion (%) | Uncertainty (%) | Tolerance limit IEC60942:2003 Class I |
|-----------------------------|----------------------------------|--------------------|--|
| 1/2 inch Bruel&Kjaer 4180 | 1.80 | ± 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. Weerachai Deechaiyae)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 29 Mar. 2023

Date of Issue : 30 Mar. 2023

Ref : 2011266032701228001

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.

Head Office

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FM.BLMTC.002 Rev.4



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ถนนพหลโยธิน 24 แขวงตลาดใหม่ เขตปทุมธานี กรุงเทพมหานคร 10900
Tel : (662) 0461472573 Fax : (662) 513-4121 E-mail : spps@tistr.or.th, www.spps.or.th

Noise R_131/24

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-R15 | ACO | 6236 | 00172062 | 10 March 2024 | 94.0 | 94.0 |
| ACO-R18 | ACO | 6236 | 00172065 | 10 March 2024 | 94.1 | 94.0 |
| ACO-R19 | ACO | 6236 | 00182001 | 10 March 2024 | 94.0 | 94.0 |
| ACO-R25 | ACO | 6236 | 00192037 | 10 March 2024 | 94.0 | 94.0 |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) | | | | | 93.94 ± 0.10 dB | |

Calibrated by :

Approved by :

ลำดับที่ 3

คุณภาพน้ำ

**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




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 : 
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.

F-G010 REV 03

**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

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

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

| <u>INSTRUMENT</u> | <u>MODEL</u> | <u>SERIAL No/ LOT No</u> | <u>CERTIFICATE No</u> | <u>DUE DATE</u> |
|---------------------------|--------------|------------------------------|-----------------------|-----------------|
| 1) pH STANDARD SOLUTION | 00651-06 | 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 |

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

| <u>mV APPLIED</u> | <u>UUC READING (mV)</u> | <u>CORRECTION (mV)</u> | <u>UUC READING (pH)</u> | <u>UNCERTAINTY OF MEASUREMENT (± mV)</u> | <u>COVERAGE FACTOR k</u> |
|-----------------------|-----------------------------|----------------------------|-----------------------------|--|----------------------------------|
| 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

F-G010 REV 03



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

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

CAL

Calibratech Co.,Ltd.

7/106-7 Moo 2, Sukhprachasan 3 Rd., Bangpoo, Pakkred, Nonthaburi 11120

Tel.(02) 964-6211 Fax.(02) 964-5155, e-mail : calibratech.cal@yahoo.com, calibratech.cal@hotmail.com



Certificate of Calibration

Certificate No. : 67-400037-2

Page : 1 of 2

Submitted by : S. P. S Consulting Service Co.,Ltd.
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900

Equipment : Liquid in Glass Thermometer
Manufacturer : SK Model : N/A
Range : 0 $^{\circ}$ C to 100 $^{\circ}$ C Resolution : 1 " C
Serial No. : N/A Immersion : Total
ID No. : TM21/59

Environment : Ambient Temperature : (23 \pm 2) " C
Relative Humidity : (50 \pm 15) %
Line Voltage : (220 \pm 22) VAC

Date of Received : 23 January 2024

Date of Calibration : 03 February 2024

Date of Issue : 03 February 2024

Calibrated by : Chortip Samchusri

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

The temperature scale used was based on ITS-90


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

1. Platinum Resistance Thermometer (PRT)

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

2. Standard Digital Thermometer

| ID No. | Cert. No. | Due Date | Traceability |
|--------|-----------|-------------|---|
| 400003 | 23E1866 | 01 Jun 2025 | National Institute of Metrology Thailand (NIMT) |
| 400004 | 23E1866 | 01 Jun 2025 | National Institute of Metrology Thailand (NIMT) |

Approved by : 
(Surachai Promthong)
Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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

CAL-F0031-03



Certificate of Calibration

Certificate No. : 67-400037-2

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

Ice point check : UUC* reading 0 °C Standard reading 0.4336 °C

| Standard Reading (°C) | UUC Reading (°C) | Correction (°C) | Uncertainty (± °C) |
|----------------------------|-----------------------|----------------------|-------------------------|
| 20.5609 | 20 | 0.6 | 0.31 |

Remark

UUC : Unit Under Calibration

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

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

- 000 -



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

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

TEL. 0-2717-3000-29 FAX. 0-2719-9484

Certificate of Calibration

Cert.No.: 24CH285

Page.: 1 of 2

Equipment : Turbidity Meter
Manufacturer : Eutech
Model : CyberScan WLTB1000
Serial No. : 201802206
ID. No. : TB 03/61
Condition As-Received: Used Item
Received Date : 05 March 2024
Calibration Date : 06 March 2024
Reference : 2403-0144WN-1
Submitted by : S.P.S. Consulting Service Co.,Ltd.
 7 Phaholyothin 24, Phaholyothin Road.,
 Jompol, Chatuchak, Bangkok 10900

Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 20) %
Calibration Procedure : In - house method : CP-CH11
 based on direct measurement by
 using Formazin standard solution

Calibrated by : Walalak Sirithean

Approved by : 
 Approved Signatory

() Pornthippa Tameyakul
 () Unnopphol Harachai
 (✓) Saitthip Meangmai

Issue Date : 06 March 2024

The Uncertainties are for a confidence probability of approximately 95%.

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



Cert.No. : 24CH285
Page. : 2 of 2

Condition of this calibration result

1. Reference Standard Instruments :

This certification is traceable to the International System of unit (SI unit) through:-
- Technology Promotion Association (Thailand-Japan).

| Instruments | Serial No. | ID No. | Certificate No. | Due date |
|-----------------------|------------|----------|-----------------|--------------|
| 1) Thermo-Hygrograph | 1103328 | 130EC010 | 23H1361 | 13 June 2024 |
| 2) Electronic Balance | 14233821 | 110RC001 | 23MM405 | 16 July 2024 |

2. Standard Material : The Formazin suspension has been prepared gravimetric from

| Material | Manufacturer | Lot No. | Assay |
|---------------------------|--------------|------------|--------|
| 1) Hexamethylenetetramine | HIMEDIA | 0000493947 | 99.65% |
| 2) Hydrazinium Sulfate | HIMEDIA | 0000522014 | 99.40% |

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

Calibration result

Performing three - Formazin suspension standard curve by using 0,10,1000 NTU

Turbidity Meter Serial Number : 201802206

| Standard Formazine suspension (NTU) | UUC* Reading (NTU) | Uncertainty of Measurement (± NTU) | Coverage Factor k |
|---|-------------------------|--|-------------------------|
| 20 | 19.2 | 0.38 | 2.00 |
| 40 | 39.4 | 0.40 | 2.00 |
| 100 | 99.0 | 0.70 | 2.00 |
| 400 | 389 | 1.5 | 2.00 |

Remark - UUC* = Unit Under Calibration
- NTU = Nephelometric Turbidity Units

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

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a 1205398



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



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. : 240213016389
CALIBRATION SERVICE : ☒ IN-LABORATORY ☐ ON-SITE

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

DATE OF RECEIVED : 13 February 2024

DATE OF ISSUED : 16 February 2024

The report of calibration shall not be reproduced except in full without approval of the Calibration Laboratory Co., Ltd.

Calibrated By :

Sukgasem Sechanart
Calibration Engineer



Approved By :

Mongkol Yotsoontorn
Authorized Signatory
16 February 2024

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. Q24016389

F3-011-05/12-23

page 1 of 4



@cdcalibration



CALIBRATION LABORATORY Co.,LTD.

2/10-11,14,55 Soi Prasert Manukit 29 Yeek 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



CALIBRATION LABORATORY Co.,LTD.

2/10-11,14,55 Soi Prasert Manukit 29 Yeek 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



REPORT OF CALIBRATION

FOR

NOMENCLATURE : CONDUCTIVITY METER
MANUFACTURER : METTLER TOLEDO
MODEL / TYPE : SEVEN COMPACT S230
SERIAL NO. : C141708983/5821320179
DATE OF CALIBRATION : 13 February 2024

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. Conductivity Solution , Hanna Product Code HI 7033L Lot Number 7830.
2. Potassium Chloride Solution (nominal 1.41 mS/cm)
3. Potassium Chloride Solution (nominal 12.8 mS/cm)
4. Calibration Bath, Kambic Model OB-22/2 ULT S/N. 17115653.
5. Precision Thermometer, ASL Model F200-A-8 S/N. 014433/03.
6. IPRT, ASL Model T100-250-1D S/N. L0193A-1-1.

Certificate No. Q24016389

F3-011-05/12-23

page 2 of 4



@clccalibration

TRACEABILITY :

1. The measurements are traceable to International System of Units (SI) , through Hanna instruments.
Certificate No. 20F21 , Due Date June 2025 .
2. The measurements are traceable to International System of Units (SI) , through Sigma-Aldrich Canada Co.
Certificate No. HC30595403 , Due Date 31 January 2026 .
3. The measurements are traceable to International System of Units (SI) , through Sigma-Aldrich Canada Co.
Certificate No. HC20111554 , Due Date 30 September 2025.
4. The measurements are traceable to International System of Units (SI) , through Calibration Laboratory Co., Ltd.
Certificate No. Q23136342, Due Date 20 December 2024.
5. The measurements are traceable to International System of Units (SI) , through Thailand Institute of Scientific and Technological Research (TISTR). Certificate No. PSL-T 0203/67, Due Date 07 December 2024.
6. The measurements are traceable to International System of Units (SI) , through National Institute of Metrology (Thailand).
Certificate No. TT-0136-23, Due Date 12 December 2024.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2.00$ which for a normal distribution corresponds to a coverage probability of approximately 95 % .
It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2022)"

Certificate No. Q24016389

F3-011-05/12-23

page 3 of 4



@clccalibration



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 : RECEIVED IN GOOD OPERATIONAL CONDITION

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 |
|--------------------------------|--------------------------------------|----------------------------|
| *84.00 µS/cm | 84.05 µS/cm [Cell Constant 0.548589] | ± 1.00 µS/cm |
| 1414.0 µS/cm | 1415 µS/cm [Cell Constant 0.548589] | ± 21.0 µS/cm |
| 12.83 mS/cm | 12.75 mS/cm [Cell Constant 0.548589] | ± 0.19 mS/cm |

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 02 Page 91 of 138

*2. Temperature Result [Probe Conductivity]

| Immersion depth (mm) | Actual Temperature (°C) | DUC Reading (°C) | Correction (°C) | Uncertainty ± (°C) |
|----------------------|---------------------------|--------------------|-------------------|----------------------|
| 100 | 25.00 | 24.9 | +0.10 | 0.07 |

Note. * 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. Q24016389

F3-011-05/12-23

page 4 of 4



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 : 24M2229
REFERENCE No : 72448-3

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : SARTORIUS
MODEL : BSA224S-CW
SERIAL No : 36591843
ID No : BA 09/61
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 08-Mar-24

APPROVED BY : [Signature]

ISSUED DATE : 14-Mar-24

RECEIVED DATE : 08-Mar-24

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

F-G010 REV 03



QUALITY CALIBRATION CO.,LTD.

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

www.qcalibration.com

CERTIFICATE No : 24M2229

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : BSA224S-CW
MANUFACTURER : SARTORIUS S/N : 36591843
ID No : BA 09/61 RECEIVED DATE : 08-Mar-24
AIR PRESSURE : 1010mbar \pm 1mbar CALIBRATION DATE : 08-Mar-24
AMBIENT TEMPERATURE : 25° C \pm 1° C RELATIVE HUMIDITY : 55 %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-1-151 | 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 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

| NOMINAL VALUE (g) | BALANCE READING (g) | CORRECTION (g) | UNCERTAINTY (\pm g) |
|-------------------|---------------------|----------------|------------------------|
| 0.0 | 0.0000 | 0.0000 | 0.000082 |
| 0.1 | 0.1000 | 0.0000 | 0.000083 |
| 0.2 | 0.2000 | 0.0000 | 0.000083 |
| 0.5 | 0.5000 | 0.0000 | 0.000083 |
| 1.0 | 1.0000 | 0.0000 | 0.000084 |
| 2.0 | 2.0000 | 0.0000 | 0.000084 |
| 5.0 | 5.0000 | 0.0000 | 0.000086 |
| 10.0 | 10.0000 | 0.0000 | 0.000089 |
| 20.0 | 20.0001 | -0.0001 | 0.000094 |
| 50.0 | 50.0000 | 0.0000 | 0.00012 |
| 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 | 100.0000 |
| 3 | 100.0000 |
| 4 | 100.0000 |
| 5 | 100.0000 |
| 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



Harikul Science Co.,Ltd.

694 Soi Ratchadanivet 24, Pracharatbamphen,
Samsaennok, Huaikhwang, Bangkok 10310

Tel: 0-2274-2456 Fax: 0-2274-2443

Email: info@harikul.com www.harikul.com

Certificate of Calibration

CERT.No.: HS-V015C

Calibration Date : 20 Mar 24

Submitted by : ASIA LAB @ CONSULTANT CO.,LTD

184 Soi Phutthamonthon Sai 2 Soi 12,

Bangphai, Bangkoe, Bangkok 10160

Avg Room Temp : 20 °C

Avg Water Temp : 20 °C

Air Pressure : 760.00 mmHg

Salinity : 0 ppt

Model : YSI 5000

S/N : 15B100751

Probe : YSI 5010

S/N : 22D100097

ID NO.

Air Temp ref : S/N. F8065C26

Barometric ref : S/N. F8065C26

Water Temp ref : S/N. 11430

Technician : Kittipong M.

Calibration Details

| Calibration Point | 100% air sat. (@20 °C, DO = 9.09 mg/l) | (status) | (status) |
|-----------------------|---|----------|----------|
| Measurement 1 (mg/l) | 9.08 | (PASS) | - |
| Measurement 2 (mg/l) | 9.08 | (PASS) | - |
| Measurement 3 (mg/l) | 9.08 | (PASS) | - |
| Measurement 4 (mg/l) | 9.08 | (PASS) | - |
| Measurement 5 (mg/l) | 9.08 | (PASS) | - |
| Measurement 6 (mg/l) | 9.08 | (PASS) | - |
| Measurement 7 (mg/l) | 9.08 | (PASS) | - |
| Measurement 8 (mg/l) | 9.08 | (PASS) | - |
| Measurement 9 (mg/l) | 9.08 | (PASS) | - |
| Measurement 10 (mg/l) | 9.08 | (PASS) | - |

| | | | | |
|------------------|------|------|---|---|
| Mean Measurement | 9.08 | mg/l | - | - |
| Inaccuracy | 0.01 | mg/l | - | - |

Overall Status (PASS)

Manufacturer Specification

Accuracy = \pm 0.02 mg/l

- 1) This certificate is issued based on the result that are found as shown on date and place of test only.
- 2) The calibration procedure followed in accordance with Harikul Science Co., Ltd.
- 3) This result shall not be used for advertising purpose.

Technician Signature

(Kittipong Maekwong)

Laboratory Manager

(Supreecha Sumanitum)

**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.comCERTIFICATE No : 24T0774
REFERENCE No : 71986-2

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : COD REACTOR

MANUFACTURER : HACH

MODEL : DRB 200

SERIAL No : 15110C0235

ID No : CRB 05/59

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

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 5-Feb-24

APPROVED BY : 

ISSUED DATE : 5-Feb-24

RECEIVED DATE : 5-Feb-24

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

F-G010 REV : 02

**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 : 24T0774

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : COD REACTOR

MANUFACTURER : HACH

ID NUMBER : CRB 05/59

RECEIVED DATE : 5-Feb-24

AMBIENT TEMPERATURE : 23° C ± 1° C

MODEL : DRB 200

SERIAL NUMBER : 15110C0235

CALIBRATION DATE : 5-Feb-24

RELATIVE HUMIDITY : 52 %RH ± 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

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

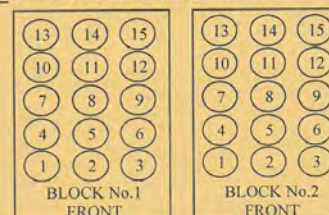
2. REFERENCE STANDARD INSTRUMENTS :-

| <u>INSTRUMENT</u> | <u>MODEL</u> | <u>SERIAL No</u> | <u>CERTIFICATE No</u> | <u>DUE DATE</u> |
|-------------------------------|--------------|------------------|-----------------------|-----------------|
| 1) DATA LOGGER WITH TC TYPE K | HYDRA 2635A | 8009008 | 23T6640 | 14-Jul-24 |

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

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

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT**TEMPERATURE MEASUREMENT ACCURACY TEST**

| Block No. | 1 | 2 |
|---|-----|-------|
| Controller temperature (°C) | 145 | 145 |
| Indicating Temperature | 145 | 145 |
| Measured Temperature (°C) at Spread Locations | 1 | 150.2 |
| | 2 | 150.2 |
| | 3 | 150.2 |
| | 4 | 149.9 |
| | 5 | 150.1 |
| | 6 | 150.7 |
| | 7 | 149.9 |
| | 8 | 149.9 |
| | 9 | 150.8 |
| | 10 | 149.5 |
| | 11 | 150.2 |
| | 12 | 150.0 |
| | 13 | 149.5 |
| | 14 | 149.5 |
| | 15 | 149.6 |
| Uncertainty of Measurement(± °C) | | 0.86 |

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

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

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

END OF CALIBRATION REPORT

F-G010

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : SP23016

Pages 1 of 3

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

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.

SITHIPORN
associates

SITHIPORN ASSOCIATES CO.,LTD.
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 ≤ 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


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

| <i>PinAAcle 900T Preventive Maintenance (PM)</i> | | | |
|---|---|--|-------------|
| 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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PerkinElmer shall not be liable for incidental or consequential damages in connection with the furnishing or use of this document.

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 ± 25 mL/min | 251 | Passed |
| External Flow Rate | 100 mL/min ± 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

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



MAINTENANCE AND TEST CERTIFICATE MODEL OPTIMA 5300DV

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

| CONFIGURATION TESTED | | ACCESSORIES/COMPONENT NOT INCLUDED |
|--|--|---|
| MODEL OPTIMA 5300DV | SERIAL NUMBER 077C7042401 | |
| TESTED EQUIPMENT IPV Methods | CALIBRATION NUMBER | 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 December 30, 2024 March 30, 2024 February 28, 2024 November 30, 2024 |
| CUSTOMER SUPPLIED 2 % HNO3 10 % HNO3 | COMMENTS | CUSTOMER INITIALS |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

| | |
|--|---|
| SERIAL NUMBER <u>077C7042401</u> | DATE TESTED <u>January 4, 2024</u> |
| 1. MECHANICAL CHECKS | |
| A. Inspect and clean all fans and filters. | <input type="checkbox"/> OK |
| B. Inspect and replace as necessary, all torch components including the RF coil. | <input type="checkbox"/> OK |
| C. Inspect all tubing for sign of clacking or leaking. | <input type="checkbox"/> OK |
| D. Adjust water and gas pressure regulator settings. | <input type="checkbox"/> OK |
| E. Inspect and leak check pneumatics drawers. | <input type="checkbox"/> OK |
| F. Clean the exterior of the instrument. | <input type="checkbox"/> OK |
| 2. OPTICAL CHECKS | |
| A. Inspect and clean all optical components. | <input type="checkbox"/> OK |
| B. As required, check and replace all purgefilters. | <input type="checkbox"/> OK |
| C. Recheck optical alignment. | <input type="checkbox"/> OK |
| 3. COOLING SYSTEM CHECKS | |
| A. Perform preventive maintenance on chiller. | <input type="checkbox"/> OK |
| B. Flush out the chiller every year. | <input type="checkbox"/> N/A |
| 4. PERFORMANCE CHECKS | |
| A. Torch View Alignment. | <input type="checkbox"/> OK |
| B. Wavelength Calibration. | <input type="checkbox"/> OK |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

| SERIAL NUMBER : <u>077C7042401</u> | | DATE TESTED : <u>January 4, 2024</u> | |
|---|---------------|---|------------------|
| 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 | Ti 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> |

WO-02612424/2024



MAINTENANCE AND TEST CERTIFICATE MODEL OPTIMA 5300DV

SERIAL NUMBER 077C7042401 DATE 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 Promlunda)

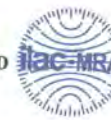
Service Engineer

Page 4 of 4

PerkinElmer Scientific (Thailand) Co., Ltd.
290 Soi Soonvijai 4, Bangkapi, Huay Kwang, Bangkok 10310 Head Office



MIRACLE INTERNATIONAL TECHNOLOGY CO.,LTD
214 Bangwaek Rd. Bangpai Bangkae 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:

(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 |

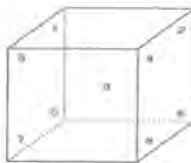
| Calibration Temperature (°C) | MPE (±°C) | Pass / Fail with Guard Band | | | | | | | | |
|------------------------------|-----------|-----------------------------|------------|------------|------------|------------|------------|------------|------------|------------|
| | | No. 1 (°C) | No. 2 (°C) | 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. I.202306247-001 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

Page 2 of 2



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 : 24T2234

REFERENCE No : 72448-8

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 : 08-Mar-24

APPROVED BY : PONGSAK J.

ISSUED DATE : 14-Mar-24

RECEIVED DATE : 08-Mar-24

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

www.qcalibration.com

CERTIFICATE No : 24T2234

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : WATER BATH
MANUFACTURER : MEMMERT
ID NUMBER : WB-05/58
RECEIVED DATE : 08-Mar-24
AMBIENT TEMPERATURE : 25 °C ± 1 °C
MODEL : WNB29
SERIAL NUMBER : L614.0123
CALIBRATION DATE : 08-Mar-24
RELATIVE HUMIDITY : 56 %RH ± 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

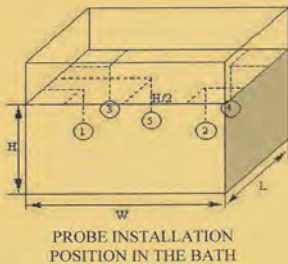
1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO ASTM E715-80 (REAPPROVED 2001) BY COMPARISON WITH CALIBRATED RTD. THE PROBES WERE PLACED ON FIVE POINTS AND LOCATED ONE PROBE IN EACH OF THE FOUR CORNERS OF THE BATH AND PLACED THE FIFTH RTD WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE WATER VOLUME (REFERENCE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

2. REFERENCE STANDARD INSTRUMENTS :-

| INSTRUMENT | MODEL | SERIAL No | CERTIFICATE No | DUE DATE |
|-------------------------|-------|-----------|----------------|-----------|
| 1) DATA LOGGER WITH RTD | 2635A | 7286308 | 23T6641 | 14-Jul-24 |

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 QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



GENERAL INFORMATION

Overall Variation of Ambient Temperature around the Bath (°C) : 2.1
Overall Variation of Line Voltage (V) : 14
Instrument Condition : Normal
Bath Inner Size (W*L*H) : 60*40*6 cm

BATH PERFORMANCE

| Controller Temperature (°C) | Temperature Stability (±°C) | Radius Uniformity (°C) | Axial Uniformity (°C) | Overall Variation (°C) |
|-----------------------------|-----------------------------|------------------------|-----------------------|------------------------|
| 50.0 | 0.05 | 0.06 | 0.04 | 0.11 |
| 60.0 | 0.07 | 0.19 | 0.03 | 0.30 |

TEMPERATURE MEASUREMENT ACCURACY TEST

| Controller Temp (°C) | Indicating Temp (°C) | Measured Temperature (°C) at Spread Locations | | | | | Uncertainty (± °C) |
|----------------------|----------------------|---|-------|-------|-------|--------|--------------------|
| | | #1 | #2 | #3 | #4 | Ref. 5 | |
| 50.0 | 50.0 | 49.61 | 49.62 | 49.63 | 49.67 | 49.65 | 0.15 |
| 60.0 | 60.0 | 59.48 | 59.67 | 59.52 | 59.60 | 59.59 | 0.16 |

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

Turbomass/Clarus Mass/ SQ8 MS Preventive Maintenance (PM)

| | | | |
|----------------------------------|--|---------------------------------|-------------|
| Company Name: | S.P.S. Consulting Service Co.,Ltd | | |
| Address (Instrument Location): | 7 Soi Phaholyothin24 Phaholyothin Road, Jompol, Chatuchak, Bangkok, 10900. | | |
| Serial Number: | 648N4050804 | PM Number: | 1 of 2 |
| Customer Name (if applicable): | Ms. Naruecha | Telephone Number: | NA |
| Service Engineer Name: | Monchai Kitcharoenkeat | Service Order Number: | WO-02760693 |
| Date PM Performed: (DD-MMM-YYYY) | 22-Feb-2024 | Next PM Due Date: (DD-MMM-YYYY) | 22-Aug-2024 |

| Part Number | Release | Publication Date | |
|-------------|---------|------------------|--|
| TH09370064 | C | March 2013 | |

Scope

The purpose of this PM is to ensure the continued functionality of the Turbomass/Clarus MS SQ8 MS by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer. The customer should save their method before the PM begins.

General Instructions:

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

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Component List

| Component / Specific Model | Serial # | Software Version | Configuration Notes |
|----------------------------|--------------|------------------|---------------------|
| Clarus680 | 680S14042502 | Totalchrom6.3 | |
| Clarus SQ8 | 648N4050804 | Turbomass 6.4 | |
| Atom X | US14113002 | Tekma AtomX | |
| | | | |

Parts lists

| Parts Included with the PM | | | | |
|-----------------------------|-------------|----------|-------------|-------------------------|
| Part Number (if applicable) | Description | Quantity | Batch/Lot # | Expiration Date (MM/YY) |
| | | | | |
| | | | | |

| Additional Tools Required for PM | | | | |
|---|-------------|----------|-------------|------------------------------|
| Part Number (if applicable) | Description | Quantity | Serial # | Calibration Due Date (MM/YY) |
| | | | | |
| | | | | |
| Additional Reagents and Standards Required for PM | | | | |
| Part Number (if applicable) | Description | Quantity | Batch/Lot # | Expiration Date (MM/YY) |
| | | | | |
| | | | | |

Procedure Checklist

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

General:

- ☒ Column type Elite 624
- ☒ Carrier gas flow rate 1 ml/min.
- ☒ Review the instrument performance with the customer and document any recent problems.
- ☒ Inspect the customer log book and make any appropriate PM entries.
- ☒ Check incoming AC line voltage for proper levels and grounding.

Mechanical:

- ☒ Inspect and clean all fans and filters.
- ☒ Check the level of FC-43 calibration compound in reference gas bulb and fill if necessary.
- ☒ Change the oil in the fore pump.
- ☒ Inspect cartridge in fore pump vacuum filter; replace adsorbent bead if necessary.
- ☒ Replace the exhaust vapor mist filter on the fore pump.
- ☒ Remove and clean the ion source assembly. Use the Insulator Replacement Kit and/or Optics Replacement Kit if necessary
- ☒ Replace the filament.
- ☒ Remove and clean the pre-quad rods.
- ☒ Observe Wide Range Gauge pressure; clean/adjust if required.
- ☒ Inspect and clean as needed all PC boards and bottom inside of MS chassis.

Electrical:

- ☒ Check head amp offset. Adjust if necessary for proper value (Service Manual).

Operational Tests:

- ☒ Vacuum pressure.
- ☒ Air/water leak check
- ☒ AutoTune and mass calibration.
- ☒ Make a Chromatographic injection to verify peak shape and integrity only (not meant for sensitivity test).

**PC Maintenance:**

- ☒ Delete all unnecessary temporary files.
- ☒ Empty deleted files from recycle bin.
- ☒ Perform hard drive defragmentation.



Review:

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

Additional Comments

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

Review

| | | |
|---|---|---------------------------------------|
| <i>The preventive maintenance checks and if applicable performance tests for Turbomass/ Clarus Mass/ SQ8 have been completed.</i> | | |
| <i>This Turbomass/ClarusMS/SQ8 Pass the preventive maintenance.</i> | | |
| Review of Preventive Maintenance: | | |
| Authorized PerkinElmer Representative Monchai Kitcharoenkeat |  | Date: 22-Feb-2024 (DD-MMM-YYYY) |
| Authorized Customer Representative: |  | Date: 22-Feb-2024 (DD-MMM-YYYY) |