

ภาคผนวกที่ 4

เอกสารสอบเทียบความถูกต้องของเครื่องมือ

ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม

| รายการตรวจวัด | เครื่องมือเก็บตัวอย่าง | เครื่องมือตรวจวิเคราะห์ |
|-----------------------------|---|-------------------------|
| | ชื่อเครื่องมือ | ชื่อเครื่องมือ |
| คุณภาพอากาศในบรรยากาศ | | |
| Total Suspended Particulate | - High Volume Air Sampler No. B03, B18, B27 | - Digital Balance |
| PM ₁₀ | - High Volume PM ₁₀ No. B01, B10, B28 | - Digital Balance |
| Sulfur Dioxide | - Gas Sampler Box No. B01, B11, B12 | - Spectrophotometer |
| Nitrogen Dioxide | - NO ₂ Analyzer No. B03, B10, B19 | - |
| ระดับเสียง | | |
| L _{eq} 24 hr | - Acoustic Calibrator - Sound Level Meter No. ACO-B45, CR-B01, CR-B02, CR-B03 | - |
| คุณภาพน้ำ | | |
| pH | - | - pH Meter |
| Total Suspended Solids | - | - Digital Balance |
| Total Dissolved Solids | - | - Digital Balance |
| BOD ₅ | - | - BOD Analyzer |
| COD | - | - COD Reactor |
| Mercury | - | - AAS |
| Lead | - | - ICP |
| Total Chromium | - | - ICP |
| Cadmium | - | - ICP |
| Nickel | - | - ICP |
| Copper | - | - ICP |
| Manganese | - | - ICP |
| Zinc | - | - ICP |
| Grease & Oil | - | - Digital Balance |
| Total Coliform Bacteria | - | - Incubator |

เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศ



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

High Volume Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

Calibration Data

High Volume Air Sampler Data

Calibration Data

| Recorder No. | Blower No. | Date | Actual Flowrate (ft ³ /min) | R ² |
|--------------|------------|------------|--|----------------|
| B01 | B01 | 01/08/2023 | y = 1.289x-5.689 | 0.999 |
| B02 | B02 | 02/08/2023 | y = 1.106x+2.666 | 0.999 |
| B03 | B03 | 01/08/2023 | y = 1.126x-0.852 | 0.997 |
| B04 | B04 | 01/08/2023 | y = 1.294x-8.235 | 0.998 |
| B05 | B05 | 04/08/2023 | y = 1.279x-7.416 | 0.996 |
| B06 | B06 | 01/08/2023 | y = 1.280x-7.015 | 0.999 |
| B07 | B07 | 01/08/2023 | y = 1.220x-6.249 | 0.998 |
| B08 | B08 | 01/08/2023 | y = 1.268x-7.621 | 0.999 |
| B09 | B09 | 01/08/2023 | y = 1.258x-5.982 | 1.000 |
| B10 | B10 | 04/08/2023 | y = 1.142x+0.294 | 0.999 |
| B11 | B11 | 04/08/2023 | y = 1.165x-3.050 | 0.998 |
| B12 | B12 | 04/08/2023 | y = 1.227x-5.594 | 0.999 |
| B13 | B13 | 04/08/2023 | y = 1.282x-7.522 | 0.998 |
| B14 | B14 | 04/08/2023 | y = 1.298x-7.713 | 0.999 |
| B15 | B15 | 02/08/2023 | y = 1.176x-3.322 | 0.997 |
| B16 | B16 | 02/08/2023 | y = 1.316x-9.126 | 0.997 |
| B17 | B17 | 02/08/2023 | y = 1.235x-5.694 | 1.000 |
| B18 | B18 | 02/08/2023 | y = 1.323x-10.629 | 0.998 |
| B19 | B19 | 02/08/2023 | y = 1.277x-8.109 | 0.997 |
| B20 | B20 | 02/08/2023 | y = 1.297x-8.466 | 0.998 |
| B21 | B21 | 03/08/2023 | y = 1.186x-3.582 | 1.000 |
| B22 | B22 | 03/08/2023 | y = 1.274x-8.729 | 0.998 |
| B23 | B23 | 03/08/2023 | y = 1.224x-5.880 | 0.995 |
| B24 | B24 | 03/08/2023 | y = 1.185x-3.773 | 0.999 |
| B25 | B25 | 01/08/2023 | y = 1.075x+1.295 | 0.998 |
| B26 | B26 | 01/08/2023 | y = 1.282x-7.798 | 0.997 |
| B27 | B27 | 01/08/2023 | y = 1.248x-7.408 | 0.997 |
| B28 | B28 | 01/08/2023 | y = 1.279x-8.370 | 0.999 |
| B29 | B29 | 04/08/2023 | y = 1.292x-7.541 | 0.999 |
| B30 | B30 | 04/08/2023 | y = 1.270x-8.142 | 0.995 |
| B31 | B31 | 04/08/2023 | y = 1.284x-8.212 | 0.999 |
| B32 | B32 | 04/08/2023 | y = 1.294x-6.759 | 0.999 |
| B33 | B33 | 04/08/2023 | y = 1.252x-5.024 | 0.999 |
| B34 | B34 | 04/08/2023 | y = 1.262x-7.362 | 0.998 |

Calibrated by :



Approved by :



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

High Volume PM-10 Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

Calibration Data

High Volume PM-10 Data

Calibration Data

| Recorder No. | Blower No. | Date | Actual Flowrate (ft ³ /min) | R ² |
|--------------|------------|------------|--|----------------|
| B01 | B01 | 03/08/2023 | y = 1.268x-3.132 | 0.995 |
| B02 | B02 | 01/08/2023 | y = 1.046x+2.277 | 0.999 |
| B03 | B03 | 01/08/2023 | y = 1.277x-6.485 | 0.998 |
| B04 | B04 | 01/08/2023 | y = 1.287x-6.164 | 0.999 |
| B05 | B05 | 01/08/2023 | y = 1.229x-5.276 | 0.998 |
| B06 | B06 | 01/08/2023 | y = 1.270x-6.448 | 0.997 |
| B07 | B07 | 03/08/2023 | y = 1.285x-6.916 | 0.998 |
| B08 | B08 | 01/08/2023 | y = 1.286x-6.261 | 0.998 |
| B09 | B09 | 03/08/2023 | y = 1.267x-5.694 | 0.997 |
| B10 | B10 | 03/08/2023 | y = 1.292x-8.553 | 0.996 |
| B11 | B11 | 03/08/2023 | y = 1.250x-6.659 | 0.998 |
| B12 | B12 | 02/08/2023 | y = 1.292x-8.553 | 0.996 |
| B13 | B13 | 02/08/2023 | y = 1.285x-7.847 | 1.000 |
| B14 | B14 | 02/08/2023 | y = 1.279x-5.782 | 0.999 |
| B15 | B15 | 02/08/2023 | y = 1.144x-0.631 | 0.999 |
| B16 | B16 | 02/08/2023 | y = 1.228x-0.850 | 0.995 |
| B17 | B17 | 01/08/2023 | y = 1.279x-7.056 | 0.997 |
| B18 | B18 | 01/08/2023 | y = 1.220x-3.845 | 0.998 |
| B19 | B19 | 01/08/2023 | y = 1.123x-0.193 | 0.999 |
| B20 | B20 | 03/08/2023 | y = 1.216x-5.924 | 0.999 |
| B21 | B21 | 03/08/2023 | y = 1.182x-1.600 | 0.996 |
| B22 | B22 | 03/08/2023 | y = 1.298x-8.251 | 0.998 |
| B23 | B23 | 02/08/2023 | y = 1.227x-4.062 | 0.999 |
| B24 | B24 | 02/08/2023 | y = 1.246x-4.841 | 0.999 |
| B25 | B25 | 02/08/2023 | y = 1.224x-5.771 | 1.000 |
| B26 | B26 | 01/08/2023 | y = 1.277x-6.994 | 0.998 |
| B27 | B27 | 04/08/2023 | y = 1.258x-8.288 | 0.999 |
| B28 | B28 | 04/08/2023 | y = 1.226x-6.184 | 0.998 |
| B29 | B29 | 04/08/2023 | y = 1.275x-8.861 | 0.999 |
| B30 | B30 | 03/08/2023 | y = 1.308x-9.003 | 0.999 |
| B31 | B31 | 03/08/2023 | y = 1.205x-1.680 | 0.995 |
| B32 | B32 | 03/08/2023 | y = 1.229x-4.453 | 0.998 |
| B33 | B33 | 03/08/2023 | y = 1.273x-7.576 | 0.996 |
| B34 | B34 | 03/08/2023 | y = 1.268x-3.565 | 0.997 |

Calibrated by :



Approved by :





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

Gas Sampler Box Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Dry Cal DCL-ML

S/N : 136164

Calibration Data

| No. | Rotameter | Date | Setting (Constant Flow) (mL/min) | Actual Flow Rate (mL/min) | | | |
|-----|-----------|------------|--|---------------------------|--------------------|------------------|--------------------|
| | | | | Sampling Line A | | Sampling Line B | |
| | | | | Normal Condition | Standard Condition | Normal Condition | Standard Condition |
| B01 | 2 (A&B) | 05/09/2023 | 200 | 200.5 | 199.1 | 200.7 | 199.2 |
| B02 | 2 (A&B) | 05/09/2023 | 200 | 200.7 | 199.3 | 200.4 | 199.0 |
| B03 | 2 (A&B) | 06/09/2023 | 200 | 200.4 | 199.0 | 200.9 | 199.4 |
| B04 | 2 (A&B) | 07/09/2023 | 200 | 200.6 | 199.2 | 200.7 | 199.3 |
| B05 | 2 (A&B) | 07/09/2023 | 200 | 200.5 | 199.0 | 200.9 | 199.4 |
| B06 | 2 (A&B) | 05/09/2023 | 200 | 200.8 | 199.4 | 200.5 | 199.1 |
| B07 | 2 (A&B) | 05/09/2023 | 200 | 200.5 | 199.0 | 200.8 | 199.3 |
| B08 | 2 (A&B) | 06/09/2023 | 200 | 200.7 | 199.2 | 200.5 | 199.1 |
| B09 | 2 (A&B) | 05/09/2023 | 200 | 200.5 | 199.0 | 200.9 | 199.5 |
| B10 | 2 (A&B) | 05/09/2023 | 200 | 200.6 | 199.2 | 200.6 | 199.2 |
| B11 | 2 (A&B) | 06/09/2023 | 200 | 200.7 | 199.3 | 200.5 | 199.0 |
| B12 | 2 (A&B) | 06/09/2023 | 200 | 200.6 | 199.1 | 200.8 | 199.3 |
| B13 | 2 (A&B) | 05/09/2023 | 200 | 200.4 | 199.0 | 200.5 | 199.1 |
| B14 | 2 (A&B) | 08/09/2023 | 200 | 200.5 | 199.1 | 200.7 | 199.2 |
| B15 | 2 (A&B) | 08/09/2023 | 200 | 200.6 | 199.2 | 200.5 | 199.1 |
| B16 | 2 (A&B) | 05/09/2023 | 200 | 200.8 | 199.3 | 200.6 | 199.2 |
| B17 | 2 (A&B) | 05/09/2023 | 200 | 200.5 | 199.1 | 200.8 | 199.3 |

Calibrated by :

Approved by :



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

CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 20 November 2023

BRAND : API

MODEL : 200A

NO. NOX-B03

SERIAL NO. 2617

Calibrator (Dilution System)

Brand : Teledyne

Model : 700E

Last Cal. Date : 30 October 2023

Serial No. : 201-S

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. : 24.6 °C

% RH : 49

CALIBRATION SETTING

| Span | Initial Reading (Before Adj.), PPB | | | Final Reading (After Adj.), PPB | |
|----------------------|------------------------------------|-------------------|-------|---------------------------------|-------|
| | Expected Concentration | Analyzer Response | % Dif | Analyzer Response | Slope |
| Zero | 0 | -0.10 | - | 0 | - |
| NO Span | 400 | 400.1 | 0.025 | 400.0 | 1.009 |
| NO _x Span | 400 | 400.3 | 0.075 | 400.0 | 1.013 |

API Model 200A NO_x Analyzer Check List

| Test Values | Observed Value | Units | Nominal Range |
|---------------------------|----------------|---------|----------------------------|
| RANGE | 500 | PPB | 500 standard |
| STABILITY (Zero Gas) | 0.1 | PPB | < 2 with zero air |
| SAMPLE FLOW | 508 | cc/min | 500 ± 50 |
| OZONE FLOW | 78 | cc/min | 80 ± 15 |
| PMT | 103.2 | mV | -20 - 150 |
| AZERO | 93.8 | mV | -20 - 150 |
| HVPS | 675 | V | 420 - 900 constant |
| RECELL TEMP | 50.2 | °C | 50 ± 1 |
| BOX TEMP | 29.4 | °C | 8 - 48 |
| PMT TEMP | 7.0 | °C | 7 ± 2 |
| MOLY TEMP | 315.1 | °C | 315 ± 5 |
| RECELL PRESS | 8.2 | IN-Hg-A | 2 - 10 constant |
| SAMPLE PRESS | 28.5 | IN-Hg-A | 25 - 30 constant |
| NO Span Conc | 400 | PPB | 20 - 20,000 |
| NO _x Span Conc | 400 | PPB | 20 - 20,000 |
| NO Slope | 1.009 | - | 1.0 ± 0.3 |
| NO _x Slope | 1.013 | - | 1.0 ± 0.3 |
| NO Offset | 1.6 | mV | -20 to +150 |
| NO _x Offset | 1.0 | mV | -20 to 150 |
| Stability at Zero | 0.1 | PPB | < 0.2 |
| Stability at Span | 0.2 | PPB | < 2 ppb @ 400 ppb span gas |

Calibrated by :

Approved by :



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

| CALIBRATION REPORT | | | | | |
|--|-----------------------------------|------------------------------|----------------------------|--------------------------------|-------|
| CHEMILUMINESCENT NO / NO ₂ / NO _x ANALYZER | | | | | |
| DATE : | 20 November 2023 | BRAND : | API | MODEL : | 200E |
| NO. | NOX-B10 | SERIAL NO. | 4465 | | |
| Calibrator (Dilution System) | | | | | |
| Brand : Teledyne | | | Model : 700E | | |
| Last Cal. Date : 30 October 2023 | | | Serial No. : 201-S | | |
| 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. | 24.6 °C | % RH | 49 |
| CALIBRATION SETTING | | | | | |
| Span | Initial Reading (Before Adj.),PPB | | | Final Reading (After Adj.),PPB | |
| Set Point | Expected Concentration | Analyzer Response | %Diff | Analyzer Response | Slope |
| Zero | 0 | -0.10 | - | 0 | - |
| NO Span | 400 | 399.7 | -0.075 | 400.0 | 1.005 |
| NO _x Span | 400 | 399.9 | -0.025 | 400.0 | 1.008 |
| API Model 200E NO _x Analyzer Check List | | | | | |
| Test Values | Observed Value | Units | Nominal Range | | |
| RANGE | 500 | PPB | 500 standard | | |
| STABILITY (Zero Gas) | 0.1 | PPB | < 2 with zero air | | |
| SAMPLE FLOW | 511 | cc/min | 500 ± 50 | | |
| OZONE FLOW | 79 | cc/min | 80 ± 15 | | |
| PMT | 103.3 | mV | -20 - 150 | | |
| AZERO | 94.0 | mV | -20 - 150 | | |
| HVPS | 671 | V | 420 - 900 constant | | |
| RCELL TEMP | 50.4 | °C | 50 ± 1 | | |
| BOX TEMP | 29.3 | °C | 8 - 48 | | |
| PMT TEMP | 7.1 | °C | 7 ± 2 | | |
| MOLY TEMP | 315.4 | °C | 315 ± 5 | | |
| RCELL PRESS | 8.5 | IN-Hg-A | 2 - 10 constant | | |
| SAMPLE PRESS | 28.7 | IN-Hg-A | 25 - 30 constant | | |
| NO Span Conc | 400 | PPB | 20 - 20,000 | | |
| NO _x Span Conc | 400 | PPB | 20 - 20,000 | | |
| NO Slope | 1.005 | - | 1.0 ± 0.3 | | |
| NO _x Slope | 1.008 | - | 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 :

Approved by :



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

| CALIBRATION REPORT | | | | | |
|--|-----------------------------------|------------------------------|----------------------------|--------------------------------|-------|
| CHEMILUMINESCENT NO / NO ₂ / NO _x ANALYZER | | | | | |
| DATE : | 20 November 2023 | BRAND : | API | MODEL : | 200E |
| NO. | NOX-B19 | SERIAL NO. | 353 | | |
| Calibrator (Dilution System) | | | | | |
| Brand : Teledyne | | | Model : 700E | | |
| Last Cal. Date : 30 October 2023 | | | Serial No. : 201-S | | |
| 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. | 24.6 °C | % RH | 49 |
| CALIBRATION SETTING | | | | | |
| Span | Initial Reading (Before Adj.),PPB | | | Final Reading (After Adj.),PPB | |
| Set Point | Expected Concentration | Analyzer Response | %Diff | Analyzer Response | Slope |
| Zero | 0 | -0.11 | - | 0 | - |
| NO Span | 400 | 399.9 | -0.025 | 400.0 | 1.007 |
| NO _x Span | 400 | 400.2 | 0.050 | 400.0 | 1.011 |
| API Model 200E NO _x Analyzer Check List | | | | | |
| Test Values | Observed Value | Units | Nominal Range | | |
| RANGE | 500 | PPB | 500 standard | | |
| STABILITY (Zero Gas) | 0.1 | PPB | < 2 with zero air | | |
| SAMPLE FLOW | 505 | cc/min | 500 ± 50 | | |
| OZONE FLOW | 78 | cc/min | 80 ± 15 | | |
| PMT | 103.0 | mV | -20 - 150 | | |
| AZERO | 93.6 | mV | -20 - 150 | | |
| HVPS | 670 | V | 420 - 900 constant | | |
| RCELL TEMP | 50.3 | °C | 50 ± 1 | | |
| BOX TEMP | 29.1 | °C | 8 - 48 | | |
| PMT TEMP | 7.2 | °C | 7 ± 2 | | |
| MOLY TEMP | 314.9 | °C | 315 ± 5 | | |
| RCELL PRESS | 8.4 | IN-Hg-A | 2 - 10 constant | | |
| SAMPLE PRESS | 28.6 | IN-Hg-A | 25 - 30 constant | | |
| NO Span Conc | 400 | PPB | 20 - 20,000 | | |
| NO _x Span Conc | 400 | PPB | 20 - 20,000 | | |
| NO Slope | 1.007 | - | 1.0 ± 0.3 | | |
| NO _x Slope | 1.011 | - | 1.0 ± 0.3 | | |
| NO Offset | 1.3 | mV | -20 to +150 | | |
| NO _x Offset | 0.9 | mV | -20 to 150 | | |
| Stability at Zero | 0.1 | PPB | < 0.2 | | |
| Stability at Span | 0.2 | PPB | < 2 ppb @ 400 ppb span gas | | |

Calibrated by :

Approved by :



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





CERTIFICATE No : 23M2441
REFERENCE No : 68471-1

PAGE : 1 OF 2

Certificate of Calibration

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

CALIBRATED BY : 
CALIBRATION DATE : 10-Mar-23
APPROVED BY : 
ISSUED DATE : 16-Mar-23
RECEIVED DATE : 10-Mar-23

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

F-G010 REV 02



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

CERTIFICATE No : 23M2441

PAGE : 2 OF 2

Calibration Report

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

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

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

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

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

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

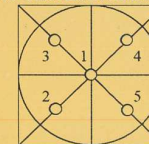
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

| NOMINAL VALUE (g) | BALANCE READING (g) | CORRECTION (g) | UNCERTAINTY (\pm g) |
|-------------------|---------------------|----------------|------------------------|
| 0.00 | 0.00000 | 0.00000 | 0.000039 |
| 0.02 | 0.02000 | 0.00000 | 0.000039 |
| 0.10 | 0.10000 | 0.00000 | 0.000039 |
| 0.20 | 0.20001 | -0.00001 | 0.000040 |
| 0.50 | 0.50001 | -0.00001 | 0.000040 |
| 1.00 | 1.00000 | 0.00000 | 0.000041 |
| 2.00 | 2.00003 | -0.00003 | 0.000042 |
| 5.00 | 5.00001 | -0.00001 | 0.000046 |
| 10.00 | 10.00003 | -0.00003 | 0.000053 |
| 20.00 | 20.00005 | -0.00005 | 0.000067 |
| 50.00 | 50.0001 | -0.0001 | 0.00011 |
| 100.00 | 100.0001 | -0.0001 | 0.00019 |
| 200.00 | 200.0001 | -0.0001 | 0.00032 |

5. OFF CENTER LOADING ERROR



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

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

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

END OF CALIBRATION REPORT

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : SP23016

Pages : 1 of 3

Calibration Certificate

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

Calibrated by :

Approved by :

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

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

เอกสารสอบเทียบเครื่องมือการตรวจวัดระดับเสียง



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

Manufacturer : ACO

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

Model : 2127

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

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

1 /

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

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

FM.BL.MTC.002 Rev.4

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

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 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 | 93.94 | -0.06 | ± 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 | 999.9 | -0.1 | ± 1.5 | $\pm 1.0\%$ |

3. Total distortion

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



Approved by :



Electrical and Electronic Standards Laboratory

Date of Calibration : 29 Mar. 2023

Industrial Metrology and Testing Service Centre

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.

FM.BL.MTC.002 Rev.4

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0358

MTC No. EEL. BP. 22/0366

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 :

Description : Sound Calibrator

Manufacturer : Cirrus

Model : CR:515

Serial No. : 92002

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) 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 : 3 Mar. 2023

Date of Calibration : 13 Mar. 2023

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

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0358

MTC No. EEL. BP. 22/0366

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 20µPa at 1000 Hz

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

1. Sound Pressure Level

| Standard Microphone Type | Measured Sound Pressure Level (dB) | Deviated value (dB) | Uncertainty (dB) | Tolerance limit IEC60942:2003 Class 1 |
|---------------------------|------------------------------------|---------------------|------------------|---------------------------------------|
| 1/2 inch Bruel&Kjaer 4180 | 93.99 | -0.01 | ± 0.10 | ± 0.40 dB |

2. Frequency

| Standard Microphone Type | Measured Frequency (Hz) | Deviated value (Hz) | Uncertainty (Hz) | Tolerance limit IEC60942:2003 Class 1 |
|---------------------------|-------------------------|---------------------|------------------|---------------------------------------|
| 1/2 inch Bruel&Kjaer 4180 | 1000.3 | 0.3 | ± 1.5 | ± 1.0% |

3. Total Distortion

| Standard Microphone Type | Measured Total Distortion (%) | Uncertainty (%) | Tolerance limit IEC60942:2003 Class 1 |
|---------------------------|-------------------------------|-----------------|---------------------------------------|
| 1/2 inch Bruel&Kjaer 4180 | 1.39 | ± 0.50 | ± 3.0% |

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

Approved by :



Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 13 Mar. 2023

Date of Issue : 14 Mar. 2023

Ref : 2011266030300928001

2 / 2

End of Certificate

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

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

FM.BLMTC.002 Rev.4

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th



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

Noise B_451_1/23

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-B45 | ACO | 6236 | 00222304 | 20 November 2023 | 94.0 | 94.0 |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) | | | | | 93.94 ± 0.10 dB | |

Calibrated by :



Approved by :



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

Noise B_451/23

Sound Level Meter Calibration Report

Acoustic Calibrator Data

| | | | |
|-------------------|----------------|------------------|---------------|
| Brand | CIRRUS | Number | AC-CR01/63 |
| Model | CR515 | Serial No. | 92002 |
| Calibration Range | 94 dB, 1000 Hz | Last Calibration | 13 March 2023 |
| | | Due Date | 13 March 2024 |

Calibration Data

| Sound Level Meter Data | | | | Calibration Data | | |
|--|--------|--------|------------|------------------|---------------------|------------------|
| SLM No. | Brand | Model | Serial No. | Date | Actual Reading [dB] | |
| | | | | | Before Adjustment | After Adjustment |
| CR-B01 | Cirrus | CR161B | G301393 | 20 November 2023 | 94.0 | 94.0 |
| CR-B02 | Cirrus | CR161B | G301157 | 20 November 2023 | 94.0 | 94.0 |
| CR-B04 | Cirrus | CR161B | G301404 | 20 November 2023 | 93.9 | 94.0 |
| Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) | | | | | 93.99 ± 0.10 dB | |

Calibrated by :



Approved by :



เอกสารสอบเทียบเครื่องมือการตรวจวิเคราะห์คุณภาพน้ำ



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



NSG-TIS-TIS17025
CALIBRATION 0049

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 : 
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 :-

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

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 RT/F = 59 mV/pH

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

END OF CALIBRATION REPORT PAGE 2 OF 3

**QUALITY CALIBRATION CO.,LTD.**

235 Petchkasem 63/2 Road, Laksong, Bangkoe, 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 (°C) | UUC READING (°C) | CORRECTION (°C) | VALUE BEFORE ADJUSTMENT | UNCERTAINTY OF MEASUREMENT (\pm °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

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 : 23M2442

REFERENCE No : 68471-2

PAGE : 1 OF 2

Certificate of Calibration

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

CALIBRATED BY : 
CALIBRATION DATE : 10-Mar-23

APPROVED BY : 

ISSUED DATE : 16-Mar-23

RECEIVED DATE : 10-Mar-23

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

F-G010 REV 02



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 : 23M2442

PAGE : 2 OF 2

Calibration Report

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

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

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

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

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

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

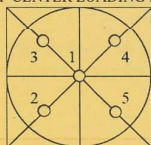
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

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

5. OFF CENTER LOADING ERROR



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

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

END OF CALIBRATION REPORT

F-G010 REV 02



CERT.No.: HS-U017D

Calibration Date : 3 Apr 23

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

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

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. E00522

Barometric ref : S/N. E00522

Water Temp ref : S/N. 11431

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.

**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.comCERTIFICATE No : 22T10972
REFERENCE No : 66837-1

PAGE : 1 OF 3

Certificate of Calibration

EQUIPMENT : COD REACTOR

MANUFACTURER : HACH

MODEL : DRB 200

SERIAL No : 15110C0497

ID No : DRB 04/59

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

CALIBRATED BY : [REDACTED]

CALIBRATION DATE : 20-Dec-22

APPROVED BY : [REDACTED]

ISSUED DATE : 20-Dec-22

RECEIVED DATE : 20-Dec-22

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, Bangkai, Bangkok 10160

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

CERTIFICATE No : 22T10972

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : COD REACTOR

MANUFACTURER : HACH

ID NUMBER : DRB 04/59

RECEIVED DATE : 20-Dec-22

AMBIENT TEMPERATURE : 23°C ± 1°C

MODEL : DRB 200

SERIAL NUMBER : 15110C0497

CALIBRATION DATE : 20-Dec-22

RELATIVE HUMIDITY : 52 %RH ± 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

| INSTRUMENT | MODEL | SERIAL No | CERTIFICATE No | DUE DATE |
|-------------------------------|-------------|-----------|----------------|-----------|
| 1) DATA LOGGER WITH TC TYPE K | HYDRA 2635A | 8009008 | 22T7511 | 10-Jul-23 |

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

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

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

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

| | | |
|---------------------|----|----|
| 13 | 14 | 15 |
| 10 | 11 | 12 |
| 7 | 8 | 9 |
| 4 | 5 | 6 |
| 1 | 2 | 3 |
| BLOCK No.1 FRONT | | |

| | | |
|---------------------|----|----|
| 13 | 14 | 15 |
| 10 | 11 | 12 |
| 7 | 8 | 9 |
| 4 | 5 | 6 |
| 1 | 2 | 3 |
| BLOCK No.2 FRONT | | |

TEMPERATURE MEASUREMENT ACCURACY TEST

| Block No. | 1 | 2 |
|---|-----|-------|
| Controller temperature (°C) | 145 | 145 |
| Indicating Temperature | 145 | 145 |
| Measured Temperature (°C) at Spread Locations | 1 | 149.8 |
| | 2 | 149.6 |
| | 3 | 149.7 |
| | 4 | 149.8 |
| | 5 | 149.9 |
| | 6 | 149.8 |
| | 7 | 149.8 |
| | 8 | 149.8 |
| | 9 | 149.9 |
| | 10 | 149.8 |
| | 11 | 149.9 |
| | 12 | 149.7 |
| | 13 | 149.9 |
| | 14 | 149.9 |
| | 15 | 149.7 |
| 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
COVERAGE FACTOR k =2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



PinAAcle 900T Preventive Maintenance Report

Company Name: SPS Consulting Service Co., Ltd.
Instrument Location: 7 Soi Phaholyothin 24, Phaholyothin Rd.
Jompol, Chatuchak, Bangkok, 10900
Instrument Serial No.: PTC514111103
Date: 29-Jun-2023

PinAAcle 900T Preventive Maintenance (PM)

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

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

Scope

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

The customer should save their method before the PM begins.

General Instructions:

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

Copyright Information

This document contains proprietary information that is protected by copyright. All rights are reserved. No part of this publication may be reproduced in any form whatsoever or translated into any language without the prior, written permission of PerkinElmer, Inc. Copyright © 2013 PerkinElmer, Inc.

Trademarks

Registered names, trademarks, etc. used in this document, even when not specifically marked as such, are protected by law. PerkinElmer is a registered trademark of PerkinElmer, Inc. All other trademarks and registered trademarks not owned by PerkinElmer, Inc. or its subsidiaries that are depicted herein are the property of their respective owners.

Except as specifically set forth in its terms and conditions of sale, PerkinElmer makes no Warranty of any kind with regard to this document, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.

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 |
|----------------------------|--------------|---------------------|
| AS900 | AS91S14B1002 | Winlab32 |
| | | |
| | | |
| | | |

Parts Lists

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

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

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

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

Procedure Checklist

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

1. General:

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

2. PC Instrument Software:

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

3. Mechanical:

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

3.1 Flame Technique

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

3.2 THGA Technique

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

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

4. Electrical:

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

5. Optics:

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

6. Gasses:

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

7. Flame Interlock Check:

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

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

8. After PM Performance tests [Flame]:

8.1 Detector Linearity with Barium

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

| Parameter | Specification | Certificate Value at 553.6 nm (Abs.) | Test Results | Pass/Fail |
|-----------------|-----------------|--------------------------------------|--------------|-----------|
| 1.0 A ND Filter | ± 5% from Cert. | 0.9798 | 0.9877 | Passed |
| 0.2 A ND Filter | ± 5% from Cert. | 0.2042 | 0.1985 | Passed |

8.2 Baseline Noise at 1.0 Absorbance with Barium

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

| Parameter | Specification | Results | Pass/Fail |
|--------------------|---------------|---------|-----------|
| Standard Deviation | ≤ 0.010 | 0.0016 | Passed |

8.3 AA Baseline Noise with Copper

Description: Check baseline noise.

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

8.4 D₂ Background Compensation with Copper

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

| Parameter | Specification | Results | Pass/Fail |
|--------------------|---------------|---------|-----------|
| Standard Deviation | ≤ 0.010 | 0.0044 | Passed |

8.5 AA-BG Baseline Noise with Copper

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

| Parameter | Specification | Results | Pass/Fail |
|--------------------|---------------|---------|-----------|
| Standard Deviation | ≤ 0.005 | 0.0001 | Passed |

8.6 AA-BG Baseline Noise with Arsenic

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

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

8.7 Flame Sensitivity

Description: Instrument Sensitivity checked against Copper standard.

| Standard Copper Sensitivity | Specification | Results (Abs.) | Pass/Fail |
|---|---------------|----------------|----------------|
| 5 mg/L Sensitivity SS Neb (if applicable) | > 0.250 Abs. | NA | Not Applicable |
| 2 mg/L Sensitivity HS Neb (if applicable) | > 0.250 Abs. | 0.3421 | Passed |

9. After PM Performance tests [THGA]:

9.1 Furnace Gas Flows

Description: Ensures the flow rates are within specification.

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

9.2 Chromium Baseline Noise

Description: Signal to noise check.

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

9.3 Chromium Characteristic Mass and Precision

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

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

9.4 Copper Characteristic Mass and Zeeman Ratio

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

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

10. Review:

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

Additional Comments

| Additional Comments Regarding the PM | |
|--------------------------------------|--|
| Zeeman Ratio | $= \frac{\text{Atomic Signal (Peak area)}}{\text{Atomic Signal (Peak area)} + \text{Background Signal (Peak area)}}$ $= \frac{0.1614}{0.1614 + 0.1448}$ $= 0.52$ |

Review

| <i>The preventive maintenance checks and if applicable performance tests for PinAAcle 900T have been completed.</i> | |
|---|--|
| <i>This PinAAcle 900T Passes <input checked="" type="checkbox"/> Fails <input type="checkbox"/> the preventive maintenance.</i> | |
| Review of Preventive Maintenance: | |
| Authorized PerkinElmer Representative: | <div style="background-color: #cccccc; width: 100px; height: 40px;"></div> |
| Authorized Customer Representative: | <div style="background-color: #cccccc; width: 100px; height: 40px;"></div> |
| Date: | 06-Jun-2023 (DD-MMM-YYYY) |
| Date: | 06-Jun-2023 (DD-MMM-YYYY) |



WO-01981290/2023

MAINTENANCE AND TEST CERTIFICATE MODEL
OPTIMA 5300DV

Customer : S.P.S.Consulting Service Co.,Ltd **Date Tested:** July 6, 2023
Address : 7 Soi Phaholyothin 24 **Recommendation Recertification**
Paholyothin Road **Period** 6 **Months**
Jompol Chatuchak, Bangkok 1090 **Recertification Due:** January 6, 2024
User Name: K.Phenpha Vipasthawatt **Date Last Certified:** January 11, 2023
Phone: 083-9269252 **Visit Number:** 1 of 2
Fax: 02-513-4221 **PerkinElmer Phone:** 02-719-6420 ext 206
PerkinElmer Fax: 02-318-5597

CONFIGURATION TESTED

MODEL
OPTIMA 5300DV

SERIAL NUMBER
077C7042401

TESTED EQUIPMENT

IPV Methods

CALIBRATION NUMBER

**ACCESSORIES/COMPONENT
NOT INCLUDED**

EXPIRATION

TEST STANDARD USED

Multielement Standard

PART NUMBER

N069-1579

EXPIRATION DATE

October 30, 2023

Wavecal Solution

N058-2152

September 30, 2023

VIS Wavecal solution

N930-2946

August 30, 2023

Instrument Cal. STD4

N930-0221

November 30, 2023

CUSTOMER SUPPLIED

2 % HNO3

COMMENTS

CUSTOMER INITIALS

10 % HNO3



WO-01981290/2023

MAINTENANCE AND TEST CERTIFICATE MODEL
OPTIMA 5300DV

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

1. MECHANICAL CHECKS

A. Inspect and clean all fans and filters.

☐ OK

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

☐ OK

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

☐ OK

D. Adjust water and gas pressure regulator settings.

☐ OK

E. Inspect and leak check pneumatics drawers.

☐ OK

F. Clean the exterior of the instrument.

☐ OK

2. OPTICAL CHECKS

A. Inspect and clean all optical components.

☐ OK

B. As required, check and replace all purgefilters.

☐ OK

C. Recheck optical alignment.

☐ OK

3. COOLING SYSTEM CHECKS

A. Perform preventive maintenance on chiller.

☐ OK

B. Flush out the chiller every year.

☐ N/A

4. PERFORMANCE CHECKS

A. Torch View Alignment.

☐ OK

B. Wavelength Calibration.

☐ OK



MAINTENANCE AND TEST CERTIFICATE MODEL
OPTIMA 5300DV

| SERIAL NUMBER : <u>077C7042401</u> | | DATE TESTED : <u>July 6, 2023</u> | |
|------------------------------------|---------------|-----------------------------------|------------------|
| PARAMETER | SPECIFICATION | | FINAL VALUE |
| Spectral Resolution : UV | As 193.696 nm | ≤ 0.007 | <u>0.00534</u> |
| | Ni 231.604 nm | ≤ 0.008 | <u>0.00682</u> |
| | Ni 341.476 nm | ≤ 0.012 | <u>0.00794</u> |
| Spectral Resolution : VIS | La 408.672 nm | ≤ 0.020 | <u>0.01613</u> |
| | Ba 455.403 nm | ≤ 0.025 | <u>0.02282</u> |
| Precision | | | |
| | As 193.656 nm | % RSD < 1.0 | <u>0.23</u> % |
| | Zn 213.856 nm | % RSD < 1.0 | <u>0.09</u> % |
| | Mn 257.610 nm | % RSD < 1.0 | <u>0.58</u> % |
| | La 379.478 nm | % RSD < 1.0 | <u>0.38</u> % |
| | Ba 455.403 nm | % RSD < 1.0 | <u>0.42</u> % |
| | Ba 493.408 nm | % RSD < 1.0 | <u>0.41</u> % |
| Detection Limits : Axial | Ti 190.080 nm | 3(sd) | <u>2.37</u> ppb |
| | As 193.696 nm | 3(sd) | <u>6.78</u> ppb |
| | Pb 220.353 nm | 3(sd) | <u>0.82</u> ppb |
| Detection Limits : Radial | As 193.696 nm | 3(sd) | <u>23.56</u> ppb |
| | Zn 213.856 nm | 3(sd) | <u>2.85</u> ppb |
| | Mn 257.610 nm | 3(sd) | <u>3.66</u> ppb |
| | La 379.478 nm | 3(sd) | <u>5.10</u> ppb |
| | Ba 455.403 nm | 3(sd) | <u>0.12</u> ppb |
| | Ba 493.408 nm | 3(sd) | <u>1.17</u> ppb |
| BEC : Axial (IB X 500)/(IS-IB) | Cd 226.502 nm | ≤ 150 ppb | <u>117.07</u> |
| BEC : Radial (IB X 1000)/(IS-IB) | Mn 257.610 nm | ≤ 45 ppb | <u>22.09</u> |

Page 3 of 4



MAINTENANCE AND TEST CERTIFICATE MODEL
OPTIMA 5300DV

| | | | |
|--|--|-------------|---------------------|
| SERIAL NUMBER | <u>077C7042401</u> | DATE TESTED | <u>July 6, 2023</u> |
| Remarks : | <u>Commissioning follow as commissioning performance sheets.</u> | | |
| This is to certify that the above tests have been performed and the configuration tested <div style="display: flex; align-items: center;"> <input checked="" type="checkbox"/> meets <div style="margin-left: 20px;"><input type="checkbox"/> does not meet</div> </div> | | | |
| 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: | <div style="background-color: gray; width: 200px; height: 100px; margin-left: 10px;"></div> | | |

Page 4 of 4



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 :

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:



Page 1 of 2

Certificate No. : S2023090437-0003

Environment : Ambient Temperature : Start record 24.3 °C, Stop record 24.5 °C
Relative Humidity : Start record 54.8 %RH, Stop record 54.6 %RH

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

Without adjustment

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

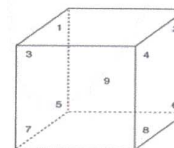
| Calibration Temperature (°C) | MPE (±°C) | Pass / Fail with Guard Band | | | | | | | | |
|------------------------------|-----------|-----------------------------|------------|------------|------------|------------|------------|------------|------------|------------|
| | | No. 1 (°C) | No. 2 (°C) |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

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

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

Note : Probe No. 9 is Reference Probe

Setting Air Fresh No. 0



Condition As-Received : Used Item

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

Measurement Standards Used & Traceability :

The International System of Units (SI) through

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

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

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

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

4. The uncertainty of measurement is included temperature stability.

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

End of Certificate

Page 2 of 2