

ภาคผนวก จ

เอกสารสอบเทียบเครื่องมือที่ใช้ในการตรวจวิเคราะห์

รายการเครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม

| No. | Instrument/Equipment | Parameter | Manufacturer | Model/Serial No. | Calibrator | Certification No. | Date of Calibration | Due date of Calibration* | Remark |
|--------------------------------------|--|---|----------------|----------------------------------|---|-------------------|---------------------|--------------------------|--------|
| Equipment for Air Quality Analysis | | | | | | | | | |
| 1 | Analytical Balance (Readability 0.1 mg) | ฝุ่นละออง (TSP) ฝุ่นละอองขนาดเล็กกว่า 10 ไมครอน (PM10) | Mettler-Toledo | AB204-S/FACT / B108115858 | National Food Institute, Ministry of Industry, Thailand | 2502228-001-01 | 19 Mar 25 | 18 Mar 26 | - |
| 2 | Analytical Balance (Readability 0.001 mg) | ฝุ่นละอองขนาดเล็กกว่า 2.5 ไมครอน (PM2.5) | Mettler-Toledo | XP6 / B322373893 | National Food Institute, Ministry of Industry, Thailand | 2502228-002-01 | 20 Mar 25 | 19 Mar 26 | - |
| Equipment for Water Quality Analysis | | | | | | | | | |
| 3 | pH Meter | ความเป็นกรด-ด่าง อุณหภูมิ | Mettler-Toledo | SevenCompact S220/ C113432421 | National Food Institute, Ministry of Industry, Thailand | 2403175-001-01 | 25 Jun 24 | 24 Jun 25 | - |
| 4 | Conductivity Meter | ความเค็ม ความนำไฟฟ้า | Mettler-Toledo | SevenDirect SD30/ C441872132 | DKSH (Thailand) Ltd. | C24250010 | 15 Jan 25 | 14 Jan 26 | - |
| 5 | Analytical Balance (Readability 0.01 mg) | ของแข็งแขวนลอย ของแข็งละลายทั้งหมด | Mettler-Toledo | XSR205DU / C210685394 | National Food Institute, Ministry of Industry, Thailand | 2502226-002-01 | 20 Mar 25 | 19 Mar 26 | - |
| 6 | Hot Air Oven | ของแข็งทั้งหมด | Memmert | UF55 / B216.1666 | National Food Institute, Ministry of Industry, Thailand | 2500116-001-01 | 8 Oct 24 | 7 Oct 25 | - |
| 7 | Analytical Balance (Readability 0.1 mg) | น้ำมันและไขมัน | Mettler-Toledo | AB-204S/FACT / 1129361010 | United Analyst and Engineering Consultant. Co.,Ltd (UAE) | 250422-1-BL002-25 | 23 Apr 25 | 22 Apr 26 | - |

รายการเครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม

| No. | Instrument/Equipment | Parameter | Manufacturer | Model/Serial No. | Calibrator | Certification No. | Date of Calibration | Due date of Calibration* | Remark |
|--------------------------------------|--|------------------------------------|-----------------|----------------------------------|--|-------------------|---------------------|--------------------------|--------|
| Equipment for Water Quality Analysis | | | | | | | | | |
| 8 | UV-VIS Spectrophotometer | ไนเตรท-ไนโตรเจน ฟอสฟอรัสทั้งหมด | Hitachi | U-5100 / 23A4-008 | DQE Services Co.,Ltd. | SP24-028 | 10 Sep 24 | 9 Sep 25 | - |
| 9 | UV-VIS Spectrophotometer | ซีโอดี | Hitachi | U-2900 / 21E22-009 | DQE Services Co.,Ltd. | SP25-001 | 3 Jan 25 | 3 Jan 26 | - |
| 10 | BOD Incubator | บีโอดี | Arco | UC4-1320 / (UAE.WAO.015/2561) | Technology Promotion Association (Thailand-Japan) | 25TM205 | 8 Feb 25 | 8 Feb 26 | - |
| 11 | DO Meter | | YSI | 4010-2W / 20260326 | Technology Promotion Association (Thailand-Japan) | 24TW222 | 17 Oct 24 | 16 Oct 25 | - |
| 12 | COD Reactor (Heating Block) | ซีโอดี | Hanna | HI839800-02 / H018500I | Hanna Instruments (Thailand) Ltd. | HIT-2510-0375 | 7 Mar 25 | 6 Mar 26 | - |
| 13 | Digester Unit | ทีเคเอ็น | Velp | DKL20 / 213517 | National Food Institute, Ministry of Industry, Thailand | 2404228 001 01 | 26 Sep 24 | 25 Sep 25 | - |
| 14 | Distillation Unit (Kjeldahl Method) | | FOSS TECATOR | KT8100/ 91889052 | FOSS South East Asia | 13854 | 24 Feb 25 | 23 Feb 26 | - |

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| No. | Instrument/Equipment | Parameter | Manufacturer | Model/Serial No. | Calibrator | Certification No. | Date of Calibration | Due date of Calibration* | Remark |
|--------------------------------------|--|--|-------------------------------|---|--|--|------------------------|-----------------------------|--------|
| Equipment for Water Quality Analysis | | | | | | | | | |
| 15 | Atomic Absorption Spectrophotometer (AAS) | ค่าอัตราส่วนการดูดซับโซเดียม, ตะกั่ว นิกเกิล, สารหนู, ทองแดง, แคดเมียม ทองแดง, พรอท, แมงกานีส, แมกนีเซียม | Agilent Technologies | System ID:G8432A AA240FS / MY13160001 | Agilent Technologies (Thailand) Co.,Ltd. | Preventive Maintenance Checklist | 30 Jan 25 | 29 Jan 26 | - |
| 16 | Inductively Coupled Plasma (ICP) | แคลเซียม, อลูมิเนียม | Agilent Technologies | System ID:G8015A G8015AA / MY18030001 | Agilent Technologies (Thailand) Co.,Ltd. | Preventive Maintenance Checklist | 4 Nov 24 | 3 Nov 25 | - |
| 17 | Cold Vapor Atomic Absorption Spectrophotometer (CVAAS) | ปรอท | Nippon Instrument Corporation | RA-4500 / 17780278 | Coax Group Corporation Ltd. | Preventive Maintenance Report | 9 Jul 24 | 8 Jul 25 | - |
| 18 | Incubator | โคลิฟอร์มทั้งหมด ฟิคอลโคลิฟอร์ม | Memmert | IPP 260 / V618.0033 | National Food Institute, Ministry of Industry, Thailand | 2502229 003 01 | 19 Mar 25 | 18 Mar 26 | - |
| 19 | Water Bath | | Memmert | WNE 14 / L416.0606 | National Food Institute, Ministry of Industry, Thailand | 25051624-001-01 | 10 Feb 25 | 9 Feb 26 | - |
| 20 | Auto Clave | | ALP | CL-40L / 808763 | National Food Institute, Ministry of Industry, Thailand | 2502229 007 01 | 19 Mar 25 | 18 Mar 26 | - |
| 21 | Analytical Balance | | OHAUS | PX623 / C236754745 | National Food Institute, Ministry of Industry, Thailand | 2502227-001-01 | 19 Mar 25 | 18 Mar 26 | - |

รายการเครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม

| No. | Instrument/Equipment | Parameter | Manufacturer | Model/Serial No. | Calibrator | Certification No. | Date of Calibration | Due date of Calibration* | Remark |
|-------|----------------------|--|---------------------------|-----------------------|--------------------------------------|----------------------|------------------------|-----------------------------|--------|
| Stack | | | | | | | | | |
| 1 | Pre-Test Console | Total Suspended Particulate | Apex Instruments, USA. | XC-572-V 0707048 | Envi Equipment Service Co., Ltd. | E24-060049 | 25 Jun 24 | 24 Jun 25 | - |
| 2 | Pre-Test Console | Total Suspended Particulate | Apex Instruments, USA. | XC-572-V 0807047 | Envi Equipment Service Co., Ltd. | E24-080074 | 26 Aug 24 | 25 Aug 25 | - |
| 3 | Flue gas Analyzer | Sulphur Dioxide Oxide of Nitrogen as Nitrogen Dioxide | Testo | Testo 350 60899615 | Entech Industrial Sulation Co., Ltd. | G 670490 | 17 Jul 24 | 16 Jul 25 | - |
| 4 | Flue gas Analyzer | Sulphur Dioxide Oxide of Nitrogen as Nitrogen Dioxide | Testo | Testo 350 60723967 | Entech Industrial Sulation Co., Ltd. | G 670643 | 13 Sep 24 | 12 Sep 25 | - |

รายการเครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม

| No. | Instrument/Equipment | Parameter | Manufacturer | Model/Serial No. | Calibrator | Certification No. | Date of Calibration | Due date of Calibration* | Remark |
|---------|---|---|---------------------------|------------------------|--|----------------------|------------------------|-----------------------------|--------|
| Ambient | | | | | | | | | |
| 1 | Orifice Transfer Standard Calibrator | Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀) | Tisch Environmental, Inc. | TE-5025A 3383 | Jiranatee Associates Co., Ltd. | COF-039-67 | 27 Sep 24 | 26 Sep 25 | - |
| 2 | U-Tube Manometer | Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀) | Dwyer | 121-36-W/M - | Technology Promotion Association (Thailand-Japan) | 25P112 | 19 Feb 25 | 18 Feb 26 | - |
| 3 | Air Flow Meter | Particular Matter (PM _{2.5}) | Mesa Labs | DeltaCal DC1 155895 | Jiranatee Associates Co., Ltd. | CGF-010-67 | 16 Oct 24 | 15 Oct 25 | - |
| 4 | Aneroid Barometer | Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀) Particular Matter (PM _{2.5}) | Barigo, Germany | - | Technology Promotion Association (Thailand-Japan) | 24P1856 | 4 Jun 24 | 3 Jun 25 | - |
| 5 | Digital Thermo - Hygrometer | Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀) Particular Matter (PM _{2.5}) | Digicon | TH-02 435031148 | Technology Promotion Association (Thailand-Japan) | 24H1487 | 15 Jul 24 | 14 Jul 25 | - |
| 6 | Nitrogen Dioxide Analyzer | Nitrogen Dioxide | Thermo Scientific | 42i CM19050148 | UAE Consultant Co., Ltd. | 20092024 | 20 Sep 24 | 19 Sep 25 | - |
| 7 | Nitrogen Dioxide Analyzer | Nitrogen Dioxide | Thermo Scientific | 42i CM19050149 | UAE Consultant Co., Ltd. | 17092024 | 17 Sep 24 | 16 Sep 25 | - |
| 8 | Nitrogen Dioxide Analyzer | Nitrogen Dioxide | Thermo Scientific | 42i CM19050150 | UAE Consultant Co., Ltd. | 17092024 | 17 Sep 24 | 16 Sep 25 | - |

รายการเครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม

| No. | Instrument/Equipment | Parameter | Manufacturer | Model/Serial No. | Calibrator | Certification No. | Date of Calibration | Due date of Calibration* | Remark |
|---------|---|---|-------------------|-----------------------|-----------------------------------|-------------------|---------------------|--------------------------|--------|
| Ambient | | | | | | | | | |
| 9 | Nitrogen Dioxide Analyzer | Nitrogen Dioxide | Thermo Scientific | 42i 1201778105 | UAE Consultant Co.,Ltd. | 26092024 | 26 Sep 24 | 25 Sep 25 | - |
| 10 | Standard Gases (Mixture) | Nitrogen Dioxide | Airgas | EB0162121 2016PSIG | Airgas an Air Liquide company | E05NI91E15A0014 | 6 Jun 23 | 6 Jun 31 | - |
| 11 | Sulphur Dioxide Analyzer | Sulphur Dioxide | Thermo Scientific | 43i CM22387061 | UAE Consultant Co.,Ltd. | 06092024 | 6 Sep 24 | 5 Sep 25 | - |
| 12 | Sulphur Dioxide Analyzer | Sulphur Dioxide | Thermo Scientific | 43i CM22387063 | UAE Consultant Co.,Ltd. | 19062024 | 19 Jun 24 | 18 Jun 25 | - |
| 13 | Sulphur Dioxide Analyzer | Sulphur Dioxide | Thermo Scientific | 43i CM22387065 | UAE Consultant Co.,Ltd. | 06092024 | 6 Sep 24 | 5 Sep 25 | - |
| 14 | Sulphur Dioxide Analyzer | Sulphur Dioxide | Thermo Scientific | 43i 1182920014 | UAE Consultant Co.,Ltd. | 04092024 | 4 Sep 24 | 3 Sep 25 | - |
| 15 | Standard Gases (Mixture) | Sulphur Dioxide | Airgas | EB0162121 2016PSIG | Airgas an Air Liquide company | E05NI91E15A0014 | 6 Jun 23 | 6 Jun 31 | - |
| 16 | Wind Speed/Wind Direction | WS/WD | Scarlet Tech Ltd. | WL-21 2111DT0072 | Thai Meteorological Department | 001/25 | 3 Jan 25 | 2 Jan 26 | - |
| 17 | Sound Level Calibrator (Acoustic Calibrator Class 1) | Calibrate Sound Level Meter UAE.EFM.167/2561 | 01dB | CAL31 84065 | Innovative Instrument Co.,Ltd. | 24-ACT-087 | 25 Jun 24 | 24 Jun 25 | - |

รายการเครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม

| No. | Instrument/Equipment | Parameter | Manufacturer | Model/Serial No. | Calibrator | Certification No. | Date of Calibration | Due date of Calibration* | Remark |
|---------|----------------------|--|--------------|-------------------------|---|----------------------|------------------------|-----------------------------|--------|
| Ambient | | | | | | | | | |
| 18 | Sound Level Meter | L _{Aeq} 24 hrs, L _{Aeq} 1 hr, L _{Amax} , L _{A90} , L _{Adn} ระดับเสียงรบกวน | Larson Davis | LxT1 0007309 | Electrical And Electronics Institute Foundation For Industrial Development | CP202340287EA | 2 Aug 24 | 1 Aug 25 | - |
| 19 | Sound Level Meter | L _{Aeq} 24 hrs, L _{Aeq} 1 hr, L _{Amax} , L _{A90} , L _{Adn} ระดับเสียงรบกวน | Larson Davis | LxT1 0007310 | Electrical And Electronics Institute Foundation For Industrial Development | CP20240289EA | 5 Aug 24 | 4 Aug 25 | - |
| 20 | Sound Level Meter | L _{Aeq} 24 hrs, L _{Aeq} 1 hr, L _{Amax} , L _{A90} , L _{Adn} ระดับเสียงรบกวน | Larson Davis | LxT1 0007312 | Electrical And Electronics Institute Foundation For Industrial Development | CP20240288EA | 5 Aug 24 | 4 Aug 25 | - |
| Water | | | | | | | | | |
| 1 | pH Meter | pH | Horiba | LAQUA-PH210 HA1G0008 | Technology Promotion Association (Thailand-Japan) | 24CH1153/1 | 18 Sep 24 | 17 Sep 25 | - |
| 2 | DO Meter | DO | Horiba | LAQUA-DO210 HE1D0010 | Technology Promotion Association (Thailand-Japan) | 24TW200 | 18 Sep 24 | 17 Sep 25 | - |
| 3 | Conductivity Meter | Conductivity | YSI | Pro30 17A102921 | Technology Promotion Association (Thailand-Japan) | 24CH1158 | 18 Sep 24 | 17 Sep 25 | - |

รายการเครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม

| No. | Instrument/Equipment | Parameter | Manufacturer | Model/Serial No. | Calibrator | Certification No. | Date of Calibration | Due date of Calibration* | Remark |
|-----------|---|-------------------------------------|----------------------------------|------------------------------|--|-------------------|---------------------|--------------------------|--------|
| Workplace | | | | | | | | | |
| 1 | Sound Level Calibrator (Acoustic Calibrator) | Calibrate Sound Level Meter | Larson Davis | CAL150 6695 | Innovative Instrument Co.,Ltd. | 24-ACT-122 | 10 Sep 24 | 9 Sep 25 | - |
| 2 | Sound Level Meter | $L_{Aeq} 8\text{ hrs}$, L_{Amax} | Rion, Japan | NL-42 00558208 | Sithiporn Associates Co., Ltd. | ACL25026 | 13 Jan 25 | 12 Jan 26 | - |
| 3 | Noise Dosimeter | Noise Dosimeter | Svantek | SV 104 143225 | Innovative Instrument Co.,Ltd. | 24-NDM-177 | 16 Jul 24 | 15 Jul 25 | - |
| 4 | Primary Flow Calibrator | Calibrate personal pump | TSL, Inc | 4146 41462327002 | Innovative Instrument Co., Ltd. | 24-AFM-156 | 19 Aug 24 | 18 Aug 25 | - |
| 5 | Aneroid Barometer | Total Dust Respirable Dust | Barigo, Germany | - | Technology Promotion Association (Thailand-Japan) | 24P1370 | 22 Apr 24 | 21 Apr 25 | - |
| 6 | Aneroid Barometer | Total Dust Respirable Dust | Barigo, Germany | - | Technology Promotion Association (Thailand-Japan) | 25P1359 | 17 Apr 25 | 16 Apr 26 | - |
| 7 | Digital Thermo - Hygrometer | Total Dust Respirable Dust | Digicon | TH-02 435031148 | Technology Promotion Association (Thailand-Japan) | 24H1487 | 15 Jul 24 | 14 Jul 25 | - |
| 8 | Light Meter | Lux | Extech Instrument, Taiwan | 407026 A 062335 | Innovative Instrument Co., Ltd. | 24-LXM-199 | 1 Aug 24 | 31 Jul 25 | - |
| 9 | Thermal Environment Monitor | Heat Meter | Quest Technologies, Inc | QuesTemp 34 TEK120020 | Innovative Instrument Co.,Ltd. | 24-TPM-371 | 15 Aug 24 | 14 Aug 25 | - |
| 10 | Thermal Environment Monitor | Heat Meter | 3M | QuesTemp 32 TPQ020022 | Innovative Instrument Co.,Ltd. | 24-TPM-369 | 15 Aug 24 | 14 Aug 25 | - |

Calibration Certificate

Certificate No.: 2502228-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhonong, Bangkok 10260

Page 1 of 3

Equipment: Electronic Balance

Manufacturer: METTLER TOLEDO

Model: AB204-S/FACT

Serial No.: B108115858

ID No.: UAE.AIR.016/2555


Order No.: 2502228

Operation No.: 2502228-001

Date of Receipt: 19 March 2025

Date of Calibration: 19 March 2025

Calibrated by Mr.Yothin Charoensuk
Scientist

Approved by 
(Mr.Pheraphat Tuanjit)

Manager, Division of Calibration Laboratory

Date of Issue: 25 March 2025

Responsible for the Technical Management Team

The uncertainties are for a confidence probability of approximately 95%

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.

F-CS-009 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2502228-001-01

Equipment:

Electronic Balance

Manufacturer: METTLER TOLEDO

Model: AB204-S/FACT

Resolution: 0.0001 g

Serial No.: B108115858

ID No.: UAE.AIR.016/2555

Capacity: 220 g

Date of Calibration: 19 March 2025

Page 2 of 3

Environment Condition: Ambient Temperature: 21.1 ± 0.6 °C Relative Humidity: 55 ± 0.75 %

Place of Calibration: 206 Balance Room 2, UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.

Condition of Equipment: Good Condition

Condition of This Results of Calibration:

1. Calibration Method: NFI Method W-MA-001 In-House Method based on UKAS Lab 14 : 2019

2. Reference Standards:

| Reference Standard | Model | Serial No. | Calibrated By | Certificate No. | Due Date |
|--------------------------|-------------|------------|---------------|-----------------|---------------|
| Standard Weight Class E2 | 1mg to 200g | B505567572 | TCS | M24041005 | 19 April 2025 |

| Instrument | Model | Serial No. | Calibrated By | Certificate No. | Due Date |
|--------------------|--------|----------------|----------------|-----------------|------------------|
| Thermo-Hygro Meter | 608-H1 | NFI.BTH 017/23 | Quality Reborn | QR25-542 | 10 February 2026 |

3. This certification is traceable to SI UNIT

4. This certificate was certified only for the instrument we calibrated.

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

Calibration Results:

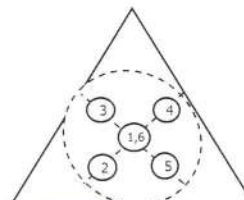
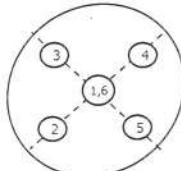
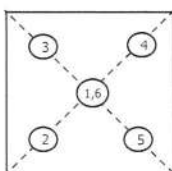
1. Repeatability of Reading:

| Nominal Value (g) | Standard Deviation of Reading (g) |
|---------------------|-------------------------------------|
| 100 | 0.000079 |
| 200 | 0.000067 |

2. Off-Center Error:

A mass of 200 g was placed and moved to various position on pan.

The balance reading obtained is given in the table.



| 1 | 2 | 3 | 4 | 5 | 6 | (Maximum Difference) |
|----------|----------|---------|----------|----------|----------|----------------------|
| (g) | (g) | (g) | (g) | (g) | (g) | (g) |
| 100.0002 | 100.0000 | 99.9998 | 100.0002 | 100.0003 | 100.0001 | 0.0004 |

Calibration Report

Certificate No.: 2502228-001-01

Equipment: Electronic Balance

Manufacturer: METTLER TOLEDO

Model: AB204-S/FACT

Resolution: 0.0001 g

Serial No.: B108115858

ID No.: UAE.AIR.016/2555

Capacity: 220 g

Date of Calibration: 19 March 2025

Page 3 of 3

Calibration Results: (Continued)

Calibration Range: 0-200 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value:

| Nominal Value (g) | Standard Value (g) | Average Reading (g) | Correction (g) | Uncertainty (± g) | Coverage Factor <i>k</i> |
|------------------------|-------------------------|--------------------------|---------------------|------------------------|-----------------------------|
| Unload | 0.00000 | 0.0000 | 0.0000 | 0.000096 | 2.00 |
| 0.1 | 0.10001 | 0.1000 | 0.0000 | 0.000096 | 2.00 |
| 1 | 1.00000 | 0.9999 | 0.0001 | 0.000097 | 2.00 |
| 3 | 3.00003 | 3.0000 | 0.0000 | 0.000098 | 2.00 |
| 5 | 5.00002 | 4.9999 | 0.0001 | 0.000098 | 2.00 |
| 10 | 10.00001 | 10.0000 | 0.0000 | 0.000099 | 2.00 |
| 20 | 20.00003 | 20.0000 | 0.0000 | 0.00011 | 2.00 |
| 50 | 50.00003 | 50.0001 | -0.0001 | 0.00012 | 2.00 |
| 70 | 70.00006 | 70.0000 | 0.0001 | 0.00014 | 2.00 |
| 100 | 100.00006 | 100.0000 | 0.0001 | 0.00016 | 2.00 |
| 150 | 150.00009 | 150.0001 | 0.0000 | 0.00021 | 2.00 |
| 200 | 200.00013 | 200.0001 | 0.0000 | 0.00028 | 2.00 |

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 %.

----- End -----

for N. nignobot

F-CS-012 Revision: 01 Date: 20-04-65




Calibration Certificate

Certificate No.: 2502228-002-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhonong, Bangkok 10260

Page 1 of 3

Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XP6
Serial No.: B322373893
ID No.: UAE.AIR.019/2556
Order No.: 2502228
Operation No.: 2502228-002
Date of Receipt: 19 March 2025
Date of Calibration: 20 March 2025

Calibrated by Mr.Yothin Charoensuk
Scientist

Approved by 
(Mr.Pheraphat Tuanjit)
Manager, Division of Calibration Laboratory
Responsible for the Technical Management Team

Date of Issue: 25 March 2025

The uncertainties are for a confidence probability of approximately 95%

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.

F-CS-009 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2502228-002-01

Equipment: Electronic Balance

Manufacturer: METTLER TOLEDO

Model: XP6

Resolution: 0.000001 g

Serial No.: B322373893

ID No.: UAE.AIR.019/2556

Capacity: 6.1 g

Date of Calibration: 20 March 2025

Page 2 of 3

Environment Condition: Ambient Temperature: 22.8 ± 0.4 °C Relative Humidity: 48 ± 0.95 %

Place of Calibration: 206 Balance Room 2, UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.

Condition of Equipment: Good Condition

Condition of This Results of Calibration:

1. Calibration Method: NFI Method W-MA-001 In-House Method based on UKAS Lab 14 : 2019

2. Reference Standards:

| Reference Standard | Model | Serial No. | Calibrated By | Certificate No. | Due Date |
|--------------------------|-------------|----------------|----------------|-----------------|------------------|
| Standard Weight Class E2 | 1mg to 200g | B505567572 | TCS | M2404100S | 19 April 2025 |
| Instrument | Model | Serial No. | Calibrated By | Certificate No. | Due Date |
| Thermo-Hygro Meter | 608-H1 | NFI.BTH 017/23 | Quality Reborn | QR25-0542 | 10 February 2026 |

3. This certification is traceable to SI UNIT

4. This certificate was certified only for the instrument we calibrated.

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

Calibration Results:

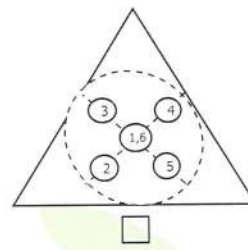
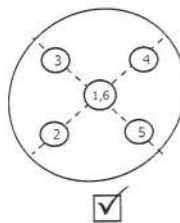
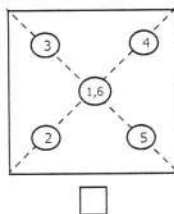
1. Repeatability of Reading:

| Nominal Value (g) | Standard Deviation of Reading (g) |
|---------------------|-------------------------------------|
| 3 | 0.00000079 |
| 6 | 0.00000067 |

2. Off-Center Error:

A mass of 2 g was placed and moved to various position on pan.

The balance reading obtained is given in the table.



| 1 | 2 | 3 | 4 | 5 | 6 | (Maximum Difference) |
|----------|----------|----------|----------|----------|----------|----------------------|
| (g) | (g) | (g) | (g) | (g) | (g) | (g) |
| 2.000018 | 2.000017 | 2.000014 | 2.000014 | 2.000024 | 2.000019 | 0.000006 |

Calibration Report

Certificate No.: 2502228-002-01

Equipment: Electronic Balance

Manufacturer: METTLER TOLEDO

Model: XP6

Resolution: 0.000001 g

Serial No.: B322373893

ID No.: UAE.AIR.019/2556

Capacity: 6.1 g

Date of Calibration: 20 March 2025

Page 3 of 3

Calibration Results: (Continued)

Calibration Range: 0-6 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value:

| Nominal Value (g) | Standard Value (g) | Average Reading (g) | Correction (g) | Uncertainty (± g) | Coverage Factor <i>k</i> |
|------------------------|-------------------------|--------------------------|---------------------|------------------------|-----------------------------|
| Unload | 0.0000000 | 0.000000 | 0.000000 | 0.0000032 | 2.00 |
| 0.001 | 0.0010030 | 0.001002 | 0.000001 | 0.0000032 | 2.00 |
| 0.01 | 0.0100030 | 0.010003 | 0.000000 | 0.0000034 | 2.00 |
| 0.05 | 0.0499960 | 0.050001 | -0.000005 | 0.0000044 | 2.00 |
| 0.10 | 0.1000110 | 0.100011 | 0.000000 | 0.0000057 | 2.00 |
| 0.15 | 0.1500070 | 0.150010 | -0.000003 | 0.0000071 | 2.00 |
| 0.17 | 0.1700130 | 0.170012 | 0.000001 | 0.0000077 | 2.00 |
| 0.20 | 0.2000110 | 0.200015 | -0.000004 | 0.0000065 | 2.00 |
| 1.50 | 1.5000190 | 1.500017 | 0.000002 | 0.000017 | 2.00 |
| 3.00 | 3.0000260 | 3.000017 | 0.000009 | 0.000019 | 2.00 |
| 4.50 | 4.5000610 | 4.500023 | 0.000038 | 0.000023 | 2.00 |
| 6.00 | 6.0000180 | 6.000014 | 0.000004 | 0.000023 | 2.00 |

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 %.

----- End -----

for N. Niyudat

F-CS-012 Revision: 01 Date: 20-04-65


Calibration Certificate

Certificate No.: 2403175-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhonong, Bangkok 10260

Page 1 of 5

Equipment: pH Meter
Manufacturer: METTLER ROLEDO
Model: SevenCompact S220
Serial No.: C113432421
ID No.: UAE.WAT.009/2564
Order No.: 2403175
Operation No.: 2403175-001
Date of Receipt: 13 June 2024
Date of Calibration: 25 June 2024

Calibrated by Mr.Pheraphat Tuanjit
Scientist

Approved by 
(Mr.Nuttapol Niyomchat)

Specialist, Division of Calibration Laboratory

Date of Issue: 28 June 2024

Responsible for the Technical Management Team

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.

F-CS-009 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2403175-001-01

Equipment:

pH Meter

Resolution: 0.01 pH ; 1 mV

Manufacturer: METTLER ROLEDO

Model: SevenCompact S220

Serial No.: C113432421

Type: Bench top

ID No.: UAE.WAT.009/2564

Date of Calibration: 25 June 2024

Page 2 of 5

Location: Chemical Calibration Laboratory, National Food Institute

Environment Condition: **Ambient Temperature:** (22.5 ± 1.5) °C **Relative Humidity:** (50 ± 3) %

Condition of Equipment: Good Condition

Condition of this Results of Calibration

1. Calibration Method W-CC-002 : In house method based on direct measurement by using standard voltage calibrator and certified reference material (CRM)

2. Reference Standards / Certified Reference Material

| Instruments | Serial / ID No. | Manufacturer | Certificate No. | Due Date |
|--|-----------------|-----------------|-----------------|------------------|
| 2.1 DC Voltage Calibrator | 2709007 | Fluke | 24E1752 | 30 May 2025 |
| 2.2 Digital Thermometer | 2709007 | Fluke | CC 660570-01 | 30 October 2024 |
| 2.3 Thermo-Hygro Meter | NFI.BTH 019/23 | testo | QR24-0492 | 4 March 2025 |
| Certified Reference Material | Lot. No. | Manufacturer | Ref N | Expire Date |
| 2.4 pH buffer 4.008 (Primary pH buffer Solution) | 873608 | CPAchem | PH216.L5 | 16 February 2025 |
| 2.5 pH buffer 6.865 (Primary pH buffer Solution) | 873609 | CPAchem | PH217.L5 | 16 February 2025 |
| 2.6 pH buffer 10.01 (Primary pH buffer Solution) | 949189 | CPAchem | PH220.L5 | 30 November 2024 |
| 2.7 pH buffer 7.00 (Standard pH buffer Solution) | C03109 | HACH LANGE GmbH | S11M004 | 16 October 2025 |

3. This certification is traceable to The International System of Unit (SI Unit)

| | | |
|--|--------------|---|
| 3.1 Instruments No.2.1 | through | NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0008 |
| 3.2 Instruments No.2.2 | through | NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0061 |
| 3.3 Instruments No.2.3 | through | NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0292 |
| 3.4 Certified Reference Material No.2.4 to 2.6 | traceable to | Primary measurement method- Harned cell using calibrated thermometer, barometer, and nanovoltmeter. The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025 |
| 3.5 Certified Reference Material No.2.7 | traceable to | PTB Certificate Nr. PTB-PHOA-563/30504/23 and Certificate Nr. PTB-PHOB-555/30620/22 (PTB: Physikalisch-Technische Bundesanstalt, Braunschweig, Germany) |

4. This certificate was certified only for the instrument we calibrated.

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

N. Nigudat

F-CS-012 Revision: 01 Date: 20-04-65

Calibration Report

Certificate No.: 2403175-001-01

Equipment: pH Meter **Resolution:** 0.01 pH ; 1 mV

Manufacturer: METTLER ROLEDO **Model:** SevenCompact S220

Serial No.: C113432421 **Type:** Bench top

ID No.: UAE.WAT.009/2564

Date of Calibration: 25 June 2024

Page 3 of 5

Calibration Results:

1. Calibration of pH Meter (Manual Temperature Compensation at 25 °C)

| Nominal pH | DC Voltage Standard (mV) | Average Indicator Reading | | Uncertainty (±mV) | Coverage Factor (k) |
|------------|----------------------------|---------------------------|-------|---------------------|-----------------------|
| | | mV | pH | | |
| 0 | 414.122 | 414 | 0.00 | 0.58 | 2.00 |
| 2 | 295.815 | 296 | 2.00 | 0.58 | 2.00 |
| 4 | 177.463 | 177 | 4.00 | 0.58 | 2.00 |
| 6 | 59.160 | 59 | 6.00 | 0.58 | 2.00 |
| 7 | 0.001 | 0 | 7.00 | 0.58 | 2.00 |
| 8 | -59.159 | -59 | 8.00 | 0.58 | 2.00 |
| 10 | -177.462 | -177 | 10.00 | 0.58 | 2.00 |
| 12 | -295.813 | -296 | 12.00 | 0.58 | 2.00 |
| 14 | -414.121 | -414 | 14.00 | 0.58 | 2.00 |

2. Calibration of pH Meter with Electrode (Manual Temperature Compensation at 25 °C)

Equipment: pH Electrode **Type:** Combined Electrode

Manufacturer: METTLER ROLEDO **Model:** InLab Expert Pro-ISM

Serial No.: 4114099 **ID.No.:** N/A

Performance of Electrode system (Three-Point Calibration at pH 4, 7 and 10)

| Certified Value @25 °C (pH) | Average Indicator Reading | | Relative Slope (%) | Uncertainty (± pH) | Coverage Factor (k) |
|-----------------------------|---------------------------|------|--------------------|----------------------|-----------------------|
| | pH | mV | | | |
| 4.008 | 4.00 | 176 | - | 0.0071 | 2.00 |
| 7.001 | 7.00 | 1 | 98.60 | 0.0086 | 2.00 |
| 9.997 | 10.00 | -174 | 98.60 | 0.0092 | 2.00 |
| 6.865 | 6.86 | 9 | - | 0.0075 | 2.00 |

N. ingudant

F-CS-012 Revision: 01 Date: 20-04-65

Calibration Report

Certificate No.: 2403175-001-01

Equipment: Digital Thermometer with RTD (pH Meter)

Resolution: 0.1 °C **Model:** SevenCompact S220

Serial No.: C113432421 **ID No.:** UAE.WAT.009/2564

Manufacturer: METTLER TOLEDO

Date of Calibration: 25 June 2024

Page 4 of 5

Location: Chemical Calibration Laboratory, National Food Institute

Environment Condition: **Ambient Temperature** 23 °C ± 1 °C

Relative Humidity 50 % ± 5 %

Condition of this results of Calibration:

- Calibration Method :
 - In house method: W-TE-025 by comparison with standard thermometer.
 - The Calibration is determined by comparing with a known temperature from a standard resistance thermometer.
 - The temperature scale in use at this laboratory is the International Temperature scale of 1990 (ITS-90).

2. Reference Standard Instrument :

| Instrument | Model | Serial No. | Certificate No. | Due Date | Through |
|---------------------------------------|-------|------------|-----------------|-------------|-------------------------|
| HANDHELD THERMOMETER | 1521 | A85997 | TE 670101-01 | 16-Dec-2024 | NATIONAL FOOD INSTITUTE |
| Platinum Resistance Thermometer (PRT) | 385 | 509201 | | | |

Support Equipment : - Low Temperature Bath (ISOCAL-6), Model: Europa-6 Plus Basic, S/N: 341592/2

- This certificate is traceable to International System of Units (SI Units).
- This certificate was certified only for the instrument we calibrated.
- This result of calibration was found accurate as shown on date and place of calibration only.

6. Condition of Calibrated item : Good

7. Result of Calibration :

☒

Without adjustment

☐

After adjustment

N. Niyudat

F-CS-012 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2403175-001-01

Equipment: Digital Thermometer with RTD (pH Meter)

Resolution: 0.1 °C Model: SevenCompact S220

Serial No.: C113432421 ID No.: UAE.WAT.009/2564

Manufacturer: METTLER TOLEDO

Date of Calibration: 25 June 2024

Page 5 of 5

Calibration point: 15.0, 25.0 and 35.0 °C

Calibration result:

- The probe was immersed in liquid bath or dry bath to a minimum depth of 100 mm.
- Description of probe, model : InLab Expert Pro-ISM S/N : 4114099
- Dimension of probe : Diameter 12 mm., Length 120 mm.,
- Sheath material : Teflon

| UUC* Reading (°C) | Standard Temperature (°C) | Correction Value (°C) | Uncertainty ± (°C) |
|-------------------|---------------------------|-----------------------|--------------------|
| 14.9 | 14.998 | 0.1 | 0.099 |
| 25.2 | 24.998 | -0.2 | 0.099 |
| 35.3 | 34.997 | -0.3 | 0.099 |

Note

- UUC* : Unit Under Calibration

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

----- End -----

N. Inprasit

F-CS-012 Revision: 01 Date: 20-04-65





Certificate of Calibration

Equipment: CONDUCTIVITY METER Certificate No.: C24250010
Model: SevenDirect SD30 Issued Date: 15 January 2025
Serial No. (or ID.): C441872132 (UAE.WAO.017/2567) Job No.: WO-00057642
Manufacturer: METTLER TOLEDO Page: 1 of 2
Electrode Serial No. 5824370998 Model : InLab 731-ISM Brand : METTLER TOLEDO
Condition: In Condition

Customer: United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak Sub-District,
Phrakhanong District, Bangkok, THAILAND 10260

Environment Condition: Temperature 21.7 °C ± 0.2 °C
Humidity 48.8 %RH ± 2.1 %RH

Calibration Place: United Analyst and Engineering Consultant Co., Ltd. (Calibration Laboratory)
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak Sub-District,
Phrakhanong District, Bangkok, THAILAND 10260

Calibration By: Mr.Atachai Ngamchanat

Calibration Date: 15 January 2025

The Method used: In house method, CAL-WI-49, base on ASTM D 1125-14 and D 5391-14

Traceability: This certificate is traceable to the SI Units maintained by CRM of NIST(SRM) through CPA chem Co., Ltd. (ISO/IEC 17034) Certificate No. 1066606, 1066608, 1066610



(Mr. Atachai Ngamchanat)

Person in charge



(Miss Kaewkan Suradech)

Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor ($k=2$) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด

DKSH Technology Limited

2533 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260

2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

Delivering Growth – in Asia and Beyond.

เอกสารไม่ควบคุม

CAL-FM-C24-09: 12 Sep 2022

Calibration Results:**Before Adjustment**

| Standard Conductivity Solution | Unit Under Calibration Reading | Correction | Coverage Factor (k) | Uncertainty (±) |
|-----------------------------------|-----------------------------------|------------------------|--------------------------|-----------------------|
| 25.000 $\mu\text{S/cm}$ | 24.8 $\mu\text{S/cm}$ | 0.200 $\mu\text{S/cm}$ | 2.00 | 0.28 $\mu\text{S/cm}$ |
| 1413.1 $\mu\text{S/cm}$ | 1398.4 $\mu\text{S/cm}$ | 14.7 $\mu\text{S/cm}$ | 2.00 | 11 $\mu\text{S/cm}$ |
| 111.3 mS/cm | 109.5 mS/cm | 1.8 mS/cm | 2.00 | 0.81 mS/cm |

After Adjustment ; at 1413.1 $\mu\text{S/cm}$

| Standard Conductivity Solution | Unit Under Calibration Reading | Correction | Coverage Factor (k) | Uncertainty (±) |
|-----------------------------------|-----------------------------------|-------------------------|--------------------------|-----------------------|
| 25.000 $\mu\text{S/cm}$ | 25.1 $\mu\text{S/cm}$ | -0.100 $\mu\text{S/cm}$ | 2.00 | 0.28 $\mu\text{S/cm}$ |
| 1413.1 $\mu\text{S/cm}$ | 1413.1 $\mu\text{S/cm}$ | 0.0 $\mu\text{S/cm}$ | 2.00 | 11 $\mu\text{S/cm}$ |
| 111.3 mS/cm | 110.2 mS/cm | 1.1 mS/cm | 2.00 | 0.81 mS/cm |

The End of Certificate


Calibration Certificate

Certificate No.: 2502226-002-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhonong, Bangkok 10260

Page 1 of 4

Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: XSR205DU
Serial No.: C210685394
ID No.: UAE.WAO.010/2565
Order No.: 2502226
Operation No.: 2502226-002
Date of Receipt: 19 March 2025
Date of Calibration: 20 March 2025

Calibrated by Mr.Yothin Charoensuk
Scientist

Approved by 
(Mr.Pheraphat Tuanjit)
Manager, Division of Calibration Laboratory
Responsible for the Technical Management Team

Date of Issue: 25 March 2025

The uncertainties are for a confidence probability of approximately 95%

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.

F-CS-009 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2502226-002-01

Equipment:

Electronic Balance

Manufacturer: METTLER TOLEDO

Model: XSR205DU

Resolution: 0.00001 g / 0.0001 g

Serial No.: C210685394

ID No.: UAE.WAO.010/2565

Capacity: 82 g / 220 g

Date of Calibration: 20 March 2025

Page 2 of 4

Environment Condition: Ambient Temperature: 21.2 ± 0.6 °C Relative Humidity: 48 ± 3.5 %

Place of Calibration: 208 Balance Room, UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.

Condition of Equipment: Good Condition

Condition of This Results of Calibration:

1. Calibration Method: NFI Method W-MA-001 In-House Method based on UKAS Lab 14 : 2019

2. Reference Standards:

| Reference Standard | Model | Serial No. | Calibrated By | Certificate No. | Due Date |
|--------------------------|-------------|------------|---------------|-----------------|---------------|
| Standard Weight Class E2 | 1mg to 200g | B505567572 | TCS | M2404100S | 19 April 2025 |

| Instrument | Model | Serial No. | Calibrated By | Certificate No. | Due Date |
|--------------------|--------|----------------|----------------|-----------------|------------------|
| Thermo-Hygro Meter | 608-H1 | NFI.BTH 017/23 | Quality Reborn | QR25-0542 | 10 February 2026 |

3. This certification is traceable to SI UNIT

4. This certificate was certified only for the instrument we calibrated.

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

Calibration Results:

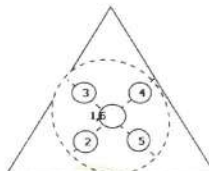
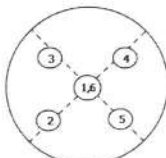
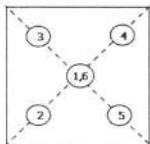
1. Repeatability of Reading:

| Nominal Value (g) | Standard Deviation of Reading (g) |
|---------------------|-------------------------------------|
| 40 | 0.0000042 |
| 80 | 0.0000042 |
| 100 | 0.0000000 |
| 200 | 0.0000000 |

2. Off-Center Error:

A mass of 100 g was placed and moved to various position on pan.

The balance reading obtained is given in the table.



| 1 | 2 | 3 | 4 | 5 | 6 | (Maximum Difference) |
|----------|----------|----------|----------|----------|----------|----------------------|
| (g) | (g) | (g) | (g) | (g) | (g) | (g) |
| 100.0001 | 100.0001 | 100.0001 | 100.0001 | 100.0001 | 100.0001 | 0.0000 |

Calibration Report

Certificate No.: 2502226-002-01

Equipment:

Electronic Balance

Manufacturer: METTLER TOLEDO

Model: XSR205DU

Resolution: 0.00001 g / 0.0001 g

Serial No.: C210685394

ID No.: UAE.WAO.010/2565

Capacity: 82 g / 220 g

Date of Calibration: 20 March 2025

Page 3 of 4

Calibration Results: (Continued)

Calibration Range: 0-80 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value: (Range: 0 - 82 g ; Resolution: 0.00001 g)

| Nominal Value (g) | Standard Value (g) | Average Reading (g) | Correction (g) | Uncertainty (± g) | Coverage Factor k |
|------------------------|-------------------------|--------------------------|---------------------|------------------------|----------------------|
| Unload | 0.000000 | 0.00000 | 0.00000 | 0.0000087 | 2.00 |
| 0.001 | 0.001003 | 0.00100 | 0.00000 | 0.0000090 | 2.00 |
| 0.005 | 0.005002 | 0.00501 | -0.00001 | 0.0000092 | 2.00 |
| 0.01 | 0.010003 | 0.01002 | -0.00002 | 0.0000089 | 2.00 |
| 0.05 | 0.049996 | 0.05001 | -0.00001 | 0.0000096 | 2.00 |
| 0.1 | 0.100011 | 0.10002 | -0.00001 | 0.000011 | 2.00 |
| 0.5 | 0.500016 | 0.50004 | -0.00002 | 0.000014 | 2.00 |
| 1 | 1.000003 | 1.00005 | -0.00005 | 0.000016 | 2.00 |
| 2 | 2.000023 | 2.00006 | -0.00004 | 0.000017 | 2.00 |
| 5 | 5.000015 | 5.00006 | -0.00005 | 0.000020 | 2.00 |
| 10 | 10.000009 | 10.00005 | -0.00004 | 0.000026 | 2.00 |
| 20 | 20.000030 | 20.00007 | -0.00004 | 0.000037 | 2.00 |
| 30 | 30.000039 | 30.00009 | -0.00005 | 0.000050 | 2.00 |
| 50 | 50.000028 | 50.00008 | -0.00005 | 0.000068 | 2.00 |
| 80 | 80.000067 | 80.00013 | -0.00006 | 0.00011 | 2.00 |



Calibration Report

Certificate No.: 2502226-002-01

Equipment:

Electronic Balance

Manufacturer: METTLER TOLEDO

Model: XSR205DU

Resolution: 0.00001 g / 0.0001 g

Serial No.: C210685394

ID No.: UAE.WAO.010/2565

Capacity: 82 g / 220 g

Date of Calibration: 20 March 2025

Page 4 of 4

Calibration Results: (Continued)

Calibration Range: >80-200 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value: (Range: >80 - 200 g ; Resolution: 0.0001 g)

| Nominal Value (g) | Standard Value (g) | Average Reading (g) | Correction (g) | Uncertainty (± g) | Coverage Factor <i>k</i> |
|------------------------|-------------------------|--------------------------|---------------------|------------------------|-----------------------------|
| 90 | 90.00010 | 90.0002 | -0.0001 | 0.00015 | 2.00 |
| 100 | 100.00006 | 100.0001 | 0.0000 | 0.00016 | 2.00 |
| 110 | 110.00007 | 110.0002 | -0.0001 | 0.00017 | 2.00 |
| 120 | 120.00009 | 120.0002 | -0.0001 | 0.00018 | 2.00 |
| 130 | 130.00010 | 130.0002 | -0.0001 | 0.00019 | 2.00 |
| 140 | 140.00013 | 140.0002 | -0.0001 | 0.00019 | 2.00 |
| 150 | 150.00009 | 150.0002 | -0.0001 | 0.00021 | 2.00 |
| 160 | 160.00010 | 160.0002 | -0.0001 | 0.00022 | 2.00 |
| 170 | 170.00012 | 170.0002 | -0.0001 | 0.00023 | 2.00 |
| 200 | 200.00013 | 200.0002 | -0.0001 | 0.00028 | 2.00 |

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 %.

----- End -----

for N. important

F-CS-012 Revision: 01 Date: 20-04-65



Calibration Certificate

Certificate No.: 2500116-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhnong, Bangkok 10260

Page 1 of 3

Equipment: CHAMBER (Hot Air Oven)

Manufacturer: MEMMERT

Model: UF55

Serial No.: B216.1666

ID No.: UAE.WAO.027/2559

Order No.: 2500116

Operation No.: 2500116-001

Date of Receipt: 8 October 2024

Date of Calibration: 8 October 2024

Calibrated by Mr.Yothin Charoensuk
Scientist

Approved by 
(Mr.Pheraphat Tuanjit)

Manager, Division of Calibration Laboratory

Date of Issue: 15 October 2024

Responsible for the Technical Management Team

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.

F-CS-009 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2500116-001-01

Equipment: CHAMBER (Hot Air Oven)

Model: UF55 Serial No.: B216.1666

Resolution: 0.1 °C ID No.: UAE.WAO.027/2559

Manufacturer: MEMMERT

Date of Calibration: 8 October 2024

Page 2 of 3

Location: Laboratory, UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.

Environment Condition:

Ambient Temperature (30.3 ± 1) °C

Relative Humidity (55 ± 1) %

Line Voltage (230 ± 3) Volt

Condition of this results of Calibration:

- This instrument was calibrated by insert 9 standard thermometer into its chamber and calibration according to W-TE-014 Based on TLAS G-20-1/02-08 (E): Guidelines for Calibration and Checks of Temperature Controlled Enclosures.
 - The temperature scale used was based on ITS - 90.
 - All data show below were final values and the initial data may be obtained upon request.

2. Reference Standard Instrument :

| Instrument | Model | Serial No./ID No. | Certificate No. | Due Date | Through |
|---------------------------------|--------|-------------------------|-----------------|-------------|-------------------------|
| Digital Thermometer with sensor | 34972A | MY57003188 | TE 670486-01 | 8 June 2025 | NATIONAL FOOD INSTITUTE |
| | RTD | CH#201-209/ RTD#201-209 | | | |

- This certificate is traceable to International System of Units (SI Units).
- This certificate was certified only for the instrument we calibrated.
- This result of calibration was found accurate as shown on date and place of calibration only.
- Condition of Calibrated item : Good

UUC Description :

Time of Record 1 Hour 9 Minute At 104.0,140.0 and 180.0 °C

Fresh air Damper ☐ Open Position ☐

☒ Close Fan 40%

☐ Not Available

7. Result of Calibration : ☒ Without adjustment ☐ After adjustment




Calibration Report

Certificate No.: 2500116-001-01

Equipment: CHAMBER (Hot Air Oven)

Model: UF55 Serial No.: B216.1666

Resolution: 0.1 °C ID No.: UAE.WAO.027/2559

Manufacturer: MEMMERT

Date of Calibration: 8 October 2024

Page 3 of 3

Calibration point: 104.0, 140.0 and 180.0 °C

Calibration result:

| Calibration Condition | Temperature (°C) | Relative Humidity (%) | Line Voltage (Volt) |
|-----------------------|------------------|-----------------------|---------------------|
| MIN | 29.3 | 54 | 227.0 |
| MAX | 31.2 | 56 | 232.0 |

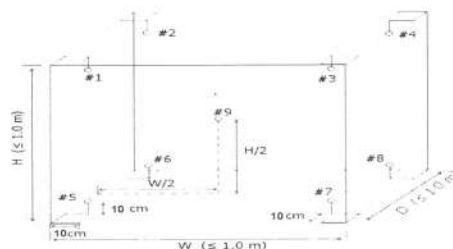


Table 1 : Reporting of Temperature

| Calibration point (°C) | Measured Temperature (°C) @ Sensor No. (Sensor No.9 is REF) | | | | | | | | | Uncertainty ± (°C) |
|------------------------|---|--------|--------|--------|--------|--------|--------|--------|--------|--------------------|
| | # 1 | # 2 | # 3 | # 4 | # 5 | # 6 | # 7 | # 8 | # 9 | |
| 104.0 | 103.89 | 103.66 | 103.88 | 103.89 | 104.40 | 103.98 | 103.70 | 104.10 | 104.15 | 0.53 |
| 140.0 | 139.85 | 139.53 | 139.87 | 139.88 | 140.67 | 140.00 | 139.60 | 140.25 | 140.23 | 0.73 |
| 180.0 | 179.63 | 179.22 | 179.71 | 179.76 | 181.03 | 180.06 | 179.41 | 180.87 | 180.39 | 0.90 |

Table 2 : Reporting of Characterization Result

| UUC* Setting (°C) | UUC* Reading (°C) | | | Stability ± (°C) | Uniformity (°C) | Overall Variation (°C) |
|-------------------|-------------------|-------|---------|------------------|-----------------|------------------------|
| | MIN | MAX | Average | | | |
| 104.0 | 104.0 | 104.0 | 104.0 | 0.15 | 0.49 | 0.88 |
| 140.0 | 140.0 | 140.0 | 140.0 | 0.13 | 0.71 | 1.2 |
| 180.0 | 180.0 | 180.0 | 180.0 | 0.13 | 1.2 | 1.9 |

Note The quoted uncertainty include " Stability " and " Loading effect (20% of Temp Uniformity) "

UUC* = Unit Under Calibration

Stability = One-half of the greatest maximum difference of measured temperatures at any one sensors, for at least half an hour after reaching steady state.

Uniformity = The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time.

Overall Variation = The difference of the maximum and minimum measured temperatures throughout observation time.

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

----- End -----




Certificate No.: 250422-1-BL002-25

Code No.: BL002-25

Page: 2 of 3

Equipment: Electronic Balance

Manufacturer: Mettler Toledo

Model: AB204-S/FACT

Readability: 0.0001 g

Serial No.: 1129361010

ID No.: UAE.WAS.002/2552

Max. Capacity: 220 g

Calibration Date: April 23, 2025

Condition As-Received: In Condition

Condition of Equipment:

Condition of This Result of Calibration:

1. Calibration Method: This instrument was calibrated by method UAE.CP.CAL.006 In-House Method based on UKAS Lab 14 : 2022

2. Reference Standards:

| Reference Standard: | Model | Serial No. | Calibrated By | Certificate No. | Traceability | Due Date |
|---------------------------------|---------------|------------|---------------|-----------------|-----------------|-----------|
| Standard Weight Class E2 (OIML) | 1 mg to 1 kg | B749109122 | AMARC | 25-009359 | Mettler-Toledo | 21-Jan-27 |
| Standard Weight Class F1 (OIML) | 1 mg to 200 g | 11119512 | AMARC | 24-013840 | Mettler-Toledo | 04-Feb-26 |
| Instrument | Model | Serial No. | Calibrated By | Certificate No. | Traceability | Due Date |
| Thermo-Hygro-Baro Meter | MHB-382SD | AK.46457 | SUCCESS | SG-H-00997/67 | Success Gateway | 21-Nov-25 |
| Thermo-Hygro-Baro Meter | MHB-382SD | AK.46457 | TPA | 25P795 | TPA | 25-Feb-26 |

3. This certification is traceable to SI Unit

4. This certification was certified only for the indtrument we calibrated

5. This result of calibration wae found accurate as show on date and place of calibration only.

6. Through the reference standard laboratory of AMARC 25-009359 Calibration 0152

Calibraton Result:

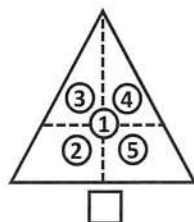
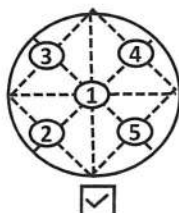
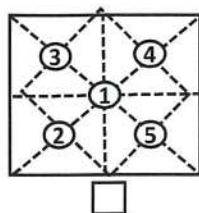
1. Repeatability of Reading:

| Nominal Value (g) | Standard Deviation of Reading (g) |
|-------------------|-----------------------------------|
| 200* | 0.000045 |

2. Eccentric or off-center loading

A mass of 100 g was placed and moved to various position on pan

The Balance reading obtained is given in the table.



| 1 (g) | 2 (g) | 3 (g) | 4 (g) | 5 (g) | Maximum Difference (g) |
|----------|----------|----------|----------|----------|---------------------------|
| 100.0000 | 99.9996 | 99.9997 | 100.0003 | 100.0005 | 0.0005 |

เอกสารไม่ควบคุม

Certificate No.: 250422-1-BL002-25

Code No.: BL002-25

Page: 3 of 3

Equipment: Electronic Balance
Model: AB204-S/FACT
Serial No.: 1129361010
Max. Capacity: 220 g
Calibration Date: April 23, 2025

Manufacturer: Mettler Toledo
Readability: 0.0001 g
ID No.: UAE.WAS.002/2552

Calibration Result: (Continued)

Calibration Range: 0 - 200 g

Calibration Adjustment: Internal Calibration

3. Error of indication from nominal or conventional mass value:

| Nominal Value (g) | Reference Value (g) | Indication (g) | Correction (g) | Uncertainty (\pm mg) | Coverage Factor <i>k</i> |
|----------------------|------------------------|-------------------|-------------------|----------------------------|-----------------------------|
| Unload | 0.0000000 | 0.0000 | 0.0000 | 0.10 | 2.05 |
| 0.01 | 0.0100025 | 0.0099 | 0.0001 | 0.10 | 2.05 |
| 0.05 | 0.0500056 | 0.0500 | 0.0000 | 0.10 | 2.05 |
| 0.1 | 0.1000012 | 0.0999 | 0.0001 | 0.10 | 2.05 |
| 0.5 | 0.5000133 | 0.5000 | 0.0000 | 0.10 | 2.05 |
| 1 | 1.0000105 | 1.0000 | 0.0000 | 0.10 | 2.05 |
| 10 | 10.000010 | 10.0000 | 0.0000 | 0.11 | 2.04 |
| 40 | 40.000076 | 40.0000 | 0.0000 | 0.14 | 2.00 |
| 50 | 50.000056 | 50.0000 | 0.0001 | 0.13 | 2.00 |
| 80 | 80.000107 | 80.0000 | 0.0001 | 0.18 | 2.00 |
| 100 | 100.000109 | 99.9999 | 0.0002 | 0.17 | 2.00 |
| 120 | 120.00015 | 119.9999 | 0.0003 | 0.21 | 2.00 |
| 150 | 150.000165 | 149.9998 | 0.0003 | 0.24 | 2.00 |
| 160 | 160.000175 | 159.9997 | 0.0005 | 0.26 | 2.00 |
| 200 | 200.000129 | 199.9998 | 0.0004 | 0.30 | 2.00 |

4. Effect of Tare test:

| Tare Load (g) | Test Load (g) | Indication (g) | Correction (g) |
|------------------|------------------|-------------------|-------------------|
| 100 | 20.000041 | 19.9999 | 0.0001 |
| | 40.000076 | 39.9998 | 0.0002 |
| | 60.000066 | 59.9997 | 0.0003 |
| | 80.000107 | 79.9999 | 0.0002 |
| | 100.000168 | 100.0004 | -0.0003 |

Remark:

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

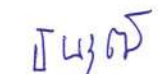
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o---o-End-o---

CERTIFICATE OF CALIBRATION

Certificate No. : SP24-028

Page 1 of 5

Customer : United Analyst and Engineering Consultant Co.,Ltd. (Head Office)**Address :** 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260**Location of calibration :** Laboratory 315**Equipment :** UV-Vis Spectrophotometer**Manufacturer :** HITACHI**Model :** U-5100**Serial No. :** 23A4-008**ID No. :** UAE.WAS.010/2567**Received Date :** 10 September 2024**Calibration Date :** 10 September 2024**Issue Date :** 13 September 2024**Condition Instrument :** Good**Calibrated by :**

(Mr.Tanawut Rittidach)

Technical Manager

Approved by :

(Ms. Chonthicha Sangngern)

Quality Manager

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

The measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the DQE Services Co., Ltd.

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REPORT OF CALIBRATION

Certificate No. : SP24-028

Page 2 of 5

Environment Condition : Ambient Temperature 25 ± 5 °CRelative humidity 55 ± 20 %RH**Calibration method :** In-house method CP-01 Based on ASTM E275-08**Certified Reference Materials :**

| Material | Serial No. | Certificate No. | Due date |
|-------------------------|------------|-----------------|-----------------|
| Absorbance Standard set | 25760 | 115663 | 25 October 2025 |
| Absorbance Standard set | 25757 | 115638 | 25 October 2025 |
| Wavelength Standard set | 25806 | 115657 | 25 October 2025 |
| Wavelength Standard set | 25758 | 115665 | 25 October 2025 |

Traceability : This certification is traceable to the International System of Unit maintained at National -
Institute of Standards and Technology (NIST) through Sarna Scientific Limited

Spectral Band Width of UUC : 5.0 nm.**Scan Speed of UUC :** 40**Scan Interval of UUC :** 0.1 nm.**Resolution of UUC :** Photometric 0.001 Abs.

Wavelength 0.1 nm.

REPORT OF CALIBRATION

Certificate No. : SP24-028

Page 3 of 5

Calibration Results : Without adjustment

Photometric Accuracy :

| Wavelength (nm.) | CRMs Values (Abs) | UUC Reading (Abs) | Correction (Abs) | Uncertainty (Abs) | Coverage factor <i>k</i> |
|---------------------|----------------------|----------------------|---------------------|----------------------|-----------------------------|
| 420 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5780 | 0.575 | 0.0030 | 0.0031 | 2.00 |
| | 1.0484 | 1.044 | 0.0044 | 0.0029 | 2.00 |
| | 2.1876 | 2.190 | -0.0024 | 0.0075 | 2.00 |
| 440 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5595 | 0.557 | 0.0025 | 0.0034 | 2.00 |
| | 1.0239 | 1.021 | 0.0029 | 0.0035 | 2.00 |
| | 2.1230 | 2.121 | 0.0020 | 0.0079 | 2.00 |
| 465 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5230 | 0.519 | 0.0040 | 0.0029 | 2.00 |
| | 0.9633 | 0.961 | 0.0023 | 0.0028 | 2.00 |
| | 1.9753 | 1.975 | 0.0003 | 0.0070 | 2.00 |
| 546.1 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5181 | 0.515 | 0.0031 | 0.0031 | 2.00 |
| | 1.0002 | 0.997 | 0.0032 | 0.0033 | 2.00 |
| | 1.9973 | 1.996 | 0.0013 | 0.0085 | 2.00 |
| 590 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5517 | 0.549 | 0.0027 | 0.0030 | 2.00 |
| | 1.0803 | 1.078 | 0.0023 | 0.0029 | 2.00 |
| | 2.0373 | 2.031 | 0.0063 | 0.0081 | 2.00 |
| 635 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5591 | 0.557 | 0.0021 | 0.0031 | 2.00 |
| | 1.0518 | 1.049 | 0.0028 | 0.0029 | 2.00 |
| | 1.9274 | 1.923 | 0.0044 | 0.0080 | 2.00 |

REPORT OF CALIBRATION

Certificate No. : SP24-028

Page 4 of 5

Photometric Accuracy :

| Wavelength (nm.) | CRMs Values (Abs) | UUC Reading (Abs) | Correction (Abs) | Uncertainty (Abs) | Coverage factor <i>k</i> |
|---------------------|----------------------|----------------------|---------------------|----------------------|-----------------------------|
| 235 | 0.0000 | 0.000 | 0.0000 | 0.0050 | 2.00 |
| | 0.7469 | 0.743 | 0.0039 | 0.0056 | 2.00 |
| 257 | 0.0000 | 0.000 | 0.0000 | 0.0050 | 2.00 |
| | 0.8674 | 0.862 | 0.0054 | 0.0059 | 2.00 |
| 313 | 0.0000 | 0.000 | 0.0000 | 0.0050 | 2.00 |
| | 0.2919 | 0.291 | 0.0009 | 0.0051 | 2.00 |
| 350 | 0.0000 | 0.000 | 0.0000 | 0.0050 | 2.00 |
| | 0.6430 | 0.639 | 0.0040 | 0.0055 | 2.00 |

REPORT OF CALIBRATION

Certificate No. : SP24-028

Page 5 of 5

Wavelength Accuracy :

| CRMs Values (nm.) | UUC Reading (nm.) | Correction (nm.) | Uncertainty (nm.) | Coverage factor <i>k</i> |
|----------------------|----------------------|---------------------|----------------------|-----------------------------|
| 241.00 | 240.4 | 0.60 | 0.18 | 2.00 |
| 279.30 | 278.7 | 0.60 | 0.18 | 2.00 |
| 288.90 | 288.5 | 0.40 | 0.18 | 2.00 |
| 334.50 | 334.2 | 0.30 | 0.18 | 2.00 |
| 361.40 | 361.1 | 0.30 | 0.18 | 2.00 |
| 418.40 | 418.0 | 0.40 | 0.18 | 2.00 |
| 447.20 | 446.7 | 0.50 | 0.18 | 2.00 |
| 459.30 | 459.6 | -0.30 | 0.18 | 2.00 |
| 537.00 | 536.6 | 0.40 | 0.18 | 2.00 |
| 638.00 | 637.4 | 0.60 | 0.18 | 2.00 |
| 441.29 | 440.8 | 0.49 | 0.18 | 2.00 |
| 479.88 | 479.6 | 0.28 | 0.18 | 2.00 |
| 513.75 | 513.5 | 0.25 | 0.18 | 2.00 |
| 528.59 | 528.6 | -0.01 | 0.18 | 2.00 |
| 575.10 | 574.9 | 0.20 | 0.18 | 2.00 |
| 585.56 | 585.3 | 0.26 | 0.20 | 2.00 |
| 684.70 | 684.1 | 0.60 | 0.18 | 2.00 |
| 740.51 | 740.0 | 0.51 | 0.20 | 2.00 |
| 747.61 | 747.2 | 0.41 | 0.18 | 2.00 |
| 807.04 | 806.3 | 0.74 | 0.18 | 2.00 |
| 879.68 | 878.9 | 0.78 | 0.18 | 2.00 |

Remark : - UUC = Unit Under Calibration

- N/A = Not Available

- The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor k ,

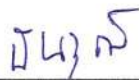
which for a normal distribution corresponds to a coverage probability of approximately 95%

- End of Certificate -

CERTIFICATE OF CALIBRATION

Certificate No. : SP25-001

Page 1 of 5

Customer : United Analyst and Engineering Consultant Co.,Ltd. (Head Office)**Address :** 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260**Location of calibration :** Laboratory 213**Equipment :** UV-Vis Spectrophotometer**Manufacturer :** Hitachi**Model :** U-2900**Serial No. :** 21E22-009**ID No. :** UAE.WAT.051/2564**Received Date :** 3 January 2025**Calibration Date :** 3 January 2025**Issue Date :** 8 January 2025**Condition Instrument :** Good**Calibrated by :**

(Mr.Tanawut Rittidach)

Technical Manager

Approved by :

(Ms. Chonthicha Sangngern)

Quality Manager

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

The measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the DQE Services Co., Ltd.

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REPORT OF CALIBRATION

Certificate No. : SP25-001

Page 2 of 5

Environment Condition : Ambient Temperature 25 ± 5 °CRelative humidity 55 ± 20 %RH**Calibration method :** In-house method CP-01 Based on ASTM E275-08**Certified Reference Materials :**

| Material | Serial No. | Certificate No. | Due date |
|-------------------------|------------|-----------------|-----------------|
| Absorbance Standard set | 25760 | 115663 | 25 October 2025 |
| Absorbance Standard set | 25757 | 115638 | 25 October 2025 |
| Wavelength Standard set | 25806 | 115657 | 25 October 2025 |
| Wavelength Standard set | 25758 | 115665 | 25 October 2025 |

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

Institute of Standards and Technology (NIST) through Starna Scientific Limited

Spectral Band Width of UUC : 1.5 nm.**Scan Speed of UUC :** 200 nm/min**Scan Interval of UUC :** 0.1 nm.**Resolution of UUC :** Photometric 0.001 Abs.

Wavelength 0.1 nm.

เอกสารไม่ควบคุม

REPORT OF CALIBRATION

Certificate No. : SP25-001

Page 3 of 5

Calibration Results : Without adjustment

Photometric Accuracy :

| Wavelength (nm.) | CRMs Values (Abs) | UUC Reading (Abs) | Correction (Abs) | Uncertainty (Abs) | Coverage factor <i>k</i> |
|---------------------|----------------------|----------------------|---------------------|----------------------|-----------------------------|
| 420 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5780 | 0.578 | 0.0000 | 0.0031 | 2.00 |
| | 1.0484 | 1.045 | 0.0034 | 0.0029 | 2.00 |
| | 2.1876 | 2.192 | -0.0044 | 0.0075 | 2.00 |
| 440 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5595 | 0.560 | -0.0005 | 0.0034 | 2.00 |
| | 1.0239 | 1.023 | 0.0009 | 0.0035 | 2.00 |
| | 2.1230 | 2.125 | -0.0020 | 0.0079 | 2.00 |
| 465 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5230 | 0.521 | 0.0020 | 0.0030 | 2.00 |
| | 0.9633 | 0.961 | 0.0023 | 0.0029 | 2.00 |
| | 1.9753 | 1.977 | -0.0017 | 0.0070 | 2.00 |
| 546.1 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5181 | 0.518 | 0.0001 | 0.0031 | 2.00 |
| | 1.0002 | 0.998 | 0.0022 | 0.0033 | 2.00 |
| | 1.9973 | 1.993 | 0.0043 | 0.0084 | 2.00 |
| 590 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5517 | 0.552 | -0.0003 | 0.0030 | 2.00 |
| | 1.0803 | 1.079 | 0.0013 | 0.0030 | 2.00 |
| | 2.0373 | 2.032 | 0.0053 | 0.0079 | 2.00 |
| 635 | 0.0000 | 0.000 | 0.0000 | 0.0028 | 2.00 |
| | 0.5591 | 0.559 | 0.0001 | 0.0031 | 2.00 |
| | 1.0518 | 1.050 | 0.0018 | 0.0030 | 2.00 |
| | 1.9274 | 1.923 | 0.0044 | 0.0079 | 2.00 |

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REPORT OF CALIBRATION

Certificate No. : SP25-001

Page 4 of 5

Photometric Accuracy :

| Wavelength (nm.) | CRMs Values (Abs) | UUC Reading (Abs) | Correction (Abs) | Uncertainty (Abs) | Coverage factor <i>k</i> |
|---------------------|----------------------|----------------------|---------------------|----------------------|-----------------------------|
| 235 | 0.0000 | 0.000 | 0.0000 | 0.0050 | 2.00 |
| | 0.7469 | 0.744 | 0.0029 | 0.0057 | 2.00 |
| 257 | 0.0000 | 0.000 | 0.0000 | 0.0050 | 2.00 |
| | 0.8674 | 0.863 | 0.0044 | 0.0059 | 2.00 |
| 313 | 0.0000 | 0.000 | 0.0000 | 0.0050 | 2.00 |
| | 0.2919 | 0.290 | 0.0019 | 0.0051 | 2.00 |
| 350 | 0.0000 | 0.000 | 0.0000 | 0.0050 | 2.00 |
| | 0.6430 | 0.640 | 0.0030 | 0.0055 | 2.00 |

REPORT OF CALIBRATION

Certificate No. : SP25-001

Page 5 of 5

Wavelength Accuracy :

| CRMs Values (nm.) | UUC Reading (nm.) | Correction (nm.) | Uncertainty (nm.) | Coverage factor <i>k</i> |
|----------------------|----------------------|---------------------|----------------------|-----------------------------|
| 241.72 | 241.1 | 0.62 | 0.18 | 2.00 |
| 279.45 | 279.0 | 0.45 | 0.18 | 2.00 |
| 287.81 | 287.3 | 0.51 | 0.18 | 2.00 |
| 334.06 | 333.8 | 0.26 | 0.18 | 2.00 |
| 360.93 | 360.6 | 0.33 | 0.18 | 2.00 |
| 418.59 | 418.2 | 0.39 | 0.18 | 2.00 |
| 445.94 | 445.5 | 0.44 | 0.18 | 2.00 |
| 453.66 | 453.4 | 0.26 | 0.18 | 2.00 |
| 460.02 | 459.8 | 0.22 | 0.18 | 2.00 |
| 536.59 | 536.6 | -0.01 | 0.18 | 2.00 |
| 637.98 | 637.7 | 0.28 | 0.18 | 2.00 |
| 431.38 | 431.1 | 0.28 | 0.18 | 2.00 |
| 472.50 | 472.3 | 0.20 | 0.18 | 2.00 |
| 513.47 | 513.4 | 0.07 | 0.18 | 2.00 |
| 528.88 | 528.9 | -0.02 | 0.18 | 2.00 |
| 573.17 | 573.3 | -0.13 | 0.18 | 2.00 |
| 585.35 | 585.1 | 0.25 | 0.20 | 2.00 |
| 684.40 | 684.5 | -0.10 | 0.18 | 2.00 |
| 740.72 | 741.0 | -0.28 | 0.20 | 2.00 |
| 748.55 | 748.8 | -0.25 | 0.18 | 2.00 |
| 807.03 | 807.3 | -0.27 | 0.18 | 2.00 |
| 879.28 | 879.6 | -0.32 | 0.18 | 2.00 |

Remark : - UUC = Unit Under Calibration

- N/A = Not Available

- The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor k ,

which for a normal distribution corresponds to a coverage probability of approximately 95%

- End of Certificate -

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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.: 25TM205

Page : 1 of 3

Equipment : BOD Incubator

Manufacturer : Arco

Model : UC4-1320

Serial No. : 13URC4S013201

ID No. : UAE.WAO.015/2561

Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road
Bangchak, Phrakhanong
Bangkok 10260

Location : Lab. Floor 2

Received Order : 08 February 2025

Calibration Date : 08 February 2025

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

AC Line Voltage : (220 ± 22) V

Calibrated by :

Krisda Malee

Approved by :

Approved Signatory

() Chakrit Waewwanjua

() Suwit Imjai

(✓) Kunchit Promprat

Issue Date :

21 February 2025

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

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Equipment : BOD Incubator
Condition As-Received : Used Item
Reference : 2502-0166OC-1

Cert. No.: 25TM205

Page : 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

| <u>Instrument</u> | <u>Serial No.</u> | <u>Cert. No.</u> | <u>Traceable</u> | <u>Due Date</u> |
|----------------------|-------------------|------------------|------------------|-----------------|
| 1) Data Acquisition | MY57013823 | 24LM71 | TPA | 12 May 2025 |

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

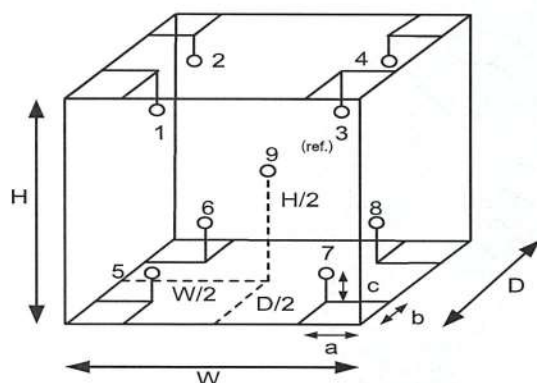
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available

| Environment during calibration | | |
|--------------------------------|-----------|----------|
| | Beginning | Finished |
| Temp. (°C) | 26 | 25 |
| REL.Humid. (%) | 49 | 52 |
| AC Supply (Volt) | 221 | 220 |



| Position : | Ref. Std. ID No.: |
|------------|-------------------|
| 1 | 21-17RTD-01 |
| 2 | 21-17RTD-02 |
| 3 | 17RTD-03 |
| 4 | 24-17RTD-04 |
| 5 | 17RTD-05 |
| 6 | 17RTD-06 |
| 7 | 17RTD-07 |
| 8 | 23-17RTD-08 |
| 9 (ref.) | 23-17RTD-09 |

Probe Installation Details :

a = 10 cm
b = 10 cm
c = 10 cm

Dimension of Chamber :

D = 0.62 m
W = 1.2 m
H = 1.2 m
Capacity = 0.89 m³

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Equipment : BOD Incubator
Condition As-Received : Used Item
Reference : 2502-0166OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Not Available

Cert. No.: 25TM205

Page : 3 of 3

| Calibration Point (°C) | UUC* Setting (°C) | UUC* Reading (°C) | Temperature stability (± °C) | Temperature uniformity (°C) | Overall Variation (°C) | Coverage Factor <i>k</i> |
|-----------------------------|------------------------|------------------------|-----------------------------------|----------------------------------|-----------------------------|-----------------------------|
| 20.0 | 20.0 | 19.9 | 0.36 | 0.56 | 0.99 | 2 |

| Calibration Point (°C) | Measured Temperature (°C) | | | | | | | | | Uncertainty (±°C) |
|--------------------------------|-----------------------------|--------|--------|--------|--------|--------|--------|--------|----------|----------------------------|
| | Position | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 (ref.) | |
| 20.0 | 19.841 | 19.714 | 20.110 | 19.862 | 19.747 | 19.710 | 19.676 | 19.789 | 19.695 | 0.54 |

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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


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

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

Certificate of Testing

Cert.No.: 24TW222

Page.: 1 of 2

Equipment : DO Meter
Manufacturer : YSI
Model : 4010-2W
Serial No. : 20260326
ID No. : UAE.WAO.060/2563
Received Date : 16 October 2024
Test Date : 17 October 2024
Reference : 2410-0532DSC-1
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260
Laboratory Condition : Temperature (25 ± 5) °C
Humidity (50 ± 20) %
Test Procedure : In - house method : CP-CH9
by Comparison Technique with Azide Modification Method
Tested by : Walalak Sirithean

Approved by : _____
Approved Signatory
() Unnopphol Harachai
() Ponpan Paipim
(✓) Saithip Meangmai
Issue Date : 17 October 2024

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Cert.No.: 24TW222

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

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

| <u>Instruments</u> | <u>Serial No.</u> | <u>ID No.</u> | <u>Certificate No.</u> | <u>Due Date</u> |
|--------------------|-------------------|---------------|------------------------|-----------------|
| 1. Burette | - | 130BU10 | 23CG1172 | 22 Mar 2025 |
| 2. Balance | 14233821 | 110RC001 | 24MM131 | 04 July 2025 |

2. Standard Material :-

| <u>Material</u> | <u>Manufacturer</u> | <u>Lot.No.</u> | <u>Assay</u> |
|---------------------------------|---------------------|----------------|--------------|
| Sodium Thiosulfate 5-Hydrate AR | KEMAUS | 2203162447 | 99.6% |

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 22M102385

| Titration Method (Azide Modification Method) (mg/L) | DO Meter Reading (mg/L) | Standard Deviation (mg/L) |
|---|---------------------------------------|-------------------------------------|
| 8.18 | 8.24 | 0.0071 |

This report was certified only for the instrument we tested. It is allowable to use for study
Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced
other in full, without written approval of the laboratory

-o0o-

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Certificate No. : HIT-2510-0375

Page : 1 of 2

CERTIFICATE OF CALIBRATION

Equipment : COD Test Tube Heater

Meter Model : HI839800-02 **Serial No. :** H018500I

Tube Heater : 25 Vial Capacity **Resolution :** 0.1°C

Temperature Range : (-10 to 160)°C **Temperature of Reaction :** 150°C

Manufacturer : Hanna Instruments **Made in :** Romania

Condition As-Received : Used Product **Reference :** RE250401

Ambient Temperature : (25 ± 2)°C **Relative Humidity :** (50 ± 15)% RH

Customer name : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Rd., Bangchak,
Phrakhanong, Bangkok 10260

Received date : 5 March 2025

Calibrate date : 7 March 2025

Issue date : 7 March 2025

Calibrated Location : Hanna Instruments (Thailand) Ltd.

Calibration Procedure : This calibrator was conducted by using in-house: calibration procedure
CP-04 by using certified reference standard instruments.

Calibrated by : ☒ Mr. Pichit Petthong
☐ Mr. Channarong Soinak

Approved by : 
Mr. Anan Suwanchaisakul

Authorized Signatory

 **HANNA**
Instruments
(Thailand) Limited

This certificate was certified only for the instrument we calibrated.

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

** This certificate may not be reproduced other than in full, except with the prior written **

approval of the head of Hanna Instrument (Thailand) **เอกสารไม่ควบคุม**

Condition of this calibration result:

Reference Standard Instruments : This certification is traceable to the international unit of unit maintained through:

| Instruments | Model | Serial No. | Certificate No. | Traceable |
|------------------------------|----------|------------|-----------------|--|
| Data Acquisition Switch Unit | 34970A | MY44065265 | WK2407-141-1 | WK Electric Co., Ltd. |
| Digital Thermo-Hygrometer | HT-771SD | AI.07155 | 25H171 | Technology Promotion Association (Thailand-Japan). |

Calibration Result:

Measurement Temperature Source Accuracy for COD Reactor.

| Capacity (Vial) | Nominal Value (°C) | Average Value (°C) | Uncertainty of Measurement (±°C) |
|--------------------|-----------------------|-----------------------|-------------------------------------|
| 25 Vial | 150.0 | 150.4 | 0.47 |

Unit : °C

| | | | | |
|---------|---------|---------|---------|---------|
| (1A) | (2A) | (3A) | (4A) | (5A) |
| 150.407 | 150.377 | 150.269 | 150.402 | 150.422 |
| (1B) | (2B) | (3B) | (4B) | (5B) |
| 150.426 | 150.394 | 150.644 | 150.690 | 150.542 |
| (1C) | (2C) | (3C) | (4C) | (5C) |
| 150.477 | 150.303 | 150.627 | 150.257 | 150.176 |
| (1D) | (2D) | (3D) | (4D) | (5D) |
| 150.462 | 150.456 | 150.199 | 150.406 | 150.102 |
| (1E) | (2E) | (3E) | (4E) | (5E) |
| 150.185 | 150.513 | 150.235 | 150.460 | 150.442 |

Figure: Shows the location of the temperature source.

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

**** End of certificate ****

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Verification Certificate

Certificate No.: 2404228-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhnong, Bangkok 10260

Page 1 of 4

Equipment: Digestion Unit (Heating Block)
Manufacturer: VELP SCIENTIFICA
Model: DKL20
Serial No.: 213517
ID No.: UAE.WAS.005/2555
Order No.: 2404228
Operation No.: 2404228-001
Date of Receipt: 26 August 2024
Date of Calibration: 26-27 August 2024

Calibrated by Mr.Worapob Sookthong
Scientist

Approved by

(Mr.Pheraphat Tuanjit)

Manager, Division of Calibration Laboratory

Date of Issue: 30 August 2024

Responsible for the Technical Management Team

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.

F-CS-009 Revision: 01 Date: 20-04-65



Verification Report

Certificate No.: 2404228-001-01

Equipment: Digestion Unit (Heating Block)

Model: DKL20 Serial No.: 213517

Resolution: 1 °C ID No : UAE.WAS.005/2555

Manufacturer: VELP SCIENTIFICA

Date of Calibration: 26-27 August 2024

Page 2 of 4

Location: Dry Laboratory (312), UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

Environment Condition:

Ambient Temperature (29 ± 1) °C

Relative Humidity (60 ± 2) %

Line Voltage (224 ± 1) Volt

Condition of this results of Calibration:

- This instrument was calibrated by insert standard thermocouples type R into its Digestion blocks and Calibration according to NFI Method W-TE-026 based on BS 4309 : 1968
 - The temperature scale used was based on ITS - 90 .
 - All data show below were final values and the initial data may be obtained upon request.

2. Reference Standard Instrument :

| Instrument | Model | Serial No. | Certificate No. | Due Date | Through |
|---------------------------------------|--------|-----------------------|-----------------|------------|----------------------------------|
| Digital Thermometer with Thermocouple | 34970A | MY44045576/MY41194453 | TC24/0063 | 5-Jun-2025 | N.M. Technical Center Laboratory |
| | Type R | R/CH1 to R/CH3 | | | |

- This certificate is traceable to International System of Units (SI Units).
- This certificate was certified only for the instrument we calibrated.
- This result of calibration was found accurate as shown on date and place of calibration only.
- Condition of Calibrated item : Good

UUC* Description

Time of Record 1 Hour 6 Minute At 380 °C

7. Result of Calibration : ☒ Without adjustment ☐ After adjustment




Verification Report

Certificate No.:

2404228-001-01

Equipment:

Digestion Unit (Heating Block)

Model: DKL20

Serial No.: 213517

Resolution: 1 °C

ID No : UAE.WAS.005/2555

Manufacturer: VELP SCIENTIFICA

Date of Calibration:

26-27 August 2024

Page 3 of 4

Calibration point:

380 °C

Calibration result:

Table1 : Reporting of Temperature

| Block No. | UUC* Setting (°C) | UUC* Reading (°C) | Stability (±°C) | Standard Thermometer (°C) | Uncertainty (±°C) |
|-----------|-------------------|-------------------|-----------------|---------------------------|-------------------|
| 1 | 380 | 380 | 0.21 | 380.14 | 2.0 |
| 2 | 380 | 380 | 0.21 | 380.70 | 2.0 |
| 3 | 380 | 380 | 0.12 | 381.17 | 2.0 |
| 4 | 380 | 380 | 0.12 | 379.82 | 2.0 |
| 5 | 380 | 380 | 0.20 | 381.01 | 2.0 |
| 6 | 380 | 380 | 0.16 | 380.48 | 2.0 |
| 7 | 380 | 380 | 0.19 | 379.35 | 2.0 |
| 8 | 380 | 380 | 0.25 | 380.27 | 2.0 |
| 9 | 380 | 380 | 0.17 | 382.28 | 2.0 |
| 10 | 380 | 380 | 0.35 | 380.98 | 2.0 |
| 11 | 380 | 380 | 0.30 | 380.35 | 2.0 |
| 12 | 380 | 380 | 0.23 | 382.38 | 2.0 |
| 13 | 380 | 380 | 0.17 | 378.95 | 2.0 |
| 14 | 380 | 380 | 0.18 | 379.69 | 2.0 |
| 15 | 380 | 380 | 0.16 | 382.06 | 2.0 |
| 16 | 380 | 380 | 0.14 | 380.14 | 2.0 |
| 17 | 380 | 380 | 0.16 | 381.09 | 2.0 |
| 18 | 380 | 380 | 0.15 | 382.71 | 2.0 |
| 19 | 380 | 380 | 0.25 | 381.32 | 2.0 |
| 20 | 380 | 380 | 0.25 | 381.21 | 2.0 |

Note:

- UUC* = Unit Under Calibration

- Immersion depth of standard thermometer in tube level high of sand is equal heater plate of UUC.

- Stability = One-half of the greatest maximum difference of measured temperatures at one sensors, for at least half an hour after reaching steady state.

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




Verification Report

Certificate No.: 2404228-001-01

Equipment: Digestion Unit (Heating Block)

Model: DKL20 Serial No.: 213517

Resolution: 1 °C ID No.: UAE.WAS.005/2555

Manufacturer: VELP SCIENTIFICA

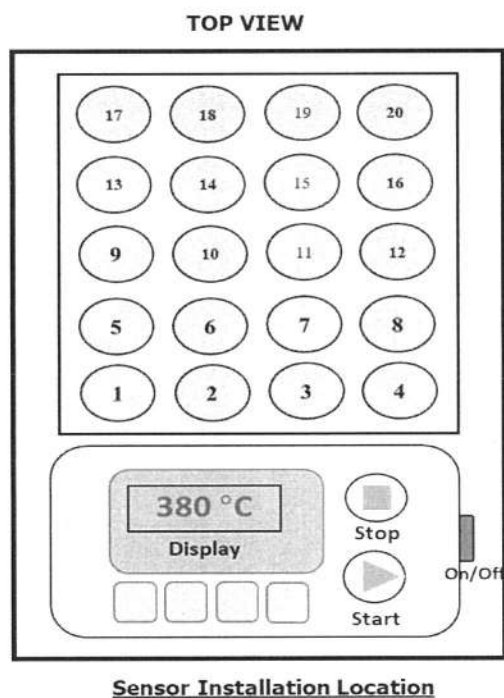
Date of Calibration: 26-27 August 2024

Calibration point: 380 °C

Calibration result: Continued

Page 4 of 4

Figure 1. Location of Reference Standard and Block Diagram of Digestion Unit



----- End -----



FOSS

FOSS South East Asia

3388 Sirinrat Building, 25th – 26th Floor, Unit No. 3388/90,
Rama IV Road, Klongton , Klongtoey, Bangkok, Thailand 10110

Customer Service Report

Report No.:

13854

Date:

24 February 2025

Customer:

VAE

Job No.:

11735

Address:

Bangkok

Instrument:

KT8100

Serial:

91889052

Start
Finish

Travel To Customer (Hrs)

07:00

09:00

2hrs

Labour (Hrs)

09:00-12:00

13:00-14:00

0hrs

Travel From Customer (Hrs)

15:00

17:00

2hrs

Job Type

| Application | | Special | | Standard | |
|-----------------|---|----------------|---|--------------------|---|
| Distributor | x | Courtesy Visit | x | Installation | x |
| Digital Service | x | PMA Onboarding | x | Quote | x |
| Internal | x | Warranty | x | Repair | x |
| Investigate | x | Sales Support | x | Remote | x |
| | | | | Training | x |
| | | | | In House | x |
| | | | | PM | x |
| | | | | Health Check Visit | x |

PMA Type

Smartcare

x

Smartcare Pro

x

Fosscore

x

Smartcare Advance

x

Fosscore Pro

x

N/A

x

Details of Work / Test

APM KT8100 12mo

- test before PM
- cleaning KT8100, 36 mo replace
- flushing Alkali pump
- test operation
 - Distillation 80 - 80 ml
 - Distillation 6 min 150-170 ml
 - Alkali 50-60 ml
 - all pass

Instrument Ready for Use

OK

x

Not OK*

x

Part No:

Batch

Description

Qty

60031810

08-01-2024

FOSS PM kit KT8100 36mo

1

I confirm this report is accurate and complete

Signed FOSS

[Signature]

Signed Customer

Suphakorn P.

Name

Name

Email:

Customer Contact.:

*Remark:

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Please scan QR code



Request No. 25-67 / 0275

MTC. ACL.No. 358 / 67

CALIBRATION CERTIFICATE

NOMENCLATURE : 1. Atomic Absorption Spectrophotometer "Agilent Technologies"

Model AA240FS, Serial No. MY13160001

2. Working standard solution "Inorganic Ventures"

Multi Analyte Custom Grade Solution, Lot No. S2-MEB675610

SUBMITTED BY : United Analyst and Engineering Consultant Co., Ltd.

3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260

CALIBRATION PROCEDURE : 1. Performance Verification of Atomic Absorption Spectrophotometer
(WI-500-02-30)

2. Estimation Uncertainty of Measurement in Analytical Chemistry (QP-513)

CALIBRATION RANGE: 0.02, 0.10, 0.30, 0.50, 0.70 mg/l at 228.8 nm.Cd, 0.10, 0.20, 0.30, 0.50, 0.70 mg/l at 357.9 nm.Cr,
0.05, 0.10, 0.30, 0.50, 0.70 mg/l at 324.7 nm.Cu, 0.10, 0.30, 0.50, 0.70, 1.00 mg/l at 248.3 nm.Fe,
0.20, 0.50, 0.70, 1.00, 1.50 mg/l at 217.0 nm.Pb, 0.05, 0.10, 0.30, 0.50, 0.70 mg/l at 279.5 nm.Mn,
0.10, 0.30, 0.50, 0.70, 1.00 mg/l at 232.0 nm.Ni, 0.05, 0.10, 0.30, 0.50, 0.70 mg/l at 213.9 nm.Zn

CALIBRATION DATE : 2 February 2024

REFERENCE MATERIAL : Traceable to NIST "Agilent Technologies", "CARLO ERBA"

Cadmium Lot No. 0006589926, Chromium Lot No. 0112384886, Copper Batch No. T117098A, Iron Batch No. T126087A,
Lead Lot No. 1227873, Manganese Batch No. T109228A, Nickel Batch No. T270178A, Zinc Batch No. T820140A

AMBIENT CONDITIONS : Temperature 25 ± 5 °C Relative humidity 50 ± 20 %

The Atomic Absorption Spectrophotometer has been calibrated against Reference Material traceable to National Institute of Standards and Technology (NIST) by The Analytical Chemistry Laboratory. The results are attached herewith.

Calibrated by Atipat

(Mr. Atipat Ratana)

Approved by Sulatta

(Miss Sutadde Deawtong)

Director of Analytical Chemistry Laboratory

Ref. 2015267020100454001

Issued Date : 11 March 2024

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

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FM.BL.MTC.002 Rev.4

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Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
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Tel. (66) 0 2259 5111 Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

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CALIBRATION DATA

1. Noise Level

| Element | Cd | Cr | Cu | Fe | Pb | Mn | Ni | Zn |
|--------------------|---------|--------|---------|---------|---------|---------|---------|---------|
| Absorbance | 0.0006 | 0.0004 | -0.0003 | 0.0001 | -0.0011 | -0.0005 | 0.0008 | 0.0004 |
| | 0.001 | 0.0017 | -0.0009 | 0.0008 | 0.0001 | 0.0002 | -0.0003 | 0.0007 |
| | 0.0006 | 0.0017 | -0.0020 | 0.0005 | 0.0005 | 0.0004 | 0.0013 | 0.0014 |
| | 0.0001 | 0.0018 | -0.0007 | 0.0005 | 0.0004 | -0.0003 | -0.0001 | 0.0010 |
| | -0.0001 | 0.0019 | -0.0014 | 0.0003 | 0.0010 | 0.0000 | 0.0002 | -0.0001 |
| | 0.0011 | 0.0014 | -0.0017 | 0.0009 | -0.0008 | 0.0004 | 0.0006 | 0.0010 |
| | -0.0002 | 0.0015 | -0.0015 | 0.0003 | 0.0002 | -0.0008 | 0.0009 | 0.0013 |
| | 0.0006 | 0.0012 | -0.0001 | 0.0006 | 0.0008 | 0.0001 | -0.0002 | 0.0013 |
| | 0.0008 | 0.0009 | -0.0003 | 0.0003 | 0.0005 | 0.0002 | 0.0001 | 0.0007 |
| | 0.0012 | 0.0011 | -0.0012 | 0.0008 | 0.0003 | 0.0004 | 0.0004 | 0.0013 |
| | 0.0003 | 0.0015 | -0.0019 | 0.0001 | -0.0002 | 0.0000 | -0.0003 | 0.0003 |
| | 0.0005 | 0.0017 | -0.0019 | -0.0007 | 0.0000 | -0.0007 | 0.0005 | 0.0005 |
| | -0.0006 | 0.0016 | 0.0000 | 0.0006 | -0.0001 | 0.0013 | 0.0006 | 0.0010 |
| | 0.0003 | 0.0011 | -0.0002 | 0.0001 | -0.0007 | 0.0009 | 0.0009 | 0.0002 |
| | 0.0003 | 0.0012 | -0.0011 | 0.0007 | -0.0003 | -0.0003 | 0.0010 | 0.0009 |
| | 0.0004 | 0.0018 | -0.0016 | -0.0004 | -0.0006 | 0.0008 | 0.0007 | 0.0007 |
| | -0.0001 | 0.0018 | -0.0018 | 0.0013 | -0.0006 | -0.0001 | 0.0014 | 0.0006 |
| | 0.0003 | 0.0017 | -0.0001 | 0.0001 | -0.0012 | -0.0004 | 0.0001 | 0.0002 |
| | 0.0010 | 0.0018 | -0.0007 | 0.0003 | -0.0005 | -0.0002 | 0.001 | 0.0003 |
| | 0.0004 | 0.0019 | -0.0008 | -0.0001 | -0.0004 | 0.0003 | 0.0002 | 0.0008 |
| Average Absorbance | 0.000 | 0.001 | -0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 0.001 |

Continue 2 / 5

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

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Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2519 8592
E-mail : sumalee@tistr.or.th

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2. Precision

| Element | Conc. (mg/l) | Absorbance | | | | | | | | | | Ave. Abs. | SD | %RSD |
|---------|-----------------|------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|--------|------|
| Cd | 0.02 | 0.0078 | 0.0076 | 0.0069 | 0.0075 | 0.0071 | 0.0070 | 0.0076 | 0.0074 | 0.0077 | 0.0067 | 0.007 | 0.0004 | 5.15 |
| | 0.30 | 0.1008 | 0.1007 | 0.0999 | 0.0997 | 0.1000 | 0.0996 | 0.1008 | 0.1002 | 0.1005 | 0.0999 | 0.100 | 0.0005 | 0.46 |
| | 0.70 | 0.2301 | 0.2306 | 0.2277 | 0.2305 | 0.2310 | 0.2295 | 0.2290 | 0.2293 | 0.2305 | 0.2296 | 0.230 | 0.0010 | 0.42 |
| Cr | 0.10 | 0.0094 | 0.0093 | 0.0093 | 0.0098 | 0.0094 | 0.0095 | 0.0090 | 0.0090 | 0.0094 | 0.0090 | 0.009 | 0.0003 | 2.75 |
| | 0.30 | 0.0241 | 0.0236 | 0.0221 | 0.0238 | 0.0231 | 0.0226 | 0.0231 | 0.0223 | 0.0230 | 0.0231 | 0.023 | 0.0006 | 2.75 |
| | 0.70 | 0.0500 | 0.0500 | 0.0500 | 0.0524 | 0.0499 | 0.0511 | 0.0509 | 0.0512 | 0.0515 | 0.0504 | 0.051 | 0.0008 | 1.63 |
| Cu | 0.05 | 0.0061 | 0.0062 | 0.0064 | 0.0061 | 0.0069 | 0.0069 | 0.0061 | 0.0062 | 0.0064 | 0.0061 | 0.006 | 0.0003 | 5.00 |
| | 0.30 | 0.0419 | 0.0411 | 0.0402 | 0.0407 | 0.0405 | 0.0404 | 0.0399 | 0.0400 | 0.0399 | 0.0400 | 0.040 | 0.0006 | 1.58 |
| | 0.70 | 0.0960 | 0.0960 | 0.0960 | 0.0959 | 0.0947 | 0.0955 | 0.0952 | 0.0952 | 0.0951 | 0.0955 | 0.096 | 0.0005 | 0.48 |
| Fe | 0.10 | 0.0096 | 0.0101 | 0.0103 | 0.0100 | 0.0099 | 0.0096 | 0.0106 | 0.0099 | 0.0105 | 0.0102 | 0.010 | 0.0003 | 3.38 |
| | 0.50 | 0.0424 | 0.0415 | 0.0428 | 0.0427 | 0.0421 | 0.0426 | 0.0413 | 0.0430 | 0.0421 | 0.0419 | 0.042 | 0.0006 | 1.33 |
| | 1.00 | 0.0830 | 0.0839 | 0.0847 | 0.0834 | 0.0832 | 0.0820 | 0.0839 | 0.0838 | 0.0837 | 0.0845 | 0.084 | 0.0008 | 0.92 |
| Pb | 0.20 | 0.0078 | 0.0074 | 0.0078 | 0.0078 | 0.0076 | 0.0078 | 0.0077 | 0.0078 | 0.0078 | 0.0077 | 0.008 | 0.0001 | 1.71 |
| | 0.70 | 0.0278 | 0.0273 | 0.0271 | 0.0267 | 0.0270 | 0.0264 | 0.0274 | 0.0273 | 0.0269 | 0.0269 | 0.027 | 0.0004 | 1.45 |
| | 1.50 | 0.0551 | 0.0548 | 0.0552 | 0.0555 | 0.0547 | 0.0546 | 0.0544 | 0.0544 | 0.0549 | 0.0547 | 0.055 | 0.0004 | 0.64 |
| Mn | 0.05 | 0.0116 | 0.0107 | 0.0110 | 0.0103 | 0.0108 | 0.0108 | 0.0112 | 0.0107 | 0.0109 | 0.0108 | 0.011 | 0.0003 | 3.15 |
| | 0.30 | 0.0650 | 0.0649 | 0.0649 | 0.0651 | 0.0646 | 0.0646 | 0.0649 | 0.0646 | 0.0640 | 0.0648 | 0.065 | 0.0003 | 0.48 |
| | 0.70 | 0.1463 | 0.1465 | 0.1459 | 0.1471 | 0.1475 | 0.1474 | 0.1487 | 0.1473 | 0.1462 | 0.1468 | 0.147 | 0.0008 | 0.56 |
| Ni | 0.10 | 0.0095 | 0.0100 | 0.0096 | 0.0103 | 0.0102 | 0.0096 | 0.0100 | 0.0095 | 0.0097 | 0.0096 | 0.010 | 0.0003 | 3.04 |
| | 0.50 | 0.0443 | 0.0433 | 0.0438 | 0.0444 | 0.0430 | 0.0437 | 0.0444 | 0.0437 | 0.0438 | 0.0434 | 0.044 | 0.0005 | 1.09 |
| | 1.00 | 0.0812 | 0.0820 | 0.0834 | 0.0829 | 0.0818 | 0.0829 | 0.0831 | 0.0835 | 0.0816 | 0.0819 | 0.082 | 0.0008 | 0.99 |
| Zn | 0.05 | 0.0374 | 0.0377 | 0.0373 | 0.0377 | 0.0374 | 0.0377 | 0.0373 | 0.0371 | 0.0371 | 0.0374 | 0.037 | 0.0002 | 0.61 |
| | 0.30 | 0.1985 | 0.1993 | 0.1975 | 0.1992 | 0.1979 | 0.1988 | 0.1995 | 0.1985 | 0.1974 | 0.2004 | 0.199 | 0.0009 | 0.47 |
| | 0.70 | 0.4027 | 0.4031 | 0.4019 | 0.4021 | 0.4023 | 0.3981 | 0.4042 | 0.4025 | 0.3993 | 0.3997 | 0.402 | 0.0019 | 0.48 |

Continue 3 / 5

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

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เอกสารไม่ควบคุม

3. Trueness

3.1 Reading on wavelength- Cadmium(Cd) at 228.8 nm.

| Element | Standard Value of RM (mg/l) | Reading (mg/l) | Error of Measurement (mg/l) | Error of Measurement (%) | Uncertainty (mg/l) |
|---------|--------------------------------|-------------------|--------------------------------|-----------------------------|-----------------------|
| Cd | 0.020 | 0.020 | 0.000 | 1.10 | ± 0.005 |
| | 0.301 | 0.301 | 0.000 | 0.11 | ± 0.005 |
| | 0.707 | 0.693 | -0.013 | 1.85 | ± 0.008 |

3.2 Reading on wavelength- Chromium (Cr) at 357.9 nm.

| Element | Standard Value of RM (mg/l) | Reading (mg/l) | Error of Measurement (mg/l) | Error of Measurement (%) | Uncertainty (mg/l) |
|---------|--------------------------------|-------------------|--------------------------------|-----------------------------|-----------------------|
| Cr | 0.1007 | 0.104 | 0.004 | 3.49 | ± 0.009 |
| | 0.3035 | 0.297 | -0.006 | 2.11 | ± 0.012 |
| | 0.7071 | 0.685 | -0.023 | 3.19 | ± 0.023 |

3.3 Reading on wavelength- Copper (Cu) at 324.7 nm.

| Element | Standard Value of RM (mg/l) | Reading (mg/l) | Error of Measurement (mg/l) | Error of Measurement (%) | Uncertainty (mg/l) |
|---------|--------------------------------|-------------------|--------------------------------|-----------------------------|-----------------------|
| Cu | 0.051 | 0.047 | -0.004 | 7.58 | ± 0.003 |
| | 0.303 | 0.296 | -0.007 | 2.19 | ± 0.009 |
| | 0.704 | 0.698 | -0.005 | 0.74 | ± 0.020 |

Sumalee

Continue 4 / 5

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

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Request No. 25-67 / 0275

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MTC. ACL. No. 358 / 67

3.4 Reading on wavelength- Iron (Fe) at 248.3 nm.

| Element | Standard Value of RM (mg/l) | Reading (mg/l) | Error of Measurement (mg/l) | Error of Measurement (%) | Uncertainty (mg/l) |
|---------|--------------------------------|-------------------|--------------------------------|-----------------------------|-----------------------|
| Fe | 0.100 | 0.104 | 0.005 | 4.60 | ± 0.014 |
| | 0.500 | 0.482 | -0.018 | 3.55 | ± 0.016 |
| | 1.006 | 0.968 | -0.038 | 3.75 | ± 0.029 |

3.5 Reading on wavelength- Lead (Pb) at 217.0 nm.

| Element | Standard Value of RM (mg/l) | Reading (mg/l) | Error of Measurement (mg/l) | Error of Measurement (%) | Uncertainty (mg/l) |
|---------|--------------------------------|-------------------|--------------------------------|-----------------------------|-----------------------|
| Pb | 0.201 | 0.202 | 0.001 | 0.34 | ± 0.014 |
| | 0.706 | 0.719 | 0.012 | 1.73 | ± 0.030 |
| | 1.513 | 1.459 | -0.054 | 3.57 | ± 0.061 |

3.6 Reading on wavelength- Manganese (Mn) at 279.5 nm.

| Element | Standard Value of RM (mg/l) | Reading (mg/l) | Error of Measurement (mg/l) | Error of Measurement (%) | Uncertainty (mg/l) |
|---------|--------------------------------|-------------------|--------------------------------|-----------------------------|-----------------------|
| Mn | 0.0505 | 0.050 | 0.000 | 0.83 | ± 0.005 |
| | 0.3031 | 0.306 | 0.003 | 1.12 | ± 0.007 |
| | 0.7023 | 0.698 | -0.004 | 0.62 | ± 0.014 |

Sumalee

Continue 5 / 5

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

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Request No. 25-67 / 0275

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MTC. ACL. No. 358 / 67

3.7 Reading on wavelength- Nickel (Ni) at 232.0 nm.

| Element | Standard Value of RM (mg/l) | Reading (mg/l) | Error of Measurement (mg/l) | Error of Measurement (%) | Uncertainty (mg/l) |
|---------|--------------------------------|-------------------|--------------------------------|-----------------------------|-----------------------|
| Ni | 0.101 | 0.098 | -0.003 | 2.90 | ± 0.013 |
| | 0.508 | 0.502 | -0.006 | 1.16 | ± 0.018 |
| | 1.012 | 0.962 | -0.051 | 5.02 | ± 0.032 |

3.8 Reading on wavelength- Zinc (Zn) at 213.9 nm.

| Element | Standard Value of RM (mg/l) | Reading (mg/l) | Error of Measurement (mg/l) | Error of Measurement (%) | Uncertainty (mg/l) |
|---------|--------------------------------|-------------------|--------------------------------|-----------------------------|-----------------------|
| Zn | 0.050 | 0.045 | -0.005 | 9.39 | ± 0.013 |
| | 0.303 | 0.324 | 0.021 | 7.04 | ± 0.013 |
| | 0.707 | 0.675 | -0.032 | 4.52 | ± 0.019 |

Remark : The reported uncertainty is an expanded uncertainty calculated using a coverage factor of 2 ($k = 2$) which gives a level of confidence of approximately 95%

Calibrated by Atipat

(Mr. Atipat Ratana)

Approved by Suladda

(Miss Suladda Deawtong)

Director of Analytical Chemistry Laboratory

Issued Date : 11 March 2024

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

End of Certificate

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

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Agilent CrossLab Start Up Services

Agilent 5100 5110 ICP-OES Preventive Maintenance



Agilent Preventive Maintenance provides factory recommended service for your analytical instruments to assure reliable operation and the accuracy of your results

Delivered by highly trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides what you need to reduce unplanned downtime and keep your systems operating at their peak performance.

This checklist is used as a guide for completing the preventive maintenance tasks. A signed copy of this checklist is provided for your records.

Introduction

Customer Information

- Customers should provide all necessary operating supplies upon request of the engineer.
- A customer representative should be available to the engineer while performing the preventive maintenance procedures. Customers are responsible for regular maintenance and are encouraged to observe the service representative.
- Any parts not included in the Parts Lists section of this document are not part of the recommended Preventive Maintenance service nor are they included in the price of this service.
- If a system requires the use of extra or special procedures and/or parts for the maintenance service, then these must be ordered separately and charged as a repair, which may incur additional costs.
- For customers using HF applications, the instrument should be returned to its standard sample introduction system.

Important Customer Web Links

- To access **Agilent University**, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- To access the **Agilent Resource Center** web page, visit <https://www.agilent.com/en-us/agilentresources>. The following information topics are available:
 - Sample Prep and Containment
 - Chemical Standards
 - Analysis
 - Service and Support
 - Application Workflows
- The **Agilent Community** is an excellent place to get answers, collaborate with others about applications and Agilent products, and find in-depth documents and videos relevant to Agilent technologies. Visit <https://community.agilent.com/welcome>
- Videos about specific preparation requirements for your instrument can be found by searching the **Agilent YouTube** channel at <https://www.youtube.com/user/agilent>
- **Need to place a service call?** [Flexible Repair Options | Agilent](#)

Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Only select those pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
- Check **"Service not applicable"** check boxes to indicate services/tasks not delivered, as appropriate.
- Complete the Preventive Maintenance services in the most logical order relevant to the individual system service in the order of the tasks listed.
- Complete the **Service Review** section together with the customer.
- Complete the fields for page numbers at the foot of each selected page
- Add relevant page numbers to selected pages and complete the total number of pages field in the Service Completion section
- **Ask the customer to sign the Service Verification section including the customer's and your signature.**

Instrument Maintenance

System Information

- ☐ Check this box if an instrument configuration report is attached instead of completing the table.

| | |
|-------------------------------------|---|
| Instrument System Name and ID | 5110 VDV ICP-OES |
| Instrument System Site and Location | United Analyst and Engineering Consultant |

| List System Component Product Numbers | List the Serial Numbers of each Component |
|---------------------------------------|---|
| 1. G 8015A | MY 18030001 |
| 2. | |
| 3. | |
| 4. | |
| 5. | |
| 6. | |
| 7. | |
| 8. | |
| 9. | |

| ICP-OES Configuration Table | Circle the type or write in the type if other |
|-----------------------------|--|
| Nebulizer Type | SeaSpray OneNeb Conikal Other |
| Spray Chamber | Cyclonic Single Pass Cyclonic Double Pass Other |
| Torch | Radial Dual View Other |
| Torch Type | One Piece Semi Demountable Fully Demountable Other |
| Injector Diameter | 2.4mm 1.8mm 1.4mm 0.8mm Other |
| Injector Material | Quartz Ceramic Other |

Preparation

- ☒ Discuss any specific issues with the customer before starting.
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors etc.
- ☒ Check system for required installation of components and implementation of Service Notes
- ☒ Check for required firmware/software updates and verify with customers if they would like them installed.
- ☐ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it. *ป.18*
- ☒ Ask the customer to remove any samples from the ICP-OES sample introduction area, auto sampler or around the ICP-OES.

Preventive Maintenance Procedures

Record Pre-PM instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table – Pre-PM.

Clean and inspect ICP-OES system

- ☒ Look for any obvious external damage or problems.
- ☒ Inspect water cooling hoses, gas lines and power cord for excessive wear or damage.
- ☒ Perform a general internal inspection of the system for excessive dust accumulation, clean if necessary.
- ☒ Inspect sample introduction components and record any required maintenance in the Service Engineer Comments and notify the customer as the required actions required.
- ☒ Record the instrument operating conditions in the ICP-OES Status Results Table.
- ☒ Replace the polychromator purge filter.
- ☒ Replace the radial pre-optics window
- ☒ Replace the axial pre-optics window for SVDV and VDV instruments.
- ☒ Check exhaust flow for the correct positive extraction at the exhaust duct to insure they meet minimum specifications.
- ☒ Replace air inlet dust filter.
- ☐ Replace high capacity air inlet dust filter element if installed. N/A
- ☒ Remove and clean instrument water inlet filter.

Agilent Water Recirculator

- ☐ **Service not applicable**
- ☒ Drain cooling fluid and remove any particles from the chiller reservoir
- ☒ Remove, clean and reinstall water inlet metal mesh filter if present.
- ☒ Re fill with Agilent Cool Clear cooling fluid.
- ☒ Clean the cooling system Air filter and the condenser.

SPS 3 Auto Sampler

- ☒ **Service not applicable**
- ☐ Power cycle the autosampler and verify successful initialization.
- ☐ Inspect X and Z axis belts for wear. Replace is necessary.
- ☐ Clean X and Z axis slide shafts.
- ☐ Using customer's racks and the Agilent software move the sample probe to the 4 outermost corners and rinse port, ensure that the probe is approximately centered in the vial.

SPS 4 Auto sampler

- ☒ **Service not applicable**
- ☐ Clean the spill tray, rack location mat, end frames and chassis with a damp soft cloth and diluted mild detergent.
- ☐ Clean the auto sampler cover panels, if cover kit is installed, with domestic window cleaner.
- ☐ Check the X-axis and Z-axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
- ☐ Check the X-axis, Theta-axis and Z-axis FFC cables for cracks, incorrect positioning, damaged edges or damaged connectors.
- ☐ Pump Tubing Replacement. Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles
- ☐ Test using customer's tray and move the sample probe to the sample vial 1, wash vial and rinse port and ensure that the probe is centered in the vial. If not use calibration wizard and calibrate the position.

AVS 4, 6, 7 Advanced Valve System

- ☒ **Service not applicable**
- ☐ Replace valve rotor seal
- ☐ Check fittings for signs of leaks
- ☐ Check tubing including autosampler tubing for kinks or excessive wear
- ☐ Check high flow pump for signs of leaks

ICP-OES adjustment

- ☒ Check position of Zn peak, adjust if required.
- ☒ Check Argon Ratio, adjust to specified value if required.
- ☒ Perform Detector Calibration.
- ☒ Perform Instrument Calibration.

Record Post-PM instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table - Post PM.
- ☒ For systems using ICP Expert version 7.3 and above, run the following Instrument tests
 - ☒ Subsystem Communications Test
 - ☒ Air Flow
 - ☒ Water Flow
 - ☒ Gas Flows
 - ☒ RF Generator
 - ☒ Camera Test
 - ☒ Optics Test
 - ☒ Nebulizer Test
- ☒ Record the result in the Instrument Test Results Table

Restore Instrument

- ☐ For HF applications, ask the customer to reinstall their sample introduction system. *N/A*
- ☒ Leave system in an idle state: on and purging.
- ☒ Guidance: If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

Service Review

- ☒ Attach available reports/printouts of all tests to this documentation.
- ☒ Record the Preventive Maintenance service activity in the customer's records/logbook.
- ☒ Record the PM event in the Smart Alerts logbook, if applicable.
- ☒ Update/reset instrument maintenance counters as appropriate.
- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☒ Complete the Service Engineer Comments section if there are additional comments.
- ☒ Review this service, parts replaced, and test results obtained with the customer.
- ☒ If the instrument firmware was updated, record the details of the change in the Service Engineer's Comments box. Systems in a compliant environment may need additional documentation.
- ☒ **Complete the Signature Page with both Service Engineer and Customer signatures.**

Test Results

Instrument Performance Test Results Table

Note: These measurements do not form part of any specification and are for reference only.

| | Pre PM Sensitivity Check | | Post PM Sensitivity Check | |
|--------------------|--------------------------|---------|---------------------------|---------|
| | Radial | Axial * | Radial | Axial* |
| Zn 213.857 nm SRBR | 1500.8 | 2217.4 | 4124.8 | 6965.9 |
| Mn 257.610 nm SRBR | 3915.0 | 7492.2 | 13017.8 | 31121.6 |
| Al 396.152 nm SBR | 7.7 | 10.7 | 9.7 | 21.1 |
| K 766.491 nm SBR | 5.7 | 28.1 | 4.8 | 45.3 |

* Axial result is not applicable for G8016AA, G8012AA Radial View instruments.

Instrument Test Results Table

Note: The Instrument Test results are for systems using ICP Expert version 7.3 and above only.

| Instrument Test | Result |
|-------------------------------|--------|
| Subsystem Communications Test | Pass |
| Air Flow | Pass |
| Water Flow | Pass |
| Gas Flows | Pass |
| RF Generator | Pass |
| Camera Test | Pass |
| Optics Test | Pass |
| Nebulizer test | Pass |

ICP-OES Status Results Table

Note: These measurements do not form part of any specification and are for reference only.

| Measurement | Standby Mode | | Plasma On | |
|------------------------------|----------------|-------|-----------|-------|
| Mains Voltage | 231.411 | VAC | 226.871 | VAC |
| Mains Current | 0.081 | A | 0.105 | A |
| Instrument Temperature | 22.1 | °C | 23.5 | °C |
| RF Air Flow (sensor speed) | 14.0 | Hz | 19.0 | Hz |
| Plasma Exhaust Temperature | No measurement | | 63.8 | °C |
| Water Flow Oscillator | No measurement | | 1.34 | L/min |
| Water Flow Detector | 0.86 | L/min | 0.81 | L/min |
| Water Inlet Temperature | 19.7 | °C | 19.7 | °C |
| Polychromator Temperature | 35.0 | °C | 35.0 | °C |
| CCD Temperature | -40.1 | °C | -39.8 | °C |
| Thermal Stabilizer | 35.0 | °C | 35.0 | °C |
| Argon Supply Pressure | 648.92 | kPa | 591.55 | kPa |
| Purge Gas Supply Pressure*1 | 646.66 | kPa | 612.41 | kPa |
| Option Gas Supply Pressure*1 | - | kPa | - | kPa |
| Nebulizer Flow | No measurement | | 0.70 | L/min |
| Nebulizer Back Pressure | No measurement | | 158.43 | kPa |
| Plasma Gas Flow | No measurement | | 11.91 | L/min |
| Auxiliary Gas Flow | No measurement | | 1.00 | L/min |
| RF Power | No measurement | | 1204.7 | W |
| RF Supply Current | No measurement | | 7.858 | A |
| RF Supply Voltage | No measurement | | 204.417 | V |

*1 If option installed

Consumed PM Parts

| Part Description | Part Number | Product or Model# where used | Quantity consumed |
|--|-------------|-------------------------------|-------------------|
| Axial Pre-Optic Window | G8010-68014 | G8010A, G8011A, G8014A/G8015A | 1 |
| Radial Pre-Optic Window | G8010-68015 | All | 1 |
| Agilent Cool Clear Coolant Fluid | 5799-0037 | Agilent Water Recirculator | - |
| Purge Gas Filter | G8010-60136 | All | 1 |
| Air inlet filter | G8000-68002 | All | 1 |
| High Capacity Air Filter | G8010-60189 | Optional | - |
| Rotor seal for 6-7 port valve for AVS6/7 | G8494-60002 | G8494A/G8495 | - |
| Rotor seal for 4 port valve for AVS4 | G8493-60002 | G8493A | - |
| Rinse solution to rinse station 2.5mm id x 1m | G8410-80123 | SPS 4 | - |
| Barb connector 2.5mm-1.5mm ID | G8410-80124 | SPS 4 | - |
| PVC waste tubing, 8mm od x 5mm id, 2m | G8410-80122 | SPS 4 | - |
| Additional Parts may be required from engineer's stock: | | | |
| X axis drive belt | 5410047500 | SPS 3 | - |
| Z axis drive belt | 5410047400 | SPS 3 | - |
| Peristaltic pump tubing, PVC SolvaFlex, 3 bridged, | 3710049000 | SPS 4 | - |

Consumed Parts Reference (Purchased by customer, not included as part of PM)

☒ Section Not Applicable.

| Part Description | Part Number | Product or Model# where used | Quantity consumed |
|------------------|-------------|------------------------------|-------------------|
| | | | |
| | | | |
| | | | |

Signature Page

Service Engineer Comments (optional)

If there are any specific points you wish to note as part of performing the installation or other items of interest for the customer, please write in this box.

Service Verification

Service Request Number:

6007197100

Service Engineer Name:

Kanyakorn S.

Service Engineer Signature:

Kanyakorn S.

Total number of pages in this document:

14

Date Service Completed:

04 Nov 2024

Customer Name:

Aphorn Onkong

Customer Signature:

Aphorn Onkong

Report Summary

| | |
|--------------------------|-------------------------------|
| Instrument Model | Agilent 5100/5110 VDV ICP-OES |
| Instrument ID | G8011A/G8015A |
| Instrument Serial Number | MY18030001 |
| Software Version | 7.3.1.9507 |
| Firmware Version | 3442 |
| Tested By | Pre Test_PM_Kanyakorn S. |
| Test Completed On | 11/4/2024 9:19:10 AM |

Result Summary

| | |
|-------------------------------|---------|
| Subsystem Communications Test | Skipped |
| Air Flow Test | Skipped |
| Water Flow Test | Skipped |
| Gas Flows Test | Skipped |
| RF Generator Test | Skipped |
| Camera Test | Skipped |
| Optics Test | Skipped |
| Advanced Valve System Test | Skipped |
| Resolution Test | Pass |
| Sensitivity Test | Fail |
| Precision Test | Pass |

Resolution Test**Pass**

| Element Wavelength | Specification | Width |
|--------------------|---------------|-------|
| N (174.213 nm) | ≤ 9.40 | 6.98 |
| As (188.980 nm) | ≤ 8.20 | 6.17 |
| C (193.027 nm) | ≤ 11.50 | 8.30 |
| Mo (202.032 nm) | ≤ 8.20 | 6.38 |
| Cr (206.158 nm) | ≤ 13.40 | 8.98 |
| Zn (213.857 nm) | ≤ 8.70 | 6.60 |
| Pb (220.353 nm) | ≤ 9.50 | 7.09 |
| Co (228.615 nm) | ≤ 17.20 | 11.67 |
| Ba (230.424 nm) | ≤ 9.40 | 7.20 |
| Mn (257.610 nm) | ≤ 13.30 | 9.43 |
| Mn (260.568 nm) | ≤ 20.30 | 14.11 |
| Cr (267.716 nm) | ≤ 11.00 | 8.04 |
| Cu (324.754 nm) | ≤ 25.00 | 18.97 |
| Cu (327.395 nm) | ≤ 14.20 | 11.23 |
| Sr (338.071 nm) | ≤ 33.50 | 24.30 |
| Ba (455.403 nm) | ≤ 44.00 | 33.47 |
| Sr (460.733 nm) | ≤ 36.00 | 17.23 |
| Ba (493.408 nm) | ≤ 36.00 | 25.37 |
| Ba (614.171 nm) | ≤ 42.00 | 25.54 |
| Ar (675.283 nm) | ≤ 74.00 | 56.51 |
| K (766.491 nm) | ≤ 80.00 | 65.86 |

Sensitivity Test**Fail****Radial**

| Element Wavelength | Specification | Method | Ratio | Standard | Blank |
|--------------------|---------------|--------|--------|-----------|---------|
| As (188.980 nm) | ≥ 46.0 | SRBR | 104.1 | 793.0 | 50.8 |
| Se (196.026 nm) | ≥ 41.0 | SRBR | 87.6 | 862.0 | 79.7 |
| Zn (213.857 nm) | ≥ 1421.0 | SRBR | 1500.8 | 41823.3 | 749.0 |
| Pb (220.353 nm) | ≥ 46.0 | SRBR | 170.7 | 2432.0 | 174.9 |
| Mn (257.610 nm) | ≥ 3518.0 | SRBR | 3915.0 | 264700.2 | 4420.0 |
| Al (396.152 nm) | ≥ 3.4 | SBR | 7.7 | 48454.6 | 5563.2 |
| Ba (493.408 nm) | ≥ 34.0 | SBR | 45.9 | 1966719.7 | 41903.8 |
| K (766.491 nm) | ≥ 1.8 | SBR | 5.7 | 99038.2 | 14687.7 |

Axial

| Element Wavelength | Specification | Method | Ratio | Standard | Blank |
|--------------------|---------------|--------|--------|-----------|----------|
| As (188.980 nm) | ≥ 208.0 | SRBR | 126.5 | 1498.8 | 119.0 |
| Se (196.026 nm) | ≥ 159.0 | SRBR | 112.0 | 1773.6 | 197.8 |
| Zn (206.200 nm) | ≥ 234.0 | SRBR | 466.0 | 6784.2 | 199.7 |
| Zn (213.857 nm) | ≥ 1743.0 | SRBR | 2217.4 | 95597.6 | 1789.7 |
| Cd (214.439 nm) | ≥ 4227.0 | SRBR | 1919.3 | 68724.6 | 1236.4 |
| Pb (220.353 nm) | ≥ 320.0 | SRBR | 332.6 | 7929.5 | 499.0 |
| Mn (257.610 nm) | ≥ 10625.0 | SRBR | 7492.2 | 991238.3 | 16911.7 |
| Cr (267.716 nm) | ≥ 1048.0 | SRBR | 2254.6 | 129706.6 | 3150.9 |
| Cu (324.754 nm) | ≥ 19.0 | SBR | 26.9 | 290746.3 | 10407.5 |
| Al (396.152 nm) | ≥ 6.0 | SBR | 10.7 | 211329.2 | 18005.0 |
| Ba (493.408 nm) | ≥ 60.0 | SBR | 49.3 | 6956460.4 | 138336.9 |
| K (766.491 nm) | ≥ 24.0 | SBR | 28.1 | 1395190.2 | 47996.2 |

Precision Test**Pass****Radial**

| Element Wavelength | Specification | Measured Value % RSD |
|--------------------|---------------|----------------------|
| As (188.980 nm) | ≤ 2.60 | 0.73 |
| Se (196.026 nm) | ≤ 2.60 | 0.95 |
| Zn (213.857 nm) | ≤ 1.50 | 0.31 |
| Pb (220.353 nm) | ≤ 2.60 | 0.73 |
| Mn (257.610 nm) | ≤ 1.50 | 0.39 |
| Al (396.152 nm) | ≤ 1.50 | 0.39 |
| Ba (493.408 nm) | ≤ 1.50 | 0.87 |
| K (766.491 nm) | ≤ 1.50 | 0.32 |

Axial

| Element Wavelength | Specification | Measured Value % RSD |
|--------------------|---------------|----------------------|
| As (188.980 nm) | ≤ 1.50 | 1.21 |
| Se (196.026 nm) | ≤ 1.50 | 0.84 |
| Zn (206.200 nm) | ≤ 1.50 | 0.56 |
| Zn (213.857 nm) | ≤ 1.50 | 0.96 |
| Cd (214.439 nm) | ≤ 1.50 | 0.26 |
| Pb (220.353 nm) | ≤ 1.50 | 0.51 |
| Mn (257.610 nm) | ≤ 1.50 | 0.97 |
| Cr (267.716 nm) | ≤ 1.50 | 0.22 |
| Cu (324.754 nm) | ≤ 1.50 | 0.24 |
| Al (396.152 nm) | ≤ 1.50 | 0.33 |
| Ba (493.408 nm) | ≤ 1.50 | 0.40 |
| K (766.491 nm) | ≤ 1.50 | 0.65 |

Report Summary

| | |
|--------------------------|-------------------------------|
| Instrument Model | Agilent 5100/5110 VDV ICP-OES |
| Instrument ID | G8011A/G8015A |
| Instrument Serial Number | MY18030001 |
| Software Version | 7.3.1.9507 |
| Firmware Version | 3442 |
| Tested By | Post Test_PM_Kanyakorn S. |
| Test Completed On | 11/4/2024 11:07:24 AM |

Result Summary

| | |
|-------------------------------|---------|
| Subsystem Communications Test | Pass |
| Air Flow Test | Skipped |
| Water Flow Test | Skipped |
| Gas Flows Test | Skipped |
| RF Generator Test | Skipped |
| Camera Test | Skipped |
| Optics Test | Pass |
| Advanced Valve System Test | Skipped |
| Resolution Test | Pass |
| Sensitivity Test | Fail |
| Precision Test | Pass |
| Subsystem Communications Test | Pass |

Optics Test

| | Radial | Axial |
|------------|---------|---------|
| Intensity | 3184054 | 3177175 |
| Wavelength | 737.212 | 737.212 |

| Resolution Test | Pass |
|-----------------|------|
|-----------------|------|

| Element Wavelength | Specification | Width |
|--------------------|---------------|-------|
| N (174.213 nm) | ≤ 9.40 | 6.97 |
| As (188.980 nm) | ≤ 8.20 | 6.14 |
| C (193.027 nm) | ≤ 11.50 | 8.33 |
| Mo (202.032 nm) | ≤ 8.20 | 6.33 |
| Cr (206.133 nm) | ≤ 13.40 | 9.06 |
| Zn (213.837 nm) | ≤ 8.70 | 6.70 |
| Pb (220.353 nm) | ≤ 9.50 | 7.03 |
| Co (228.615 nm) | ≤ 17.20 | 11.72 |
| Ba (230.424 nm) | ≤ 9.40 | 7.32 |
| Mn (257.610 nm) | ≤ 13.30 | 9.44 |
| Mn (260.568 nm) | ≤ 20.30 | 14.21 |
| Cr (267.716 nm) | ≤ 11.00 | 7.94 |
| Cu (324.754 nm) | ≤ 25.00 | 18.99 |
| Cu (327.395 nm) | ≤ 14.20 | 11.27 |
| Sr (338.071 nm) | ≤ 33.50 | 24.40 |
| Ba (455.403 nm) | ≤ 44.00 | 33.50 |
| Sr (460.733 nm) | ≤ 36.00 | 17.31 |
| Ba (493.408 nm) | ≤ 36.00 | 25.44 |
| Ba (614.171 nm) | ≤ 42.00 | 25.16 |
| Ar (675.283 nm) | ≤ 74.00 | 56.15 |
| K (766.491 nm) | ≤ 80.00 | 65.56 |

Sensitivity Test**Fail****Radial**

| Element Wavelength | Specification | Method | Ratio | Standard | Blank |
|--------------------|---------------|--------|---------|-----------|---------|
| As (188.980 nm) | ≥ 46.0 | SRBR | 130.6 | 977.1 | 50.4 |
| Se (196.026 nm) | ≥ 41.0 | SRBR | 106.0 | 958.7 | 70.2 |
| Zn (213.857 nm) | ≥ 1421.0 | SRBR | 4124.8 | 44037.7 | 113.4 |
| Pb (220.353 nm) | ≥ 46.0 | SRBR | 207.2 | 2554.7 | 136.2 |
| Mn (257.610 nm) | ≥ 3518.0 | SRBR | 13017.8 | 271846.6 | 434.7 |
| Al (396.152 nm) | ≥ 3.4 | SBR | 9.7 | 50615.5 | 4717.0 |
| Ba (493.408 nm) | ≥ 34.0 | SBR | 133.7 | 2069203.0 | 15359.3 |
| K (766.491 nm) | ≥ 1.8 | SBR | 4.8 | 100199.5 | 17235.5 |

Axial

| Element Wavelength | Specification | Method | Ratio | Standard | Blank |
|--------------------|---------------|--------|---------|-----------|---------|
| As (188.980 nm) | ≥ 208.0 | SRBR | 174.9 | 1566.7 | 73.0 |
| Se (196.026 nm) | ≥ 159.0 | SRBR | 167.0 | 1863.4 | 110.2 |
| Zn (206.200 nm) | ≥ 234.0 | SRBR | 740.9 | 6836.0 | 83.1 |
| Zn (213.857 nm) | ≥ 1743.0 | SRBR | 6965.9 | 101568.1 | 211.7 |
| Cd (214.439 nm) | ≥ 4227.0 | SRBR | 5781.0 | 72852.9 | 158.1 |
| Pb (220.353 nm) | ≥ 320.0 | SRBR | 501.0 | 8464.3 | 267.7 |
| Mn (257.610 nm) | ≥ 10625.0 | SRBR | 31121.6 | 1006637.8 | 1044.0 |
| Cr (267.716 nm) | ≥ 1048.0 | SRBR | 4424.8 | 132202.9 | 880.8 |
| Cu (324.754 nm) | ≥ 19.0 | SBR | 68.7 | 302907.8 | 4345.6 |
| Al (396.152 nm) | ≥ 6.0 | SBR | 21.1 | 218771.0 | 9892.3 |
| Ba (493.408 nm) | ≥ 60.0 | SBR | 250.6 | 7137380.9 | 28367.3 |
| K (766.491 nm) | ≥ 24.0 | SBR | 45.3 | 1435050.6 | 31025.0 |

Precision Test**Pass****Radial**

| Element Wavelength | Specification | Measured Value % RSD |
|--------------------|---------------|----------------------|
| As (188.980 nm) | ≤ 2.60 | 0.81 |
| Se (196.026 nm) | ≤ 2.60 | 0.98 |
| Zn (213.857 nm) | ≤ 1.50 | 0.22 |
| Pb (220.353 nm) | ≤ 2.60 | 0.37 |
| Mn (257.610 nm) | ≤ 1.50 | 0.27 |
| Al (396.152 nm) | ≤ 1.50 | 0.25 |
| Ba (493.408 nm) | ≤ 1.50 | 0.53 |
| K (766.491 nm) | ≤ 1.50 | 0.15 |

Axial

| Element Wavelength | Specification | Measured Value % RSD |
|--------------------|---------------|----------------------|
| As (188.980 nm) | ≤ 1.50 | 0.81 |
| Se (196.026 nm) | ≤ 1.50 | 0.65 |
| Zn (206.200 nm) | ≤ 1.50 | 0.79 |
| Zn (213.857 nm) | ≤ 1.50 | 0.81 |
| Cd (214.439 nm) | ≤ 1.50 | 0.35 |
| Pb (220.353 nm) | ≤ 1.50 | 0.33 |
| Mn (257.610 nm) | ≤ 1.50 | 1.02 |
| Cr (267.716 nm) | ≤ 1.50 | 0.32 |
| Cu (324.754 nm) | ≤ 1.50 | 0.51 |
| Al (396.152 nm) | ≤ 1.50 | 0.37 |
| Ba (493.408 nm) | ≤ 1.50 | 0.68 |
| K (766.491 nm) | ≤ 1.50 | 0.74 |

Report Summary

| | |
|--------------------------|-------------------------------|
| Instrument Model | Agilent 5100/5110 VDV ICP-OES |
| Instrument ID | G8011A/G8015A |
| Instrument Serial Number | MY18030001 |
| Software Version | 7.3.1.9507 |
| Firmware Version | 3442 |
| Tested By | Post Test_PM_Kanyakorn S. |
| Test Completed On | 11/4/2024 11:30:15 AM |

Result Summary

| | |
|-------------------------------|---------|
| Subsystem Communications Test | Pass |
| Air Flow Test | Pass |
| Water Flow Test | Pass |
| Gas Flows Test | Pass |
| RF Generator Test | Pass |
| Camera Test | Pass |
| Optics Test | Skipped |
| Advanced Valve System Test | Skipped |
| Resolution Test | Skipped |
| Sensitivity Test | Skipped |
| Precision Test | Skipped |

| | |
|-------------------------------|------|
| Subsystem Communications Test | Pass |
|-------------------------------|------|

| | |
|---------------|------|
| Air Flow Test | Pass |
|---------------|------|

| | |
|-------------------------------|-------------------------------|
| 30% Air Flow (relative speed) | 75% Air Flow (relative speed) |
| 15.00 | 19.00 |

| | |
|-----------------|------|
| Water Flow Test | Pass |
|-----------------|------|

| | | |
|----------------------|---------------------------|------------------------------|
| RF Water Flow(L/min) | Camera Water Flow (L/min) | Water Inlet Temperature (°C) |
| 1.30 | 0.81 | 20.55 |

Gas Flows Test**Pass**

| | | | | | |
|--------------------------|-------------|------------------|--------------------------|-------------|------------------|
| Nebulizer Target Flow | Actual Flow | Back Pressure | Auxiliary Target Flow | Actual Flow | Back Pressure |
| 0.70 | 0.70 | 154.65 | 2.00 | 2.00 | 110.92 |
| Makeup Target Flow | Actual Flow | Back Pressure | Plasma Target Flow | Actual Flow | Back Pressure |
| 2.00 | 2.00 | 115.38 | 18.00 | 17.97 | 21.48 |

RF Generator Test**Pass**

| | |
|----------------------------------|---------|
| RF Power Supply Test | Passed |
| RF Power Supply (V) | 128.554 |
| RF Oscillator Test | Passed |
| RF Oscillator Frequency (MHz) | 25.834 |
| Work Coil Current (A) | 44.660 |
| RF Power Supply Current (A) | 1.999 |

Camera Test**Pass**

| | | | |
|------------------------|--------------------------|--------------------|--------|
| | Integration Time (ms) | Standard Deviation | Status |
| Electronic Offset Test | 1000 | 5.228 | Passed |
| Dark Current Test | 6000 | 1.168 | Passed |
| Array Test | 5 | 0.024 | Passed |
| Linearity Test | | 0.118 | Passed |

Report Summary

| | |
|--------------------------|-------------------------------|
| Instrument Model | Agilent 5100/5110 VDV ICP-OES |
| Instrument ID | G8011A/G8015A |
| Instrument Serial Number | MY18030001 |
| Software Version | 7.3.1.9507 |
| Firmware Version | 3442 |
| Tested By | change mirror |
| Test Completed On | 11/6/2024 10:35:26 AM |

Result Summary

| | |
|-------------------------------|---------|
| Subsystem Communications Test | Skipped |
| Air Flow Test | Skipped |
| Water Flow Test | Skipped |
| Gas Flows Test | Skipped |
| RF Generator Test | Skipped |
| Camera Test | Skipped |
| Optics Test | Skipped |
| Advanced Valve System Test | Skipped |
| Resolution Test | Pass |
| Sensitivity Test | Pass |
| Precision Test | Pass |

Resolution Test**Pass**

| Element Wavelength | Specification | Width |
|--------------------|---------------|-------|
| N (174.213 nm) | ≤ 9.40 | 6.79 |
| As (188.980 nm) | ≤ 8.20 | 5.80 |
| C (193.027 nm) | ≤ 11.50 | 8.15 |
| Mo (202.032 nm) | ≤ 8.20 | 5.90 |
| Cr (206.158 nm) | ≤ 13.40 | 8.85 |
| Zn (213.857 nm) | ≤ 8.70 | 6.77 |
| Pb (220.353 nm) | ≤ 9.50 | 6.61 |
| Co (228.615 nm) | ≤ 17.20 | 11.79 |
| Ba (230.424 nm) | ≤ 9.40 | 7.25 |
| Mn (257.610 nm) | ≤ 13.30 | 9.47 |
| Mn (260.568 nm) | ≤ 20.30 | 14.50 |
| Cr (267.716 nm) | ≤ 11.00 | 7.91 |
| Cu (324.754 nm) | ≤ 25.00 | 18.72 |
| Cu (327.395 nm) | ≤ 14.20 | 11.09 |
| Sr (338.071 nm) | ≤ 33.50 | 25.39 |
| Ba (455.403 nm) | ≤ 44.00 | 33.09 |
| Sr (460.793 nm) | ≤ 36.00 | 18.54 |
| Ba (493.408 nm) | ≤ 36.00 | 25.74 |
| Ba (614.171 nm) | ≤ 42.00 | 25.23 |
| Ar (675.283 nm) | ≤ 74.00 | 58.92 |
| K (766.491 nm) | ≤ 80.00 | 63.16 |

Sensitivity Test**Pass****Radial**

| Element Wavelength | Specification | Method | Ratio | Standard | Blank |
|--------------------|---------------|--------|---------|-----------|---------|
| As (188.980 nm) | ≥ 46.0 | SRBR | 110.5 | 868.9 | 54.3 |
| Se (196.026 nm) | ≥ 41.0 | SRBR | 88.3 | 934.7 | 91.3 |
| Zn (213.857 nm) | ≥ 1421.0 | SRBR | 3535.4 | 44017.7 | 153.9 |
| Pb (220.353 nm) | ≥ 46.0 | SRBR | 184.5 | 2492.3 | 159.8 |
| Mn (257.610 nm) | ≥ 3518.0 | SRBR | 11099.6 | 249595.3 | 503.6 |
| Al (396.152 nm) | ≥ 3.4 | SBR | 8.7 | 50274.4 | 5172.0 |
| Ba (493.408 nm) | ≥ 34.0 | SBR | 124.5 | 1903164.1 | 15166.0 |
| K (766.491 nm) | ≥ 1.8 | SBR | 6.9 | 110041.4 | 13991.2 |

Axial

| Element Wavelength | Specification | Method | Ratio | Standard | Blank |
|--------------------|---------------|--------|---------|-----------|---------|
| As (188.980 nm) | ≥ 208.0 | SRBR | 253.3 | 3744.3 | 196.3 |
| Se (196.026 nm) | ≥ 159.0 | SRBR | 206.7 | 4199.7 | 347.2 |
| Zn (206.200 nm) | ≥ 234.0 | SRBR | 923.0 | 12282.3 | 172.1 |
| Zn (213.857 nm) | ≥ 1743.0 | SRBR | 6398.3 | 157551.5 | 601.7 |
| Cd (214.439 nm) | ≥ 4227.0 | SRBR | 5069.2 | 99873.7 | 385.2 |
| Pb (220.353 nm) | ≥ 320.0 | SRBR | 389.0 | 10641.1 | 658.6 |
| Mn (257.610 nm) | ≥ 10625.0 | SRBR | 21190.4 | 985528.7 | 2153.6 |
| Cr (267.716 nm) | ≥ 1048.0 | SRBR | 3054.1 | 131797.6 | 1811.5 |
| Cu (324.754 nm) | ≥ 19.0 | SBR | 36.3 | 301401.4 | 8082.9 |
| Al (396.152 nm) | ≥ 6.0 | SBR | 10.8 | 228359.5 | 19280.5 |
| Ba (493.408 nm) | ≥ 60.0 | SBR | 106.5 | 6460421.5 | 60122.8 |
| K (766.491 nm) | ≥ 24.0 | SBR | 30.2 | 1639840.6 | 52562.1 |

Precision Test**Pass****Radial**

| Element Wavelength | Specification | Measured Value % RSD |
|--------------------|---------------|----------------------|
| As (188.980 nm) | ≤ 2.60 | 1.56 |
| Se (196.026 nm) | ≤ 2.60 | 1.16 |
| Zn (213.857 nm) | ≤ 1.50 | 0.50 |
| Pb (220.353 nm) | ≤ 2.60 | 0.74 |
| Mn (257.610 nm) | ≤ 1.50 | 0.63 |
| Al (396.152 nm) | ≤ 1.50 | 0.54 |
| Ba (493.408 nm) | ≤ 1.50 | 0.78 |
| K (766.491 nm) | ≤ 1.50 | 0.44 |

Axial

| Element Wavelength | Specification | Measured Value % RSD |
|--------------------|---------------|----------------------|
| As (188.980 nm) | ≤ 1.50 | 0.82 |
| Se (196.026 nm) | ≤ 1.50 | 0.82 |
| Zn (206.200 nm) | ≤ 1.50 | 0.35 |
| Zn (213.857 nm) | ≤ 1.50 | 0.34 |
| Cd (214.439 nm) | ≤ 1.50 | 0.44 |
| Pb (220.353 nm) | ≤ 1.50 | 0.48 |
| Mn (257.610 nm) | ≤ 1.50 | 0.83 |
| Cr (267.716 nm) | ≤ 1.50 | 0.53 |
| Cu (324.754 nm) | ≤ 1.50 | 0.69 |
| Al (396.152 nm) | ≤ 1.50 | 0.56 |
| Ba (493.408 nm) | ≤ 1.50 | 1.29 |
| K (766.491 nm) | ≤ 1.50 | 0.74 |

UNITED ANALYST AND ENGINEERING CONSULTANT COMPANY Ltd.

Automatic Mercury Analyzer

Model RA-4500


Preventive Maintenance Report


Serial No. : 17780278

Soft version : Ver 2.0.7

ROM version : Ver 2.0.1

Date : 09 July 2024

PM by : 
(Pradit M.)

Approved by : 
(Kitichai S.)



Coax Group Corporation Ltd.

1131/62,64,325-331 Nakornchaisri road,

Kwang Thanon Nakornchaisri, Dusit, Bangkok 10300 Thailand

Tel. 02-2435263, 02-6682436 Fax. 02-2437386

เอกสารไม่ควบคุม

Inspection result

| ITEM | | STANDARD | RESULT | JUDGE |
|--------------------------------------|---------------------------------|--|--|-------|
| 1. Self Check | 1.1 Heating | | PASS | OK |
| | 1.2 Cooling | | PASS | OK |
| | 1.3 Leak | | PASS | OK |
| | 1.4 Optical system | | PASS | OK |
| | 1.5 Drift | | PASS | OK |
| 2. Analytical curve inspection(AREA) | | | | |
| | 2.1 No Pretreatment (Low Conc.) | Correlation coefficient (r) \geq 0.9990 | 0.9999 | OK |
| 3. Repeatability(AREA) | | | | |
| | 3.1 No Pretreatment 100ppb, n=3 | | 1. 99.60 ppb 2. 101.84 ppb 3. 101.22 ppb | |
| | | C.V. \leq 5% | 1.15% | OK |
| 4. Blank | | | | |
| | | Below 1.0 (AREA) | 0.1002 | OK |

Counter

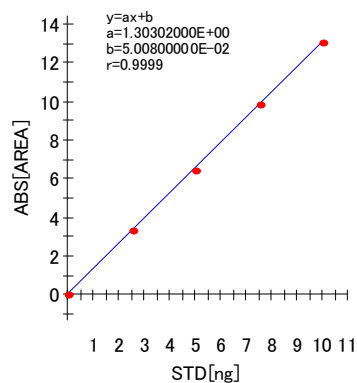
Maintenance ×

| MAIN | SC | Counter | Parameter |
|---|-------------------|--------------------------------------|--|
| Measurement Count | 20577(22-08-08) | <input type="button" value="Clear"/> | P1 tube[H](2000h) 0h00m(24-07-08) <input type="button" value="Clear"/> |
| Mercury Exhaust Filter Amount[mq](1500mq) | 1(22-08-08) | <input type="button" value="Clear"/> | P2 tube[H](2000h) 0h01m(24-07-08) <input type="button" value="Clear"/> |
| Lamp Active time(5000h) | 1h13m(24-07-08) | <input type="button" value="Clear"/> | P3 tube[H](2000h) 0h00m(24-07-08) <input type="button" value="Clear"/> |
| Membrane Filter Usage Time(2000h) | 0h58m(24-07-08) | <input type="button" value="Clear"/> | P4 tube[H](2000h) 0h00m(24-07-08) <input type="button" value="Clear"/> |
| Main Pump tube(750h) | 0h58m(24-07-08) | <input type="button" value="Clear"/> | P5 tube[H](2000h) 0h00m(24-07-08) <input type="button" value="Clear"/> |
| Heating Lamp Time | 580h23m(22-08-08) | <input type="button" value="Clear"/> | P6 tube[H](2000h) 0h00m(24-07-08) <input type="button" value="Clear"/> |
| | | | P7 tube[H](2000h) 0h02m(24-07-08) <input type="button" value="Clear"/> |

Exit

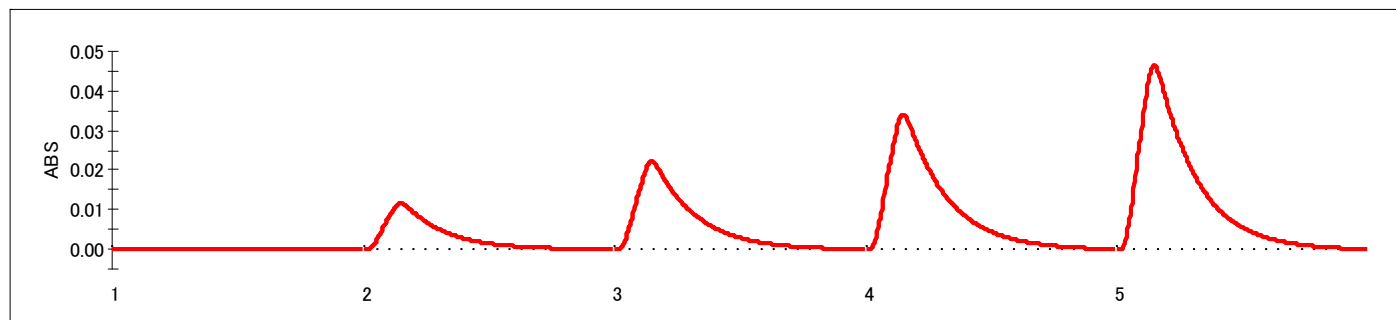
Title : Preventive Maintenance RA-4500 sn:17780278
 Date : 2024-07-09
 Name : Coax Group
 Memo : Calibration Curve 0-10ng

Calib



STD

| No. | STD [ppb] | SVOL [mL] | CVOL [mL] | DVOL [mL] | STD [ng] | AREA [ON] | MEAS [ng] | Dev [%] | Note |
|-----|-----------|-----------|-----------|-----------|----------|-----------|-----------|---------|------|
| 1 | 100.000 | 0.000 | 5.000 | 5.000 | 0.000 | 0.0846 | 0.0265 | - | |
| 2 | 100.000 | 0.025 | 5.000 | 5.000 | 2.500 | 3.3464 | 2.5298 | 1.2 | |
| 3 | 100.000 | 0.050 | 5.000 | 5.000 | 5.000 | 6.4170 | 4.8863 | 2.3 | |
| 4 | 100.000 | 0.075 | 5.000 | 5.000 | 7.500 | 9.8647 | 7.5322 | 0.4 | |
| 5 | 100.000 | 0.100 | 5.000 | 5.000 | 10.000 | 13.1132 | 10.0253 | 0.3 | |

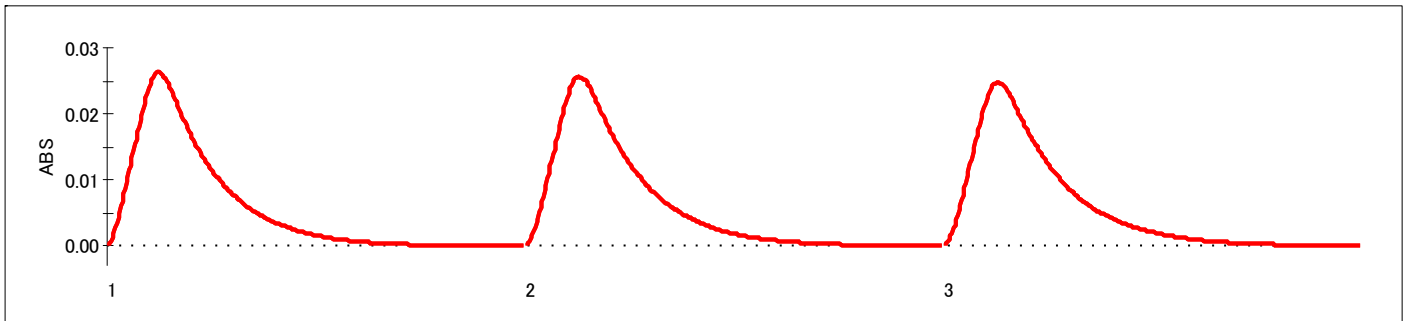


SMP

| No. | NAME | SVOL [mL] | CVOL [mL] | DVOL [mL] | AREA [ON] | MEAS [ng] | CONC [ug/L] | Note |
|-----|--------|-----------|-----------|-----------|-----------|-----------|-------------|------|
| 1 | 100ppb | 0.050 | 5.000 | 5.000 | 6.5389 | 4.9798 | 99.60 | |
| 2 | 100ppb | 0.050 | 5.000 | 5.000 | 6.6848 | 5.0918 | 101.84 | |
| 3 | 100ppb | 0.050 | 5.000 | 5.000 | 6.6446 | 5.0610 | 101.22 | |

Statistics

| No. | NAME | TRY | AV [ug/L] | SD [ug/L] | Cv [%] |
|-----|--------|-----|-----------|-----------|--------|
| 1 | 100ppb | 3 | 100.887 | 1.15660 | 1.15 |



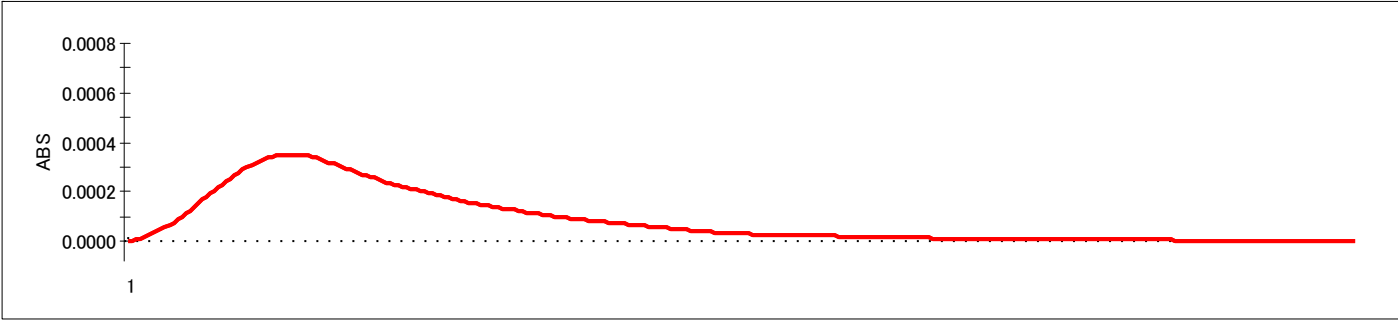
Self Check

Heat check:PASS!! (26.3degC[05:00] -> 30.3degC[02:29])
 Sensor check:PASS!! (53- 10= 43)
 Leak check:PASS!! (0.19L/min)
 Sig/Ref check:PASS!! (Sig:4.00V, Ref:4.02V)
 Drift check:PASS!! (0.0000061 - -0.0000179 = 0.0000240)

Title : Preventive Maintenance RA-4500 sn:17780278
Date : 2024-07-09
Name : Coax Group
Memo : Blank

SMP

| No. | NAME | SVOL [mL] | CVOL [mL] | DVOL [mL] | AREA [ON] | MEAS [ng] | CONC [ug/L] | Note |
|-----|----------|--------------|--------------|--------------|--------------|--------------|----------------|------|
| 1 | Blank DI | | | | 0.1002 | 0.0385 | | |



Calibration Certificate

Certificate No.: 2502229-003-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhnong, Bangkok 10260

Page 1 of 3

Equipment: CHAMBER (Incubator)

Manufacturer: MEMMERT

Model: IPP260

Serial No.: V618.0033

ID No.: UAE.MIC.021/2561

Order No.: 2502229

Operation No.: 2502229-003

Date of Receipt: 19 March 2025

Date of Calibration: 19 March 2025

Calibrated by Mr.Yothin Charoensuk
Scientist

Approved by


(Mr.Pheraphat Tuanjit) (for)

Manager, Division of Calibration Laboratory

Date of Issue: 25 March 2025

Responsible for the Technical Management Team

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.

F-CS-009 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2502229-003-01

Equipment: CHAMBER (Incubator)

Model: IPP260 Serial No.: V618.0033

Resolution: 0.1 °C ID No.: UAE.MIC.021/2561

Manufacturer: MEMMERT

Date of Calibration: 19 March 2025

Page 2 of 3

Location: 302, UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.

Environment Condition:

Ambient Temperature (23.0 ± 1) °C

Relative Humidity (59 ± 1) %

Line Voltage (223 ± 3) Volt

Condition of this results of Calibration:

- This instrument was calibrated by insert 9 standard thermometer into its chamber and calibration according to W-TE-014 Based on TLAS G-20-1/02-08 (E): Guidelines for Calibration and Checks of Temperature Controlled Enclosures.
 - The temperature scale used was based on ITS - 90.
 - All data show below were final values and the initial data may be obtained upon request.

2. Reference Standard Instrument :

| Instrument | Model | Serial No./ID No. | Certificate No. | Due Date | Through |
|---------------------------------|--------|-------------------------|-----------------|-------------|-------------------------|
| Digital Thermometer with sensor | 34972A | MY57003188 | TE 670486-01 | 8 June 2025 | NATIONAL FOOD INSTITUTE |
| | RTD | CH#301-309/ RTD#301-309 | | | |

- This certificate is traceable to International System of Units (SI Units).
- This certificate was certified only for the instrument we calibrated.
- This result of calibration was found accurate as shown on date and place of calibration only.
- Condition of Calibrated item : Good

UUC Description :

Time of Record 1 Hour 9 Minute At 22.0 and 25.0 °C

Fresh air Damper ☐ Open Position ☐

☒ Close Fan ☐

☐ Not Available

7. Result of Calibration : ☒ Without adjustment ☐ After adjustment

P. Jueghantit
25 March 2025



Calibration Report

Certificate No.: 2502229-003-01

Equipment: CHAMBER (Incubator)

Model: IPP260 Serial No.: V618.0033

Resolution: 0.1 °C ID No.: UAE.MIC.021/2561

Manufacturer: MEMMERT

Date of Calibration: 19 March 2025

Page 3 of 3

Calibration point: 22.0 and 25.0 °C

Calibration result:

| Calibration Condition | Temperature (°C) | Relative Humidity (%) | Line Voltage (Volt) |
|-----------------------|------------------|-----------------------|---------------------|
| MIN | 22.7 | 58 | 220.0 |
| MAX | 23.3 | 60 | 225.0 |

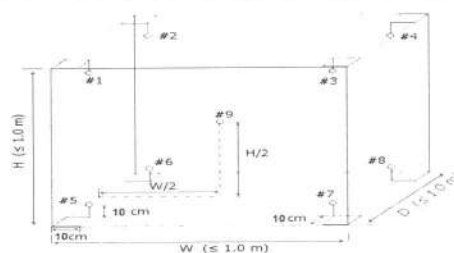


Table 1 : Reporting of Temperature

| Calibration point (°C) | Measured Temperature (°C) @ Sensor No. (Sensor No.9 is REF) | | | | | | | | | Uncertainty ± (°C) |
|------------------------|---|-------|-------|-------|-------|-------|-------|-------|-------|--------------------|
| | # 1 | # 2 | # 3 | # 4 | # 5 | # 6 | # 7 | # 8 | # 9 | |
| 22.0 | 22.18 | 22.18 | 22.16 | 22.19 | 21.94 | 21.95 | 21.96 | 21.98 | 22.08 | 0.27 |
| 25.0 | 25.51 | 25.32 | 25.29 | 25.34 | 25.05 | 25.02 | 25.04 | 25.09 | 25.15 | 0.27 |

Table 2 : Reporting of Characterization Result

| UUC* Setting (°C) | UUC* Reading (°C) | | | Stability ± (°C) | Uniformity (°C) | Overall Variation (°C) |
|-------------------|-------------------|------|---------|------------------|-----------------|------------------------|
| | MIN | MAX | Average | | | |
| 22.0 | 22.0 | 22.0 | 22.0 | 0.026 | 0.14 | 0.29 |
| 25.0 | 25.0 | 25.0 | 25.0 | 0.035 | 0.36 | 0.55 |

Note The quoted uncertainty include " Stability " and " Loading effect (20% of Temp Uniformity) "

UUC* = Unit Under Calibration

Stability = One-half of the greatest maximum difference of measured temperatures at any one sensors, for at least half an hour after reaching steady state.

Uniformity = The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time.

Overall Variation = The difference of the maximum and minimum measured temperatures throughout observation time.

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

----- End -----

P. Jongsakul
25 March 2025



Calibration Certificate

Certificate No.: 2501624-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakanong, Bangkok 10260

Page 1 of 3

Equipment: Water Bath
Manufacturer: MEMMERT
Model: WNE14
Serial No.: L416.0606
ID No.: UAE.MIC.002/2560
Order No.: 2501624
Operation No.: 2501624-001
Date of Receipt: 10 February 2025
Date of Calibration: 10 February 2025

Calibrated by Mr.Worapob Sooktong
Scientist
WB

Approved by

P. Pheraphat
(Mr.Pheraphat Tuanjit) (for)

Manager, Division of Calibration Laboratory

Date of Issue: 19 February 2025

Responsible for the Technical Management Team

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.

F-CS-009 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2501624-001-01

Equipment:

Water Bath

Model: WNE14

Serial No.: L416.0606

Resolution: 0.1 °C

ID No.: UAE.MIC.002/2560

Manufacturer: MEMMERT

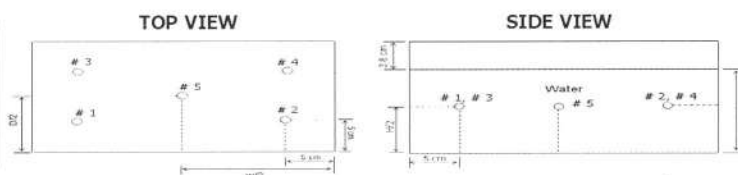
Date of Calibration: 10 February 2025

Page 3 of 3

Calibration point: 44.5 °C

Calibration result:

| Calibration Condition | Temperature (°C) | Relative Humidity (%) | Line Voltage (Volt) |
|-----------------------|------------------|-----------------------|---------------------|
| Min | 25.7 | 52 | 223.0 |
| Max | 26.3 | 65 | 225.0 |



Sensor Installation Location

Table1 : Reporting of Temperature

| Calibration Point (°C) | Measured Temperature (°C) @ Sensor No. (Sensor No.5 is REF) | | | | | Uncertainty ± (°C) |
|------------------------|---|-------|-------|-------|-------|--------------------|
| | # 1 | # 2 | # 3 | # 4 | # 5 | |
| 44.5 | 44.55 | 44.46 | 44.48 | 44.47 | 44.48 | 0.18 |

Table 2 : Reporting of Characterization Result

| UUC* Setting (°C) | UUC* Reading (°C) | | | Stability ± (°C) | Uniformity (°C) | Overall Variation (°C) |
|-------------------|-------------------|------|---------|------------------|-----------------|------------------------|
| | MIN | MAX | Average | | | |
| 44.5 | 44.5 | 44.5 | 44.5 | 0.082 | 0.070 | 0.29 |

Note The quoted uncertainty include " Stability " and " Loading effect (20% of Temp Uniformity)"

UUC* = Unit Under Calibration

Stability = One-half of the greatest maximum difference of measured temperatures at any one sensors, for at least half an hour after reaching steady state.

Uniformity = The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time.

Overall Variation = The difference of the maximum and minimum measured temperatures throughout observation time.

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

----- End -----

F-CS-012 Revision: 01 Date: 20-04-65

P. Jongsakul
19 Feb. 2025



Calibration Report

Certificate No.: 2501624-001-01

Equipment: Water Bath

Model: WNE14 Serial No.: L416.0606

Resolution: 0.1 °C ID No.: UAE.MIC.002/2560

Manufacturer: MEMMERT

Date of Calibration: 10 February 2025 Page 2 of 3

Location: 302 Microbiology Laboratory, UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.

Environment Condition:

Ambient Temperature (26 ± 1) °C

Relative Humidity (59 ± 7) %

Line Voltage (224 ± 1) Volt

Condition of this results of Calibration:

- This instrument was calibrated by insert 5 standard thermometer into its liquid bath and calibration according to W-TE-011 based on ASTM E715-80 (2022): Standard Specification for Gravity-Convection and Forced-Circulation Water Baths.
 - The temperature scale used is ITS - 90.
 - All data show below were final values and the initial data may be obtained upon request.

2. Reference Standard Instrument :

| Instrument | Model | Serial No./ ID No. | Certificate No. | Due Date | Through |
|---------------------------------|--------|--------------------------|-----------------|----------|-------------------------|
| Digital Thermometer with sensor | 34972A | MY59002902 | TE 670478-01 | 4-May-25 | NATIONAL FOOD INSTITUTE |
| | RTD | RTD#301-305 / CH#301-305 | | | |

- This certificate is traceable to International System of Units (SI Units).
- This certificate was certified only for the instrument we calibrated.
- This result of calibration was found accurate as shown on date and place of calibration only.
- Condition of Calibrated item : Good

UUC Description:

Time of Record 1 Hour 9 Minute At 44.5 °C

7. Result of Calibration :
- | | |
|-------------------------------------|--------------------|
| <input checked="" type="checkbox"/> | Without adjustment |
| <input type="checkbox"/> | After adjustment |

P. Jengharit
19 Feb. 2025

Calibration Certificate

Certificate No.: 2502229-007-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakanong, Bangkok 10260

Page 1 of 3

Equipment: Autoclave
Manufacturer: ALP
Model: CL-40L
Serial No.: 808763
ID No.: UAE.MIC.026/2563
Order No.: 2502229
Operation No.: 2502229-007
Date of Receipt: 19 March 2025
Date of Calibration: 19 March 2025

Calibrated by Mr.Jerawut Prapawuttipong
Scientist

Approved by



(Mr.Pheraphat Tuanjit) (for)

Manager, Division of Calibration Laboratory

Responsible for the Technical Management Team

Date of Issue: 25 March 2025

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.

F-CS-009 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2502229-007-01

Equipment: Autoclave

Model: CL-40L Serial No.: 808763

Resolution: 0.1 °C ID No.: UAE.MIC.026/2563

Manufacturer: ALP

Date of Calibration: 19 March 2025

Page 2 of 3

Location: LABORATORY, UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.

Environment Condition: Ambient Temperature (23 ± 1) °C

Relative Humidity (60 ± 5) %

Line Voltage (225 ± 1) Volt

Condition of this results of Calibration:

1. This instrument was calibrated by insert 3 standard Data loggers with RTD into its autoclave and calibration according to W-TE-018 based on BS 2646-1:2021, Autoclaves for sterilization in laboratories

Part 1: Design, construction, safety and performance - Specification.

- The temperature scale used was based on ITS - 90.

- All data show below were final values and the initial data may be obtained upon request.

2. Reference Standard Instrument :

| Instrument | Model | Serial No. | Certificate No. | Due Date | Through |
|--|--------------|------------|-----------------|-----------|-------------------------|
| Digital Thermometer with RTD (Data Logger) | HiTemp140-PT | S35646 | TE 670370-01 | 23-Mar-25 | NATIONAL FOOD INSTITUTE |
| | HiTemp140-PT | S33753 | TE 670371-01 | 23-Mar-25 | NATIONAL FOOD INSTITUTE |
| | HiTemp140-PT | S29973 | TE 670372-01 | 23-Mar-25 | NATIONAL FOOD INSTITUTE |

3. This certificate is traceable to International System of Units (SI Units).

4. This certificate was certified only for the instrument we calibrated.

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

6. This standard does not apply to sterilizers or disinfectors used for medical, dental, pharmaceutical.

7. Condition of Calibrated item : Good

UUC Description : Setting program function sterilization : STERILIZE/NORMAL

Time of sterilization 15 Minute At 115.0 aand 121.0 °C

8. Result of Calibration :

☒

Without adjustment

☐

After adjustment

P. Jengharit
25 March 2025



Calibration Report

Certificate No.: 2502229-007-01

Equipment: Autoclave

Model: CL-40L

Serial No.: 808763

Resolution: 0.1 °C

ID No.: UAE.MIC.026/2563

Manufacturer: ALP

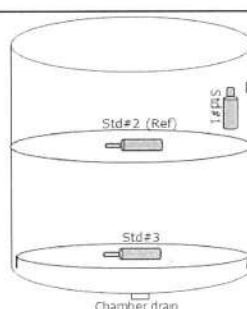
Date of Calibration: 19 March 2025

Page 3 of 3

Calibration point: 115.0 and 121.0 °C

Calibration result:

| Calibration Condition | Temperature (°C) | Relative Humidity (%) | Line Voltage (Volt) |
|-----------------------|------------------|-----------------------|---------------------|
| Min | 22.0 | 55 | 224 |
| Max | 24.0 | 65 | 226 |



Standard at Position

Std#1 = Attached to the load temperature probe, within 20 mm.
Std#2 = In the upper half of the chamber
Std#3 = In the chamber drain, within 100 mm.

Table1 : Reporting of Temperature

| Calibration Point (°C) | Measured Temperature (°C) @ Sensor No. (Sensor No.2 is REF) | | | Uncertainty ± (°C) |
|------------------------|---|---------------|---------|--------------------|
| | Std.# 1 | Std.# 2 (Ref) | Std.# 3 | |
| 115.0 | 115.32 | 115.46 | 115.22 | 0.64 |
| 121.0 | 121.31 | 121.53 | 121.31 | 0.64 |

Table 2 : Reporting of Characterization Result

| UUC* Setting (°C) | UUC* Reading | | | | Stability ± (°C) | Uniformity (°C) | Overall Variation (°C) |
|-------------------|--------------|----------|--------------|------|------------------|-----------------|------------------------|
| | Min (°C) | Max (°C) | Average (°C) | MPa | | | |
| 115.0 | 115.0 | 115.1 | 115.0 | 0.08 | 0.11 | 0.12 | 0.26 |
| 121.0 | 121.0 | 121.1 | 121.0 | 0.12 | 0.13 | 0.15 | 0.29 |

Note

The quoted uncertainty include " Stability " and " Loading effect (20% of Uniformity)"

UUC* = Unit Under Calibration

Stability = One-half of the greatest maximum difference of measured temperatures at any one sensors, for at least half an hour after reaching steady state.

Uniformity = The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time.

Overall Variation = The difference of the maximum and minimum measured temperatures throughout observation time.

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

----- End -----

F-CS-012 Revision: 01 Date: 20-04-65

P. Jongsakul
25 March 2025



Calibration Certificate

Certificate No.: 2402419-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhonong, Bangkok 10260

Page 1 of 3

Equipment: Electronic Balance
Manufacturer: OHAUS
Model: PX623
Serial No.: C236754745
ID No.: UAE.MIC.055/2565
Order No.: 2402419
Operation No.: 2402419-001
Date of Receipt: 19 April 2024
Date of Calibration: 19 April 2024

Calibrated by Mr.Pheraphat Tuanjit
Scientist

Approved by 
(Miss Preeyaporn Jaengkarnkit)

Vice President, Department of Laboratory Services
Responsible for the Technical Management Team

Date of Issue: 23 April 2024

The uncertainties are for a confidence probability of approximately 95%

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.

F-CS-009 Revision: 01 Date: 20-04-65



Calibration Report

Certificate No.: 2402419-001-01

Equipment:

Electronic Balance

Manufacturer: OHAUS

Model: PX623

Resolution: 0.001 g

Serial No.: C236754745

ID No.: UAE.MIC.055/2565

Capacity: 620 g

Date of Calibration: 19 April 2024

Page 2 of 3

Environment Condition: Ambient Temperature: 26.0 ± 0.3 °C Relative Humidity: 57 ± 8.4 %

Place of Calibration: Room 301, UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

Condition of Equipment: Good Condition

Condition of This Results of Calibration:

1. Calibration Method: NFI Method W-MA-001 In-House Method based on UKAS Lab 14 : 2019

2. Reference Standards:

| Reference Standard | Model | Serial No. | Calibrated By | Certificate No. | Due Date |
|--------------------------|--------|------------|---------------|-----------------|------------------|
| Standard Weight Class E2 | 1-500g | 15882 | TCS | M2311182S | 28 November 2024 |

| Instrument | Model | Serial No. | Calibrated By | Certificate No. | Due Date |
|--------------------|--------|----------------|----------------|-----------------|--------------|
| Thermo-Hygro Meter | 608-H1 | NFI.BTH 019/23 | Quality Reborn | QR24-0492 | 4 March 2025 |

3. This certification is traceable to SI UNIT

4. This certificate was certified only for the instrument we calibrated.

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

Calibration Results:

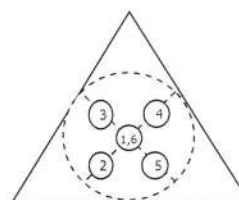
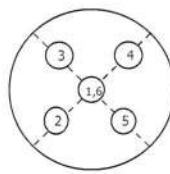
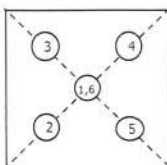
1. Repeatability of Reading:

| Nominal Value (g) | Standard Deviation of Reading (g) |
|---------------------|-------------------------------------|
| 300 | 0.00067 |
| 600 | 0.0010 |

2. Off-Center Error:

A mass of 200 g was placed and moved to various position on pan.

The balance reading obtained is given in the table.



| 1 (g) | 2 (g) | 3 (g) | 4 (g) | 5 (g) | 6 (g) | (Maximum Difference) (g) |
|------------|------------|------------|------------|------------|------------|-------------------------------|
| 200.000 | 200.002 | 200.001 | 199.999 | 200.000 | 200.000 | 0.002 |

F-CS-012 Revision: 01 Date: 20-04-65

P. Jongsakul
23 April 2024

Calibration Report

Certificate No.: 2402419-001-01

Equipment: Electronic Balance

Manufacturer: OHAUS

Model: PX623

Resolution: 0.001 g

Serial No.: C236754745

ID No.: UAE.MIC.055/2565

Capacity: 620 g

Date of Calibration: 19 April 2024

Page 3 of 3

Calibration Results: (Continued)

Calibration Range: 0-600 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value:

| Nominal Value (g) | Standard Value (g) | Average Reading (g) | Correction (g) | Uncertainty (± g) | Coverage Factor <i>k</i> |
|------------------------|-------------------------|--------------------------|---------------------|------------------------|-----------------------------|
| Unload | 0.0000 | 0.000 | 0.000 | 0.00093 | 2.00 |
| 1 | 1.0000 | 1.000 | 0.000 | 0.00093 | 2.00 |
| 5 | 5.0000 | 5.000 | 0.000 | 0.00093 | 2.00 |
| 10 | 10.0000 | 10.000 | 0.000 | 0.00093 | 2.00 |
| 20 | 20.0000 | 20.000 | 0.000 | 0.00093 | 2.00 |
| 50 | 50.0000 | 50.001 | -0.001 | 0.00093 | 2.00 |
| 100 | 100.0000 | 100.001 | -0.001 | 0.00094 | 2.00 |
| 200 | 200.0000 | 200.001 | -0.001 | 0.0011 | 2.00 |
| 300 | 300.0000 | 300.003 | -0.003 | 0.0011 | 2.00 |
| 400 | 399.9999 | 400.003 | -0.003 | 0.0012 | 2.00 |
| 500 | 499.9999 | 500.003 | -0.003 | 0.0013 | 2.00 |
| 600 | 599.9999 | 600.002 | -0.002 | 0.0014 | 2.00 |

P. Jongsakul
23 April 2024

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 %.

----- End -----

F-CS-012 Revision: 01 Date: 20-04-65



Envi Equipment Service Co., Ltd.

110/254 Moo 3, Tumbon Bang Rak Phatthana, Amphur Bang Bua Thong, Nonthaburi 11110

Tel. 098 362 9152, 089 478 7885

E-mail: sales@envi-ees.com

Certificate No.: E24-060049

Page.: 1 of 6

CERTIFICATE OF CALIBRATION

Customer : United Analyst and Engineering Consultant Co., Ltd.

Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

Description of Equipment : Console meter

Manufacturer : Apex Instrument

Model Number : XC-572-V

Serial Number : 0707048

ID./Control No. : UAE.EFM. 154/2550

Environment Conditions : **Temperature** (25 ± 2) °C
: **Humidity** (50 ± 15) % RH

Cal. Date : 25/06/2024

Issue Date : 25/06/2024

Calibration Method or Calibration Procedure Used

US EPA Method (United State Environmental Protection Agency)

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

Result of Calibration

This certificate may not be reproduced other than in full except with prior Written approval of the Technical Manager, Envi Equipment Service Company Limited.

These reported uncertainties of measurement are expanded by a coverage factor of k=2, providing a 95% confidence level

Calibrated by : Mr. Sanya Sangnil

Approved by :  (Mr. Mana Fuekhuad)

Technical Manger

เอกสารไม่ควบคุม



METHOD 5 CONSOLE CALIBRATION
USING REFERENCE WET GAS METER W-NK-2.5-B-Z No.547425
5-POINT METRIC UNIT

| Meter Console Information | | Calibration Conditions | | | | Factors/Conversions | | |
|---------------------------|----------|---------------------------|------|--------------|----------|---------------------|-------|-------|
| Console Model Number | XC-572-V | Date | Time | 25/06/2024 | 09:05 AM | Std Temp | 293 | K |
| Console Serial Number | 0707048 | Calibration Reference No. | | SER24-060019 | | Std Press | 760 | mm Hg |
| DGM Model Number | SK25EX | Barometric Pressure | | 754.41 | mmHg | K ₁ | 0.386 | |
| DGM Serial Number | 00005715 | Calibration Meter Gamma | | 1.001 | | Console Leak Check | | PASS |

| Calibration Data | | | | | | | | | |
|------------------|---------------------|--------------------|--------------------|---------------------|--------------------|--------------------|--------------------|---------------------|--------------------|
| Run Time | Metering Console | | | | | Calibration Meter | | | |
| Elapsed | DGM Orifice DH | Volume Initial | Volume Final | Outlet Temp Initial | Outlet Temp Final | Volume Initial | Volume Final | Outlet Temp Initial | Outlet Temp Final |
| (Q) | (P _m) | (V _{mi}) | (V _{mf}) | (t _{mi}) | (t _{mf}) | (V _{wi}) | (V _{wf}) | (t _{wi}) | (t _{wf}) |
| min | mm H ₂ O | m ³ | m ³ | °C | °C | m ³ | m ³ | °C | °C |
| 12.25 | 13.0 | 1006.591 | 1006.731 | 30 | 30 | 224.31426 | 224.45480 | 28 | 28 |
| 12.30 | 13.0 | 1006.731 | 1006.871 | 30 | 30 | 224.45480 | 224.59514 | 28 | 28 |
| 8.57 | 26.0 | 1006.878 | 1007.018 | 29 | 29 | 224.60216 | 224.74278 | 28 | 28 |
| 8.57 | 26.0 | 1007.018 | 1007.158 | 29 | 29 | 224.74278 | 224.88286 | 28 | 28 |
| 13.85 | 40.0 | 1007.166 | 1007.446 | 29 | 29 | 224.89090 | 225.16890 | 27 | 27 |
| 14.03 | 40.0 | 1007.446 | 1007.726 | 30 | 30 | 225.16890 | 225.44958 | 27 | 27 |
| 10.45 | 70.0 | 1007.743 | 1008.023 | 30 | 30 | 225.46640 | 225.74430 | 26 | 26 |
| 10.43 | 70.0 | 1008.023 | 1008.303 | 30 | 30 | 225.74430 | 226.02136 | 26 | 26 |
| 9.15 | 90.0 | 1008.315 | 1008.595 | 30 | 30 | 226.03294 | 226.30764 | 26 | 26 |
| 9.15 | 90.0 | 1008.595 | 1008.875 | 30 | 30 | 226.30764 | 226.58212 | 26 | 26 |



เอกสารไม่ควบคุม

METHOD 5 CONSOLE CALIBRATION
USING REFERENCE WET GAS METER W-NK-2.5-B-Z No.547425
5-POINT METRIC UNIT

| Meter Console Information | | Calibration Conditions | | | | Factors/Conversions | | |
|---------------------------|----------|---------------------------|------|--------------|----------|---------------------|-------|-------|
| Console Model Number | XC-572-V | Date | Time | 25/06/2024 | 09:05 AM | Std Temp | 293 | K |
| Console Serial Number | 0707048 | Calibration Reference No. | | SER24-060019 | | Std Press | 760 | mm Hg |
| DGM Model Number | SK25EX | Barometric Pressure | | 754.41 | | K ₁ | 0.386 | |
| DGM Serial Number | 00005715 | Calibration Meter Gamma | | 1.001 | | Console Leak Check | | PASS |

| Calibration Data | | | | | | | | |
|------------------------|------------------------|------------------------|------------------------|--------------------|-----------|------------------------------|--|----------------------------|
| Results | | | | | | | | |
| Standardized Data | | | | Dry Gas Meter | | | | |
| Dry Gas Meter | | Calibration Meter | | Calibration Factor | | Flowrate | .0212 m ³ _{std} /min | Variation |
| (V _{m(std)}) | (Q _{m(std)}) | (V _{w(std)}) | (Q _{w(std)}) | Value | Variation | Std & Corr | | |
| m ³ | m ³ /min | m ³ | m ³ /min | (Y) | (ΔY) | (Q _{m(std)(corr)}) | (ΔH _@) | (ΔH _@) |
| | | | | | | m ³ /min | mm H ₂ O | |
| 0.135 | 0.011 | 0.136 | 0.011 | 1.004 | 0.012 | 0.011 | 46.115 | -0.256 |
| 0.135 | 0.011 | 0.136 | 0.011 | 1.002 | 0.011 | 0.011 | 46.625 | 0.254 |
| 0.136 | 0.016 | 0.136 | 0.016 | 1.003 | 0.011 | 0.016 | 45.168 | -1.203 |
| 0.136 | 0.016 | 0.135 | 0.016 | 0.999 | 0.008 | 0.016 | 45.517 | -0.854 |
| 0.273 | 0.020 | 0.270 | 0.019 | 0.990 | -0.001 | 0.019 | 46.444 | 0.073 |
| 0.273 | 0.019 | 0.272 | 0.019 | 1.000 | 0.008 | 0.019 | 46.776 | 0.405 |
| 0.274 | 0.026 | 0.271 | 0.026 | 0.987 | -0.005 | 0.026 | 46.419 | 0.048 |
| 0.274 | 0.026 | 0.270 | 0.026 | 0.984 | -0.008 | 0.026 | 46.552 | 0.181 |
| 0.275 | 0.030 | 0.267 | 0.029 | 0.974 | -0.018 | 0.029 | 47.010 | 0.639 |
| 0.275 | 0.030 | 0.267 | 0.029 | 0.973 | -0.019 | 0.029 | 47.085 | 0.714 |
| | | | | 0.991 | Y Average | | 46.371 | ΔH _@ Average |

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ± 0.02 .

For $\Delta H_{@}$, orifice pressure differential that equates to 0.75 cfm (0.0212 m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 0.2 inches (5.1mm) H₂O.



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| Meter Console Information | |
|---------------------------|----------|
| Console Model Number | XC-572-V |
| Console Serial Number | 0707048 |
| DGM Model Number | SK25EX |
| DGM Serial Number | 00005715 |

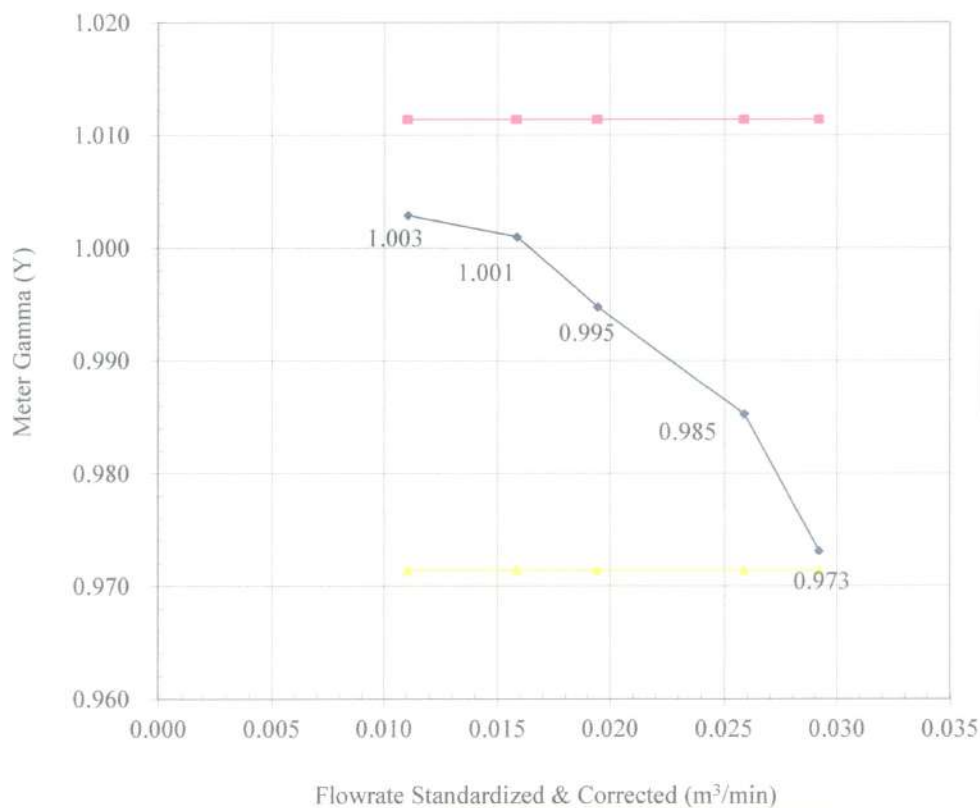
| Calibration Conditions | | | |
|---------------------------|--------------|------------|----------|
| Date | Time | 25/06/2024 | 09:05 AM |
| Calibration Reference No. | SER24-060019 | | |
| Barometric Pressure | 754.41 | mmHg | |
| Calibration Meter Gamma | 1.001 | | |

| Factors/Conversions | | |
|---------------------|-------|-------|
| Std Temp | 293 | K |
| Std Press | 760 | mm Hg |
| K ₁ | 0.386 | |
| Console Leak Check | PASS | |

Calibration Date: 25-6-2024

Calibration Reference No: SER24-060019

Meter Gamma vs Flowrate



Console Serial: 0707048

Console Model: XC-572-V



เอกสารไม่ควบคุม

| Meter Console Information | |
|---------------------------|----------|
| Console Model Number | XC-572-V |
| Console Serial Number | 0707048 |
| DGM Model Number | SK25EX |
| DGM Serial Number | 00005715 |

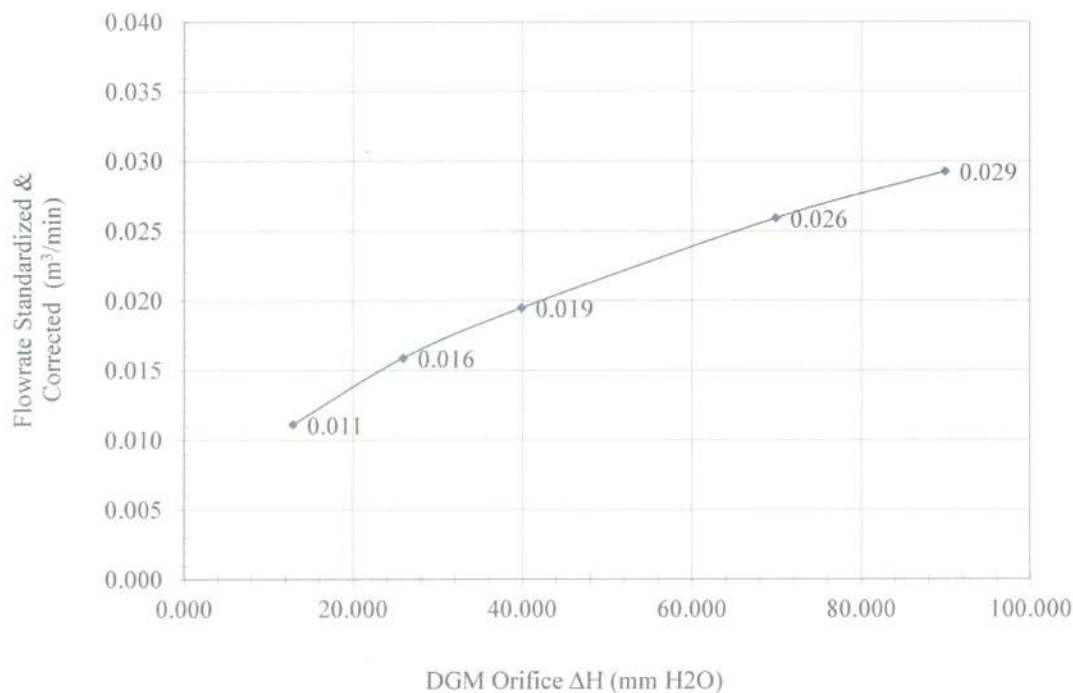
| Calibration Conditions | | | |
|---------------------------|------|--------------|----------|
| Date | Time | 25/06/2024 | 09:05 AM |
| Calibration Reference No. | | SER24-060019 | |
| Barometric Pressure | | 754.41 | mmHg |
| Calibration Meter Gamma | | 1.001 | |

| Factors/Conversions | | |
|---------------------|-------|-------|
| Std Temp | 293 | K |
| Std Press | 760 | mm Hg |
| K ₁ | 0.386 | |
| Console Leak Check | | PASS |

Calibration Date: 25-6-2024

Calibration Reference No: SER24-060019

Meter Pressure vs Flowrate



Console Serial: 0707048

Console Model: XC-572-V



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THERMOCOUPLES SYSTEM CALIBRATION

| Sampling System Equipment Information | |
|---------------------------------------|--------------|
| Console Model Number | XC-572-V |
| Console Serial Number | 0707048 |
| DGM Model Number | SK25EX |
| DGM Serial Number | 00005715 |
| Meter Box Model Number | JENCO 765 KF |
| Meter Box Serial Number | JC 15588 |

| Calibration Conditions | | | |
|---------------------------|------|--------------|----------|
| Date | Time | 25/06/2024 | 11:35 AM |
| Calibration Reference No. | | SER24-060019 | |
| Reference Thermometer | | DIGICON | |
| Serial Number | | 183169105 | |
| | | | |
| | | | |

| Results | | | | | | | | | | | |
|--------------------------------|--|------|------|------|-------|-------|-------|-------|-------|-------|--------|
| Console Thermocouple Simulator | | | | | | | | | | | |
| Channel and test point | Meter Box Channel Temperature Reading (°C) | | | | | | | | | | |
| | -18.0 | 25.0 | 38.0 | 93.0 | 149.0 | 260.0 | 371.0 | 482.0 | 593.0 | 816.0 | 1038.0 |
| Stack | -18.0 | 25.0 | 37.0 | 92.0 | 147.0 | 256.0 | 365.0 | 476.0 | 585.0 | 805.0 | 1024.0 |
| Aux | -18.0 | 25.0 | 37.0 | 92.0 | 147.0 | | | | | | |
| Probe | -18.0 | 25.0 | 37.0 | 92.0 | 147.0 | | | | | | |
| Filter | -18.0 | 25.0 | 37.0 | 92.0 | 147.0 | | | | | | |
| Exit | -18.0 | 25.0 | 37.0 | | | | | | | | |

Tolerance Range

Stack ± 1.50% Absolute
 Probe ± 3.0 °C
 Filter ± 3.0 °C

Meter ± 3.0 °C
 Exit ± 2.0 °C



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Envi Equipment Service Co., Ltd.

110/254 Moo 3, Tumbon Bang Rak Phatthana, Amphur Bang Bua Thong, Nonthaburi 11110

Tel. 098 362 9152, 089 478 7885

E-mail: sales@envi-ees.com

Certificate No.: E24-080074

Page.: 1 of 6

CERTIFICATE OF CALIBRATION

Customer : United Analyst and Engineering Consultant Co., Ltd.

Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

Description of Equipment : Console meter

Manufacturer : Apex Instrument

Model Number : XC-572-V

Serial Number : 0807047

ID./Control No. : UAE.ANV 212/2551

Environment Conditions : Temperature (25 ± 2) °C
Humidity (50 ± 15) % RH

Cal. Date : 26/08/2024

Issue Date : 26/08/2024

Calibration Method or Calibration Procedure Used

US EPA Method (United State Environmental Protection Agency)

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

Result of Calibration

This certificate may not be reproduced other than in full except with prior Written approval of the Technical Manager, Envi Equipment Service Company Limited.

These reported uncertainties of measurement are expanded by a coverage factor of k=2, providing a 95% confidence level

Calibrated by : Mr. Sanya Sangnil

Approved by :

(Mr. Mana Fuekhud)

Technical Manger

เอกสารไม่ควบคุม



METHOD 5 CONSOLE CALIBRATION
USING REFERENCE WET GAS METER W-NK-2.5-B-Z No.547425
5-POINT METRIC UNIT

| Meter Console Information | | Calibration Conditions | | | | Factors/Conversions | | |
|---------------------------|----------|---------------------------|------|--------------|----------|---------------------|-------|-------|
| Console Model Number | XC-572-V | Date | Time | 26/08/2024 | 01:10 PM | Std Temp | 293 | K |
| Console Serial Number | 0807047 | Calibration Reference No. | | SER24-080032 | | Std Press | 760 | mm Hg |
| DGM Model Number | SK25EX | Barometric Pressure | | 755.91 | mmHg | K ₁ | 0.386 | |
| DGM Serial Number | 00003580 | Calibration Meter Gamma | | 1.001 | | Console Leak Check | PASS | |

| Calibration Data | | | | | | | | | |
|------------------|---------------------|--------------------|--------------------|---------------------|--------------------|--------------------|--------------------|---------------------|--------------------|
| Run Time | Metering Console | | | | | Calibration Meter | | | |
| Elapsed | DGM Orifice DH | Volume Initial | Volume Final | Outlet Temp Initial | Outlet Temp Final | Volume Initial | Volume Final | Outlet Temp Initial | Outlet Temp Final |
| (Q) | (P _m) | (V _{mi}) | (V _{mf}) | (t _{mi}) | (t _{mf}) | (V _{wi}) | (V _{wf}) | (t _{wi}) | (t _{wf}) |
| min | mm H ₂ O | m ³ | m ³ | °C | °C | m ³ | m ³ | °C | °C |
| 11.88 | 13.0 | 1160.277 | 1160.417 | 24 | 24 | 249.83548 | 249.97320 | 25 | 25 |
| 11.87 | 13.0 | 1160.417 | 1160.557 | 23 | 23 | 249.97320 | 250.11036 | 25 | 25 |
| 8.47 | 26.0 | 1160.565 | 1160.705 | 23 | 23 | 250.11794 | 250.25472 | 25 | 25 |
| 8.43 | 26.0 | 1160.705 | 1160.845 | 23 | 23 | 250.25472 | 250.39116 | 25 | 25 |
| 13.70 | 40.0 | 1160.856 | 1161.136 | 24 | 24 | 250.39676 | 250.67384 | 25 | 25 |
| 13.63 | 40.0 | 1161.136 | 1161.416 | 24 | 24 | 250.67384 | 250.94928 | 25 | 25 |
| 10.27 | 70.0 | 1161.428 | 1161.708 | 25 | 25 | 250.95446 | 251.23044 | 25 | 25 |
| 10.23 | 70.0 | 1161.708 | 1161.988 | 26 | 26 | 251.23044 | 251.50574 | 25 | 25 |
| 8.98 | 90.0 | 1162.001 | 1162.281 | 26 | 26 | 251.51066 | 251.78586 | 24 | 24 |
| 8.95 | 90.0 | 1162.281 | 1162.561 | 27 | 27 | 251.78586 | 252.06032 | 24 | 24 |



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METHOD 5 CONSOLE CALIBRATION
USING REFERENCE WET GAS METER W-NK-2.5-B-Z No.547425
5-POINT METRIC UNIT

| Meter Console Information | | Calibration Conditions | | | | Factors/Conversions | | |
|---------------------------|----------|---------------------------|------|--------------|----------|---------------------|-------|-------|
| Console Model Number | XC-572-V | Date | Time | 26/08/2024 | 01:10 PM | Std Temp | 293 | K |
| Console Serial Number | 0807047 | Calibration Reference No. | | SER24-080032 | | Std Press | 760 | mm Hg |
| DGM Model Number | SK25EX | Barometric Pressure | | 755.91 | | K ₁ | 0.386 | |
| DGM Serial Number | 00003580 | Calibration Meter Gamma | | 1.001 | | Console Leak Check | | PASS |

| Calibration Data | | | | | | | | |
|------------------------|------------------------|------------------------|------------------------|--------------------|-----------|------------------------------|--|--------------------|
| Results | | | | | | | | |
| Standardized Data | | | | Dry Gas Meter | | | | |
| Dry Gas Meter | | Calibration Meter | | Calibration Factor | | Flowrate | .0212 m ³ _{std} /min | Variation |
| | | | | Value | Variation | Std & Corr | | |
| (V _{m(std)}) | (Q _{m(std)}) | (V _{w(std)}) | (Q _{w(std)}) | (Y) | (ΔY) | (Q _{m(std)})(corr) | (ΔH _@) | (ΔH _@) |
| m ³ | m ³ /min | m ³ | m ³ /min | | | m ³ /min | mm H ₂ O | |
| 0.137 | 0.012 | 0.135 | 0.011 | 0.981 | 0.005 | 0.011 | 44.831 | -0.558 |
| 0.137 | 0.012 | 0.134 | 0.011 | 0.977 | 0.001 | 0.011 | 45.071 | -0.318 |
| 0.137 | 0.016 | 0.134 | 0.016 | 0.974 | -0.003 | 0.016 | 46.259 | 0.870 |
| 0.137 | 0.016 | 0.133 | 0.016 | 0.971 | -0.005 | 0.016 | 46.125 | 0.736 |
| 0.275 | 0.020 | 0.271 | 0.020 | 0.985 | 0.008 | 0.020 | 45.532 | 0.143 |
| 0.275 | 0.020 | 0.269 | 0.020 | 0.979 | 0.002 | 0.020 | 45.628 | 0.240 |
| 0.276 | 0.027 | 0.270 | 0.026 | 0.978 | 0.001 | 0.026 | 45.368 | -0.021 |
| 0.276 | 0.027 | 0.269 | 0.026 | 0.976 | -0.001 | 0.026 | 45.297 | -0.092 |
| 0.277 | 0.031 | 0.270 | 0.030 | 0.973 | -0.003 | 0.030 | 44.935 | -0.454 |
| 0.277 | 0.031 | 0.269 | 0.030 | 0.971 | -0.006 | 0.030 | 44.843 | -0.546 |
| | | | | 0.977 | Y Average | | 45.389 | ΔH@ Average |

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ± 0.02 .

For $\Delta H_{@}$, orifice pressure differential that equates to 0.75 cfm (0.0212 m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 0.2 inches (5.1mm) H₂O.



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| Meter Console Information | |
|---------------------------|----------|
| Console Model Number | XC-572-V |
| Console Serial Number | 0807047 |
| DGM Model Number | SK25EX |
| DGM Serial Number | 00003580 |

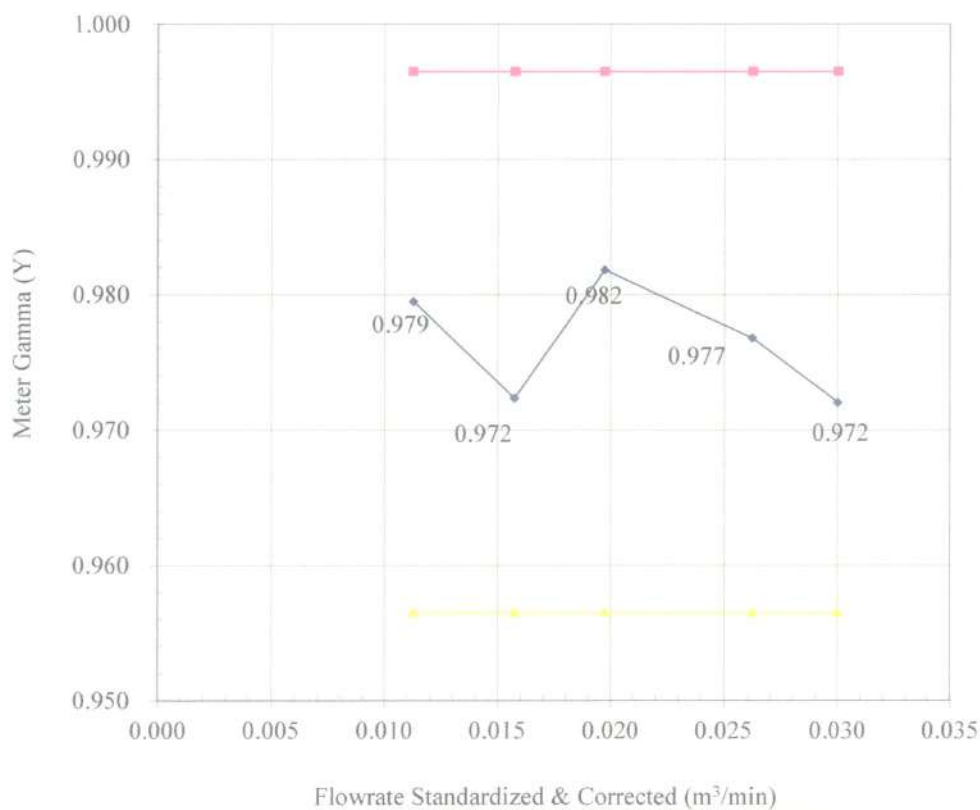
| Calibration Conditions | | | |
|---------------------------|--------------|------------|----------|
| Date | Time | 26/08/2024 | 01:10 PM |
| Calibration Reference No. | SER24-080032 | | |
| Barometric Pressure | 755.91 | mmHg | |
| Calibration Meter Gamma | 1.001 | | |

| Factors/Conversions | | |
|---------------------|-------|-------|
| Std Temp | 293 | K |
| Std Press | 760 | mm Hg |
| K ₁ | 0.386 | |
| Console Leak Check | PASS | |

Calibration Date: 26-8-2024

Calibration Reference No: SER24-080032

Meter Gamma vs Flowrate



Console Serial: 0807047

Console Model: XC-572-V



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| Meter Console Information | |
|---------------------------|----------|
| Console Model Number | XC-572-V |
| Console Serial Number | 0807047 |
| DGM Model Number | SK25EX |
| DGM Serial Number | 00003580 |

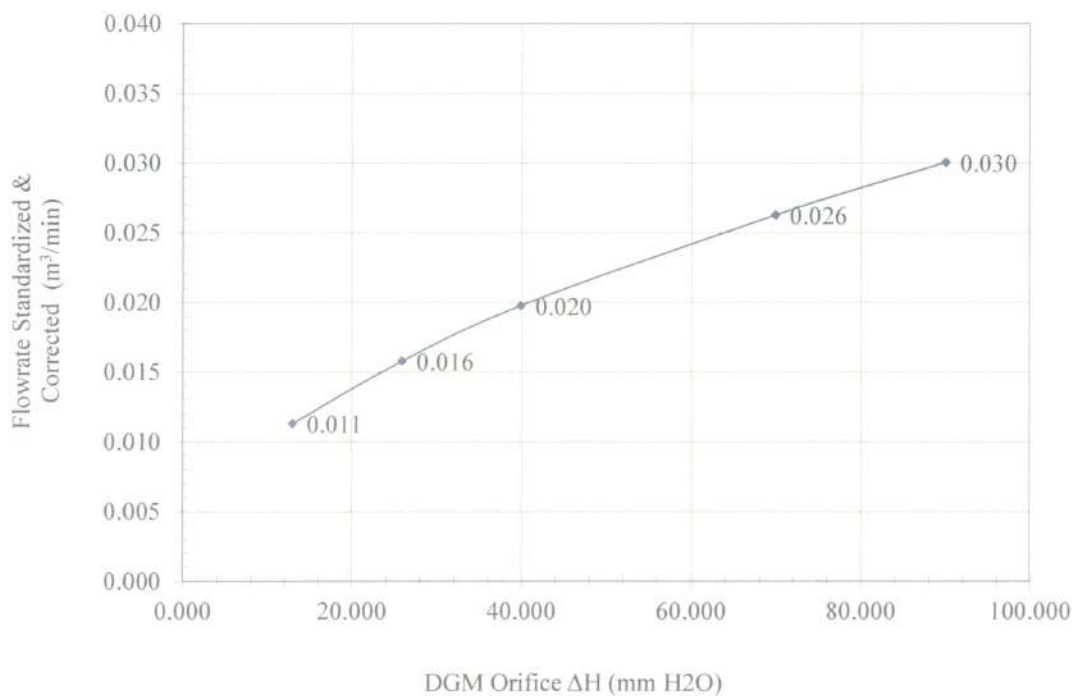
| Calibration Conditions | | | |
|---------------------------|--------------|------------|----------|
| Date | Time | 26/08/2024 | 01:10 PM |
| Calibration Reference No. | SER24-080032 | | |
| Barometric Pressure | 755.91 | mmHg | |
| Calibration Meter Gamma | 1.001 | | |

| Factors/Conversions | | |
|---------------------|-------|-------|
| Std Temp | 293 | K |
| Std Press | 760 | mm Hg |
| K ₁ | 0.386 | |
| Console Leak Check | PASS | |

Calibration Date: 26-8-2024

Calibration Reference No: SER24-080032

Meter Pressure vs Flowrate



Console Serial: 0807047

Console Model: XC-572-V



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THERMOCOUPLES SYSTEM CALIBRATION

| Sampling System Equipment Information | |
|---------------------------------------|--------------|
| Console Model Number | XC-572-V |
| Console Serial Number | 0807047 |
| DGM Model Number | SK25EX |
| DGM Serial Number | 00003080 |
| Meter Box Model Number | JENCO 765 KF |
| Meter Box Serial Number | JC 19778 |

| Calibration Conditions | | | |
|---------------------------|------|--------------|----------|
| Date | Time | 26/08/2024 | 03:10 PM |
| Calibration Reference No. | | SER24-080032 | |
| Reference Thermometer | | DIGICON | |
| Serial Number | | 183169105 | |
| | | | |
| | | | |

| Results | | | | | | | | | | | |
|--------------------------------|--|------|------|------|-------|-------|-------|-------|-------|-------|--------|
| Console Thermocouple Simulator | | | | | | | | | | | |
| Channel and test point | Meter Box Channel Temperature Reading (°C) | | | | | | | | | | |
| | -18.0 | 25.0 | 38.0 | 93.0 | 149.0 | 260.0 | 371.0 | 482.0 | 593.0 | 816.0 | 1038.0 |
| Stack | -17.0 | 25.0 | 38.0 | 92.0 | 147.0 | 256.0 | 368.0 | 485.0 | 590.0 | 814.0 | 1036.0 |
| Aux | -17.0 | 25.0 | 38.0 | 92.0 | 147.0 | | | | | | |
| Probe | -17.0 | 25.0 | 38.0 | 92.0 | 147.0 | | | | | | |
| Filter | -17.0 | 25.0 | 38.0 | 92.0 | 147.0 | | | | | | |
| Oven | -17.0 | 25.0 | 38.0 | 92.0 | 147.0 | | | | | | |
| Exit | -17.0 | 25.0 | 38.0 | | | | | | | | |

Tolerance Range

Stack ± 1.50% Absolute
 Probe ± 3.0 °C
 Filter ± 3.0 °C

Meter ± 3.0 °C
 Exit ± 2.0 °C



เอกสารไม่ควบคุม

Certificate No: G 670643

Date of issue : 13-Sep-24

Instrument description : Flue Gas Analyzer
Instrument model : Testo 350 New
Instrument serial no. : 60723967/609
Control unit serial no. : 03064673/609
ID no. or control no. : UAE.EFM.027/2559
Manufacturer : Testo SE & Co. KGaA
Probe description : -
Probe model : -
Probe serial no. : -
Customer name : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Customer address : 81 SOI UDOMSUK41,SUKHUMVIT ROAD,BANGCHAK PRAKANONG BANGKOK 10260

Total pages of certificate : 2 Pages
Receiving no. : L-243478
Receiving date. : 06-Sep-24
Parameter of calibration : Gas Calibration(Oxygen 2.50,10.04,21.02 %vol, Carbon Monoxide 80.18,302,1007 ppm, Nitrogen Dioxide 30.68,81.32,201.9 ppm, Nitric Oxide 30.01,151.5,322.5 ppm, Sulphur Dioxide 50.36,100.8,600.8 ppm)
Condition of UUC. : Used
Ambient condition : All of the Measurment ware caried out the stabilized labotary
 Temperature : 23 ±5 °C
 Humidity : 55 ± 15 %RH
Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210
Calibration procedure no. : This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no. WI-CL-28-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurent Multiplied by coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

This certificate is applied only to item under test Environmental condition.

This Calibration Certificate may not be reporduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature and seal not valid and The results relate only to the items tested/calibrated.

This calibration certificate documents are tracebility to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 13-Sep-24



Mr. Kwanchai Khamdoun
Calibration Technician



Mrs. Nongluck Wongsettee
Technical Manager

Certificate No.: G 670643

Standard References (Table 1)

| Standard | Certificate No. | Vendor | Due date |
|--|-----------------|--------|-----------|
| Oxygen (O ₂) 2.50 % Vol | 2412/23 | Linde | 27-Aug-27 |
| Oxygen (O ₂) 10.04 % Vol | CG-0153-21 | Nimt | 18-Nov-26 |
| Oxygen (O ₂) 21.02 % Vol | CG-0041-22 | Nimt | 10-Feb-27 |
| Carbon monoxide (CO) 80.18 ppm | CG-0002-24 | Nimt | 11-Jan-29 |
| Carbon monoxide (CO) 302 ppm | 1915/23 | Linde | 16-Jun-25 |
| Carbon monoxide (CO) 1007 ppm | 1870/24 | Linde | 17-Jun-26 |
| Nitrogen Dioxide (NO ₂) 30.68 ppm | 2832/24 | Linde | 08-Sep-26 |
| Nitrogen Dioxide (NO ₂) 81.32 ppm | 3546/23 | Linde | 14-Jan-26 |
| Nitrogen Dioxide (NO ₂) 201.9 ppm | 1975/23 | Linde | 17-Jul-25 |
| Nitric Oxide (NO) 30.01 ppm | CG-0014-23 | Nimt | 19-Feb-25 |
| Nitric Oxide (NO) 151.5 ppm | 0161/23 | Linde | 22-Jan-25 |
| Nitric Oxide (NO) 322.5 ppm | 1974/23 | Linde | 17-Jul-25 |
| Sulphur Dioxide (SO ₂) 50.36 ppm | 2004/23 | Linde | 17-Jul-25 |
| Sulphur Dioxide (SO ₂) 100.8 ppm | 3507/22 | Linde | 09-Nov-24 |
| Sulphur Dioxide (SO ₂) 600.8 ppm | 2003/23 | Linde | 17-Jul-25 |

Measured room conditions

Temperature : 22.7 °C Humidity : 61.2 %RH Pressure : 1010.7 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,200 ml/min Gas pressure : 1013.8 mbar

Calibration Results (Without adjustment) (Table 2)

| Parameter of Standard | Standard Values | Mean of UUC | Error | Uncertainty (±) |
|-----------------------|-----------------|-------------|-------|-----------------|
| O ₂ (%Vol) | 2.50 | 2.47 | -0.03 | 0.15 |
| O ₂ (%Vol) | 10.04 | 10.11 | 0.07 | 0.20 |
| O ₂ (%Vol) | 21.02 | 21.12 | 0.10 | 0.30 |
| CO (ppm) | 80.18 | 81 | 0.82 | 3.0 |
| CO (ppm) | 302 | 304 | 2 | 6.0 |
| CO (ppm) | 1007 | 1011 | 4 | 12 |
| NO ₂ (ppm) | 30.68 | 32.9 | 2.56 | 8.0 |
| NO ₂ (ppm) | 81.32 | 80.2 | -1.12 | 8.0 |
| NO ₂ (ppm) | 201.9 | 204.2 | 2.3 | 12 |
| NO (ppm) | 30.01 | 31 | 0.99 | 8.0 |
| NO (ppm) | 151.5 | 154 | 2.5 | 8.0 |
| NO (ppm) | 322.5 | 324 | 1.5 | 12 |
| SO ₂ (ppm) | 50.36 | 51 | 0.64 | 6.0 |
| SO ₂ (ppm) | 100.8 | 100 | -0.8 | 6.0 |
| SO ₂ (ppm) | 600.8 | 598 | -2.8 | 13 |

Remark : 1 cmol/mol = 1 %vol. 1 μmol/mol = 1 ppm.

End of Report

Certificate No: G 670490

Date of issue : 17-Jul-24

Instrument description : Flue Gas Analyzer
Instrument model : Testo 350 New
Control unit serial no. : 03099401/701
Instrument serial no. : 60899615/701
ID no. or control no. : UAE.EFM. 006/2560
Manufacturer : Testo SE & Co. KGaA
Probe description : -
Probe model : -
Probe serial no. : -
Customer name : United Analyst and Engineering Consultant Co., Ltd.
Customer address : 81 Soi Udomsuk 41, Sukhumvit Rd., Bangchak, Phrakhanong, Bangkok 10260

Total pages of certificate : 2 Pages
Receiving no. : L-242678
Receiving date. : 15-Jul-24
Parameter of calibration : Gas Calibration(Oxygen 2.50,10.04,21.02 %vol, Carbon Monoxide 80.18,302,1007 ppm, Nitrogen Dioxide 30.34,81.32, 201.9 ppm, Nitric Oxide 30.01, 151.5, 322.5 ppm, Sulphur Dioxide 50.36, 100.8, 600.8 ppm)
Condition of UUC. : Used
Ambient condition : All of the Measurment ware caried out the stabilized labotary
 Temperature : 23 ±5 °C
 Humidity : 55 ± 15 %RH
Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210
Calibration procedure no. : This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no. WI-CL-28-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurent Multiplied by coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.

This certificate is applied only to item under test Environmental condition.

This Calibration Certificate may not be reporduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature and seal not valid and The results relate only to the items tested/calibrated.

This calibration certificate documents are tracebility to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 17-Jul-24

Kwanchai

Mr. Kwanchai Khamdoun

Calibration Technician

Nongluck

Mrs. Nongluck Wongsettee

Technical Manager

Certificate No.: G 670490

Standard References (Table 1)

| Standard | Certificate No. | Vendor | Due date |
|--|-----------------|--------|-----------|
| Oxygen (O ₂) 2.50 % Vol | 2412/23 | Linde | 27-Aug-27 |
| Oxygen (O ₂) 10.04 % Vol | CG-0153-21 | Nimt | 18-Nov-26 |
| Oxygen (O ₂) 21.02 % Vol | CG-0041-22 | Nimt | 10-Feb-27 |
| Carbon monoxide (CO) 80.18 ppm | CG-0002-24 | Nimt | 11-Jan-29 |
| Carbon monoxide (CO) 302 ppm | 1915/23 | Linde | 16-Jun-25 |
| Carbon monoxide (CO) 1007 ppm | 1870/24 | Linde | 17-Jun-26 |
| Nitrogen Dioxide (NO ₂) 30.34 ppm | 2703/22 | Linde | 22-Aug-24 |
| Nitrogen Dioxide (NO ₂) 81.32 ppm | 3546/23 | Linde | 14-Jan-26 |
| Nitrogen Dioxide (NO ₂) 201.9 ppm | 1975/23 | Linde | 17-Jul-25 |
| Nitric Oxide (NO) 30.01 ppm | CG-0014-23 | Nimt | 19-Feb-25 |
| Nitric Oxide (NO) 151.5 ppm | 0161/23 | Linde | 22-Jan-25 |
| Nitric Oxide (NO) 322.5 ppm | 1974/23 | Linde | 17-Jul-25 |
| Sulphur Dioxide (SO ₂) 50.36 ppm | 2004/23 | Linde | 17-Jul-25 |
| Sulphur Dioxide (SO ₂) 100.8 ppm | 3507/22 | Linde | 09-Nov-24 |
| Sulphur Dioxide (SO ₂) 600.8 ppm | 2003/23 | Linde | 17-Jul-25 |

Measured room conditions

Temperature : 23.1 °C Humidity : 66.3 %RH Pressure : 1010.2 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,200 ml/min Gas pressure : 1014.5 mbar

Calibration Results (Without adjustment) (Table 2)

| Parameter of Standard | Standard Values | Mean of UUC | Error | Uncertainty (±) |
|-----------------------|-----------------|-------------|-------|-----------------|
| O ₂ (%Vol) | 2.50 | 2.55 | 0.05 | 0.15 |
| O ₂ (%Vol) | 10.04 | 10.12 | 0.08 | 0.20 |
| O ₂ (%Vol) | 21.02 | 21.13 | 0.11 | 0.30 |
| CO (ppm) | 80.18 | 81 | 0.82 | 3.0 |
| CO (ppm) | 302 | 303 | 1 | 6.0 |
| CO (ppm) | 1007 | 1009 | 2 | 12 |
| NO ₂ (ppm) | 30.34 | 32.5 | 2.16 | 8.0 |
| NO ₂ (ppm) | 81.32 | 82.7 | 1.38 | 8.0 |
| NO ₂ (ppm) | 201.9 | 202.8 | 0.9 | 12 |
| NO (ppm) | 30.01 | 31 | 0.99 | 8.0 |
| NO (ppm) | 151.5 | 153 | 1.5 | 8.0 |
| NO (ppm) | 322.5 | 324 | 1.5 | 12 |
| SO ₂ (ppm) | 50.36 | 50 | -0.36 | 6.0 |
| SO ₂ (ppm) | 100.8 | 100 | -0.8 | 6.0 |
| SO ₂ (ppm) | 600.8 | 603 | 2.2 | 13 |

Remark : 1 cmol/mol = 1 %vol. 1 μmol/mol = 1 ppm.

End of Report



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Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Flow measurement laboratory
Calibration services department.



CERTIFICATE OF CALIBRATION

Certificate No. : COF-039-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Top Load Orifice
MANUFACTURER : TISCH
MODEL/TYPE : TE-5025A
SERIAL NUMBER : 3383
ID NUMBER : UAE.EFM.063/2560
CONDITION AS-RECEIVED : Used item
CUSTOMER : United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong,
Bangkok 10260

RECEIVED DATE : 16 Sep 2024
MEASUREMENT DATE : 27 Sep 2024
ISSUE DATE : 27 Sep 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

| | | |
|----------------------|-------------------|-----|
| Temperature | : 23.0 ± 3.0 | °C |
| Relative Humidity | : 55.0 ± 15.0 | %RH |
| Atmospheric Pressure | : 1010 ± 10 | hPa |

CALIBRATION CONDITION:

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are 23.9°C and $49.0\% \text{RH}$.

NOTED: The certificate is valid only to the item calibrated on date and place of calibration.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:

The Orifice gas flow device was calibrated against Standard Rotary Displacement Meter (Roots Meter) Model G65/IMC/W2-dp. The WI-CL-004 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0063-23.

Uncertainty of Measurement:

The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor $k=2$, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'

Calibrated by:

- ☐ Mr. Sorawit Thachalad
☒ Miss Jittraporn Lertsomphol



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

MEASUREMENT RESULTS:

The Orifice gas flow device was calibrated by direct comparison method with the Standard Rotary Displacement Meter (Roots Meter). The Humid air was used as a medium in the system. The standard conditions are 25°C (298.15 K) and 760 mmHg for standard temperature and standard pressure respectively.

Table 1: The results of Q Standard calibration data

| Plate | Flow rate m^3/min | Pressure [Pa] mmHg | Temperature [Ta] °C | Temperature [Tm] °C | Δp_{meter} mmHg | $\Delta p_{Orifice}$ inH ₂ O | Y | Standard Flow [Q_s] m^3/min |
|-------|------------------------|--------------------------|---------------------------|---------------------------|----------------------------|--|-------|--------------------------------------|
| 1 | 0.703 | 758.131 | 23.92 | 22.49 | 56.556 | 1.738 | 1.319 | 0.654 |
| 2 | 1.000 | 758.205 | 23.70 | 22.81 | 63.034 | 3.473 | 1.865 | 0.922 |
| 3 | 1.121 | 758.284 | 23.64 | 22.69 | 42.633 | 4.642 | 2.157 | 1.064 |
| 4 | 1.167 | 758.274 | 23.64 | 22.65 | 31.359 | 5.197 | 2.282 | 1.125 |
| 5 | 1.409 | 758.325 | 24.00 | 23.14 | 30.402 | 7.654 | 2.768 | 1.358 |

Slope (m): 2.05577
 Intercept (b): -0.02807
 Correlation coefficient (r): 0.99985
 Uncertainty ($k=2$): 0.015 m^3/min

Table 2: The results of Q actual calibration data

| Plate | Flow rate m^3/min | Pressure [Pa] mmHg | Temperature [Ta] °C | Temperature [Tm] °C | Δp_{meter} mmHg | $\Delta p_{Orifice}$ inH ₂ O | Y | Standard Flow [Q_s] m^3/min |
|-------|------------------------|--------------------------|---------------------------|---------------------------|----------------------------|--|-------|--------------------------------------|
| 1 | 0.703 | 758.131 | 23.92 | 22.49 | 56.556 | 1.738 | 0.825 | 0.653 |
| 2 | 1.000 | 758.205 | 23.70 | 22.81 | 63.034 | 3.473 | 1.166 | 0.920 |
| 3 | 1.121 | 758.284 | 23.64 | 22.69 | 42.633 | 4.642 | 1.348 | 1.061 |
| 4 | 1.167 | 758.274 | 23.64 | 22.65 | 31.359 | 5.197 | 1.426 | 1.123 |
| 5 | 1.409 | 758.325 | 24.00 | 23.14 | 30.402 | 7.654 | 1.732 | 1.357 |

Slope (m): 1.28763
 Intercept (b): -0.01756
 Correlation coefficient (r): 0.99985
 Uncertainty ($k = 2$): 0.015 m^3/min

End of Certificate of Calibration



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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484

Certificate of Calibration

Certificate No. : 25P112

Page : 1 of 2

Equipment : U-Tube Manometer

Manufacturer: Dwyer

Model : 121-36-W/M

Serial No.:

ID No.: UAE.EFM.181/2561

Condition As-Received: Used Item

Received Date: 10 February 2025

Calibration Date: 19 February 2025

Reference: 2502-0083WSC

Submitted by: United Analyst and Engineering Consultant Co.,Ltd.

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

Atmospheric Pressure: 1012 mbar

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

81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P04, using " DKD-R 6-1 ; Calibration of Pressure Gauges, Edition 03/2014 " as a guidelines.

Condition of this result of calibration

1.Reference standards instruments :

| <u>Instrument</u> | <u>Model</u> | <u>Serial No.</u> | <u>Certificate No.</u> | <u>Due Date</u> |
|------------------------|--------------|-------------------|------------------------|-----------------|
| 1) Pressure Calibrator | PC106P | 1189 | MP-0113-24 | 10 Jul 2025 |

2.This result of calibration was made on requested at the point specified by customer.

3.Scale and conversion factor is 1 kPa = 4.0146293 inH₂O

4.This instrument was used clean air as pressure media.

5.This instrument was installed in vertical orientation and center of connector was used as the reference level.

6.The certificate is valid only to the item calibrated on date and place of calibration.

7.This Certification is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Nopparat Phongam

Issue Date : 21 February 2025

Approved Signatory : Attapol P.

[] Phalinee Prabpaipal

[] Sura Suwannasri

☒ Attapol Panurach

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B 0250406



Cert.No.: 25P112

Page: 2 of 2

Result of calibration:- Without adjustment

Function:- Pressure Measurement

Increasing Pressure

Range : 0 inH₂O to 36 inH₂O

Scale Interval : 0.1 inH₂O (The Fifth Estimate)

| Applied Pressure (inH ₂ O) | UUC Indication | | ΔP (inH ₂ O) | Error (inH ₂ O) |
|--|--|---------------------------------------|------------------------------------|-------------------------------|
| | High-port side (inH ₂ O) | Low-port side (inH ₂ O) | | |
| 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2.00 | 1.00 | -0.98 | 1.98 | -0.02 |
| 4.00 | 2.00 | -1.98 | 3.98 | -0.02 |
| 6.00 | 3.00 | -3.02 | 6.02 | 0.02 |
| 8.00 | 4.00 | -4.02 | 8.02 | 0.02 |
| 10.00 | 5.00 | -5.04 | 10.04 | 0.04 |
| 12.00 | 6.00 | -6.04 | 12.04 | 0.04 |
| 14.00 | 7.00 | -7.06 | 14.06 | 0.06 |
| 16.00 | 8.00 | -8.06 | 16.06 | 0.06 |
| 18.00 | 9.00 | -9.06 | 18.06 | 0.06 |
| 20.00 | 10.00 | -10.06 | 20.06 | 0.06 |
| 22.00 | 11.00 | -11.08 | 22.08 | 0.08 |
| 24.00 | 12.00 | -12.08 | 24.08 | 0.08 |
| 26.00 | 13.02 | -13.10 | 26.12 | 0.12 |
| 28.00 | 14.02 | -14.10 | 28.12 | 0.12 |
| 30.00 | 15.02 | -15.10 | 30.12 | 0.12 |
| 32.00 | 16.02 | -16.10 | 32.12 | 0.12 |
| 34.00 | 17.02 | -17.08 | 34.10 | 0.10 |
| 35.50 | 17.86 | -17.92 | 35.78 | 0.28 |

The uncertainty of measurement was ± 0.11 inH₂O

* UUC = Unit Under Calibration

* ΔP = High-port side - Low-port side

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

-o0o-

Attapol P.

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a 1037943



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NSC-TISI-TIS 17025
CALIBRATION 0367

Flow measurement laboratory
Calibration services department.

CERTIFICATE OF CALIBRATION

Certificate No. : CGF-010-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Volumetric Air Flow Calibrator
MANUFACTURER : BGI Incorporated
MODEL/TYPE : DeltaCal DC1
SERIAL NUMBER : 155895
ID NUMBER : UAE.EFM.076/2560
CONDITION AS-RECEIVED : Used item
CUSTOMER : United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong,
Bangkok 10260

RECEIVED DATE : 07 Oct 2024
MEASUREMENT DATE : 16 Oct 2024
ISSUE DATE : 16 Oct 2024

CONDITION OF THIS RESULT OF CALIBRATION:

- 1.The Unit Under Calibration was preconditioning 24 hours at ambient conditions prior to calibration being performed.
- 2.The Unit Under Calibration was reading under actual conditions.
- 3.Calibration condition:

| | | |
|--------------------------------------|--------------------|-----|
| Flow transmitting medium | : Air | |
| t_{Amb} average during calibration | : (23.9±0.7) | °C |
| H_{Amb} average during calibration | : (49.7±0.2) | %RH |
| P_{Amb} average during calibration | : (1010.40.39±0.6) | hPa |
- 4.The certificate is valid only to the item calibrated on date and place of calibration.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:

The Gas flow meter was calibrated against Standard Gas Flow Meter (Piston Prover) Model ML-800-44. The WI-CL-005 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through NIMT (National Institute of Metrology Thailand) via Certificate number: MW-0046-24.

Uncertainty of Measurement:

The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor $k=2$, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'

Calibrated by:

- ☐ Mr. Sorawit Thachalad
☒ Miss Jittrapon Lertsomphol



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

MEASUREMENT RESULTS:

The Gas flow meter was calibrated by comparison method with the Standard Gas Flow Meter (Piston Prover). The air was used as a medium in the system.

Calibration in the range of : 15 L/min to 18.3 L/min ☒ Without adjustment ☐ With adjustment

The results of calibration and associated measurement uncertainties are reported in the table below.

| Standard Reading | UUC Reading | Error | Uncertainty (k=2) |
|------------------|-------------|-------|-------------------|
| (L/min) | (L/min) | (%) | (%) |
| 15.228 | 15.00 | -1.52 | 0.48 |
| 16.084 | 15.82 | -1.62 | 0.48 |
| 16.943 | 16.67 | -1.64 | 0.48 |
| 17.802 | 17.50 | -1.72 | 0.48 |
| 18.615 | 18.30 | -1.69 | 0.48 |

End of Certificate of Calibration



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Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Temperature measurement laboratory
Calibration services department.



CERTIFICATE OF CALIBRATION

Certificate No. : CDT-179-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Temperature sensor with display
MANUFACTURER : BGI Incorporated
MODEL/TYPE : DeltaCal DC1
SERIAL NUMBER : 155895
ID NUMBER : UAE.EFM.076/2560
CONDITION AS-RECEIVED : Used item
CUSTOMER : United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260

RECEIVED DATE : 07 Oct 2024
MEASUREMENT DATE : 16 Oct 2024
ISSUE DATE : 16 Oct 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH

NOTED: The certificate is valid only to the item calibrated on date and place of calibration.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:

The temperature calibration was done by In-House calibration method as WI-CL-001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS-90.

Traceability:

The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0047-24, Certificate number: ER-0101-23

Reference Used During Calibration:

1. Standard Temperature Probe
Model: STS-100 A500, Serial No.: 667682-09
2. Digital Temperature Indicator
Model: DTI-1000-A MK II, Serial No.: 671407-00591

Uncertainty of Measurement:

The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor $k=2$, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'

Calibrated by:

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



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C to 40 °C

Function:

Table 1: This equipment was connected with Ambient temperature sensor probe (Ta) Model: - S/N: -
Dimension: Diameter 2.0 mm. Length 44.0 mm.

| <u>Immersion Depth</u> (mm) | <u>Standard Reading</u> (°C) | <u>UUC Reading</u> (°C) | <u>Error</u> (°C) | <u>Uncertainty</u> (°C) |
|--------------------------------|---------------------------------|----------------------------|----------------------|----------------------------|
| 40 | 20.033 | 20.0 | 0.0 | 0.099 |
| 40 | 30.014 | 30.1 | 0.1 | 0.099 |
| 40 | 35.008 | 35.1 | 0.1 | 0.099 |
| 40 | 40.000 | 40.2 | 0.2 | 0.099 |
| 40 | 49.997 | 49.9 | -0.1 | 0.099 |

Table 2: This equipment was connected with Filter temperature sensor probe (Tf) Model: - S/N: -
Dimension: Diameter 7.97 mm. Length 102 mm.

| <u>Immersion Depth</u> (mm) | <u>Standard Reading</u> (°C) | <u>UUC Reading</u> (°C) | <u>Error</u> (°C) | <u>Uncertainty</u> (°C) |
|--------------------------------|---------------------------------|----------------------------|----------------------|----------------------------|
| 90 | 20.033 | 20.0 | 0.0 | 0.099 |
| 90 | 30.013 | 30.0 | 0.0 | 0.099 |
| 90 | 35.008 | 35.0 | 0.0 | 0.099 |
| 90 | 40.000 | 40.0 | 0.0 | 0.099 |
| 90 | 49.998 | 49.7 | -0.3 | 0.099 |

UUC*: Unit Under Calibration

End of Certificate of Calibration



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NSC-TISI-TIS 17025
CALIBRATION 0367

Pressure measurement laboratory
Calibration services department.



CERTIFICATE OF CALIBRATION

Certificate No. : CPR-026-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer with display
MANUFACTURER : BGI by Mesa Labs
MODEL/TYPE : DeltaCal DC1
SERIAL NUMBER : 155895
ID NUMBER : UAE.EFM.076/2560
CONDITION AS-RECEIVED : Used item
CUSTOMER : United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260

RECEIVED DATE : 07 Oct 2024
MEASUREMENT DATE : 16 Oct 2024
ISSUE DATE : 16 Oct 2024

Calibration procedure:

The Digital barometer was calibrated against Digital pressure calibrator. The WI-CL-003 was used as a calibration guideline.

Traceability:

The measurement results are traceable to the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MP-0009-24

Uncertainty of Measurement:

The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor $k=2$, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

| Instrument | Model | Serial No. | Certificate No. | Due Date |
|------------------------------|---------|------------|-----------------|-------------|
| Absolute Pressure Transducer | CPG2500 | 4100126P | MP-0009-24 | 27 Dec 2024 |

1. Calibration effort for calibration sequence C

2. The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level.

3. Calibration conditions:

4. Condition : ☒ Normal ☐ Abnormal

Pressure transmitting medium : Air

ρ_{F1} (20°C, 1 bar) : 1.19 kg/m³

H_{amb} : (55±15) %

t_{amb} : (23±3) °C

p_{amb} : (1010±10) mbar

5. The certificate is valid only to the item calibrated on date and place of calibration

Calibrated by:

- ☒ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager



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Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Pressure measurement laboratory
Calibration services department.



CERTIFICATE OF CALIBRATION

Certificate No. : CPR-026-67

Page 2 of 2 Pages

MEASUREMENT RESULTS : ☐ Without adjustment ☒ With adjustment

CALIBRATION IN THE RANGE OF : 740 mmHg to 765 mmHg

The results of calibration and associated measurement uncertainties are reported in the table below.

| STD (mmHg) | UUC* (mmHg) | Error (mmHg) | Uncertainty (k=2) (mmHg) |
|---------------|----------------|-----------------|-----------------------------|
| 740.08 | 739.7 | -0.3 | 0.49 |
| 745.08 | 744.8 | -0.3 | 0.49 |
| 750.07 | 750.0 | -0.1 | 0.44 |
| 755.06 | 755.0 | -0.1 | 0.45 |
| 760.07 | 760.0 | -0.1 | 0.45 |
| 765.06 | 765.0 | -0.1 | 0.45 |

Note: UUC* Unit Under Calibration

: To convert the result in report unit to Pa should be multiply by 133.32

End of certificate



เอกสารไม่ควบคุม



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484



Certificate of Calibration

Certificate No. : 24P1856

Page : 1 of 2

Equipment : Aneroid Barometer
Manufacturer: Barigo
Model : -
Serial No.: -
ID No.: UAE.EMA2.110/2555

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

Condition As-Received: Used Item

Received Date: 24 May 2024

Calibration Date: 04 June 2024

Reference: 2405-0919WSC

Submitted by: United Analyst and Engineering Consultant Co.,Ltd.

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

81 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260

Atmospheric Pressure: 1006 mbar

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P10, using " DKD-R 6-1 ; Calibration of Pressure Gauges, Edition 03/2014 " as a guidelines.

Condition of this result of calibration

1.Reference standards instruments :

| <u>Instrument</u> | <u>Model</u> | <u>Serial No.</u> | <u>Certificate No.</u> | <u>Due Date</u> |
|-----------------------|--------------|-------------------|------------------------|-----------------|
| 1) Standard Barometer | DPI142 | 1422505046 | MP-0094-24 | 03 May 2025 |

2.This instrument was installed in vertical orientation and center of the dial was used as the reference level.

3.This result of calibration was made on requested at the point specified by customer.

4.This result of calibration instrument was in absolute pressure.

5.This instrument was used clean air as pressure media.

6.The certificate is valid only to the item calibrated on date and place of calibration.

7.This Certification is traceable to the International System of Unit maintained through:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suksan Khankaew
Issue Date : 06 June 2024

Approved Signatory :

Attapol P.
[] Phalinee Prabpaipal
[] Sura Suwannasri
✓ [] Attapol Panurach

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B 0316956



Cert.No.: 24P1856

Page: 2 of 2

Result of calibration:- Without adjustment

Range : 720 mmHg to 800 mmHg

Function:- Absolute Pressure Measurement

Scale Interval : 1 mmHg (The Fifth Estimate)

Increasing Pressure

| | | | | | | | | |
|-------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Applied Pressure (mmHg) | 720.43 | 730.67 | 740.34 | 751.52 | 756.56 | 761.83 | 773.53 | 798.76 |
| UUC* Indication (mmHg) | 720.0 | 730.0 | 740.0 | 750.0 | 755.0 | 760.0 | 770.0 | 790.0 |
| Error (mmHg) | -0.43 | -0.67 | -0.34 | -1.52 | -1.56 | -1.83 | -3.53 | -8.76 |

Decreasing Pressure

| | | | | | | | | |
|-------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Applied Pressure (mmHg) | 798.76 | 773.60 | 761.89 | 756.65 | 751.59 | 740.72 | 730.68 | 720.59 |
| UUC* Indication (mmHg) | 790.0 | 770.0 | 760.0 | 755.0 | 750.0 | 740.0 | 730.0 | 720.0 |
| Error (mmHg) | -8.76 | -3.60 | -1.89 | -1.65 | -1.59 | -0.72 | -0.68 | -0.59 |

The uncertainty of measurement was ± 0.24 mmHg

* UUC = Unit Under Calibration

The 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 %.

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Attapol P.

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a 1165502



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484



Certificate of Calibration

Certificate No. : 24H1487

Page : 1 of 2

Equipment : Digital Thermo-Hygrometer
Manufacturer: Digicon
Model : TH-02A
Serial No.: 435031148
ID No.: UAE.EFM.006/2567

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except with the prior written approval of the head of
Corporate Services 3: Equipment Calibration and Testing Services.

Condition As-Received: New Item

Received Date: 10 July 2024

Calibration Date: 15 July 2024
to 17 July 2024

Reference: 2407-0393WSC

Submitted by: United Analyst and Engineering Consultant Co.,Ltd.

Ambient Temperature: (25 \pm 3) °C

Relative Humidity: (50 \pm 20) %

81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260

Procedure used: Calibration were conducted using in-house calibration procedure CP-H03 according to comparison with standard chilled mirror sensor for humidity measurement function and comparison with standard temperature probe for temperature measurement function into humidity / temperature chamber.

Condition of this result of calibration

1.Reference standards instruments :

| <u>Instrument</u> | <u>Model</u> | <u>Serial No.</u> | <u>Certificate No.</u> | <u>Due Date</u> |
|--|--------------|-------------------|------------------------|-----------------|
| 1) Standard Chilled Mirror Hygrometer Sensor | Dew Prime II | 31863 | 21819 | 25 Sep 2024 |
| 2) Handheld Thermometer With Sensor | 1523 | 5717096 | 2311321 | 08 Nov 2024 |

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

3.This Certification is traceable to the International System of Unit maintained through:-

-Thunder Scientific Corporation, NVLAB Accreditation No. Calibration 200582-0

-Technology Promotion Association (Thailand-Japan), NSC-ONSC Accredited No. Calibration 0008

Calibrated by : Surasit Phansudnoi
Issue Date : 17 July 2024

Approved Signatory :

Viporn

[] Chakrit Waewwanjua

[✓] Viporn Tantiyawutti

[] Unnopphol Harachai

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Cert. No.: 24H1487

Page.: 2 of 2

Result of Calibration:- Without Adjustment

Function: Humidity Measurement.

| <u>Reference Temperature</u> (°C) | <u>Standard Humidity</u> (%R.H.) | <u>UUC* Reading</u> (%R.H.) | <u>Error</u> (%R.H.) | <u>Uncertainty of Measurement</u> (±%R.H.) |
|--|---|------------------------------------|-------------------------|---|
| 25.0 | 40.1 | 39 | -1.1 | 1.4 |
| 25.0 | 50.1 | 48 | -2.1 | 1.6 |
| 25.0 | 60.0 | 58 | -2.0 | 1.6 |
| 25.0 | 70.2 | 68 | -2.2 | 1.6 |

Result of Calibration:- Without Adjustment

Function: Temperature Measurement.

| <u>Standard Temperature</u> (°C) | <u>UUC* Reading</u> (°C) | <u>Error</u> (°C) | <u>Uncertainty of Measurement</u> (±°C) |
|---|---------------------------------|----------------------|--|
| 20.014 | 20.3 | 0.286 | 0.42 |
| 24.984 | 25.2 | 0.216 | 0.42 |
| 30.050 | 30.1 | 0.050 | 0.42 |
| 40.027 | 40.0 | -0.027 | 0.42 |

UUC* : Unit Under Calibration

The reported uncertainty of measurement was base on standard uncertainty multiplied by coverage factor $k = 2.00$, providing confidence level approximately 95%.

-oOo-

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MULTI-POINT GAS TEST REPORT

Test Date : Sep 17, 2024

Equipment : Gas Analyzer (NO₂)

Model : 42i

Manufacturer : Thermo Scientific

Serial Number : CM19050149

Standard Gas Concentration

| | |
|------------------------------------|--------------|
| Sulphur Dioxide (SO ₂) | 42.89 |
| Nitric Oxide (NO) | 46.77 |
| Methane (CH ₄) | - |
| Carbon Monoxide (CO) | 965.9 |
| Cylinder No. : | EB0159156 |
| Expiration Date : | Nov 06, 2026 |

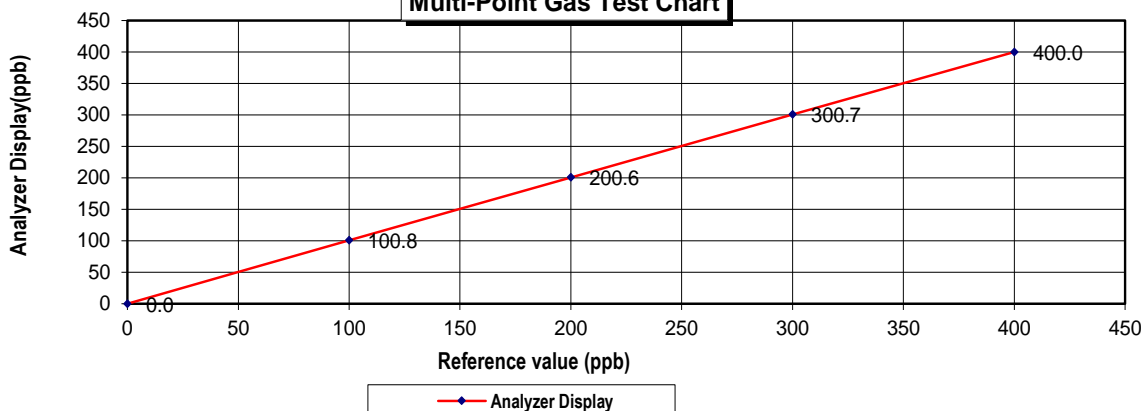
Dilutor Detail

| | |
|-----------------|-------------------|
| Manufacturer : | Thermo Scientific |
| Model : | 146i |
| Serial Number : | 1180540071 |

Multi-point gas test data

| | Reference Value (ppb) | | Analyzer Display (ppb) | Difference Error | Percent Error | [% Error] |
|-----------------------------|-----------------------|-------|------------------------|------------------------|---------------|-----------|
| Level 1 | Zero | 0.0 | 0.0 | 0.00 | 0.00 | 0.00 |
| Level 2 | 20.00% | 100.0 | 100.8 | 0.80 | 0.79 | 0.79 |
| Level 3 | 40.00% | 200.0 | 200.6 | 0.60 | 0.30 | 0.30 |
| Level 4 | 60.00% | 300.0 | 300.7 | 0.70 | 0.23 | 0.23 |
| Level 5 | 80.00% | 400.0 | 400.0 | 0.00 | 0.00 | 0.00 |
| Remark : Measuring Range | | | 500.0 ppb | Average Difference (%) | | 0.27 |
| :Acceptable Limit $\pm 5\%$ | | | | | | |

Multi-Point Gas Test Chart



Calculate by

17 / 9 / 2567

Approve by

17 / Sep / 2024

MULTI-POINT GAS TEST REPORT

Test Date : Sep 20,2024

Equipment : Gas Analyzer (NO₂)

Model : 42i

Manufacturer : Thermo Scientific

Serial Number : CM19050148

Standard Gas Concentration

| | |
|------------------------------------|------------|
| Sulphur Dioxide (SO ₂) | 42.89 |
| Nitric Oxide (NO) | 46.77 |
| Methane (CH ₄) | - |
| Carbon Monoxide (CO) | 965.9 |
| Cylinder No. : | EB0159156 |
| Expiration Date : | Nov 6,2026 |

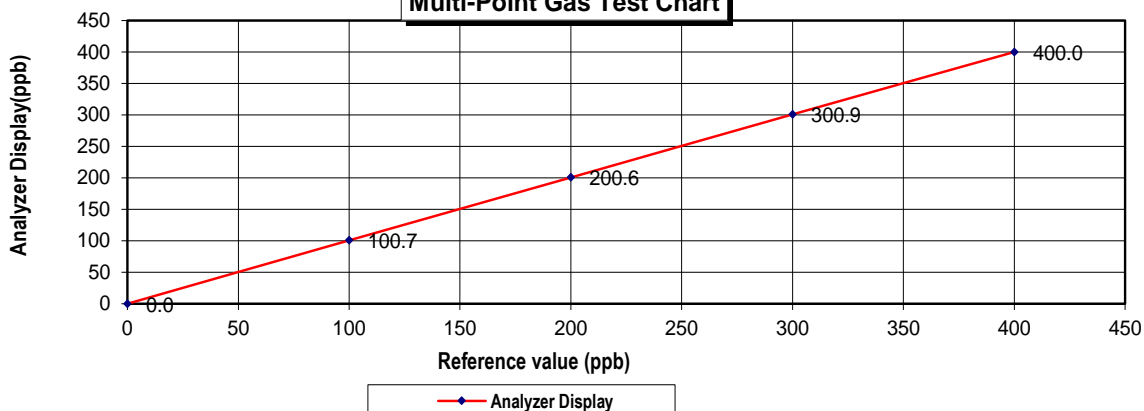
Dilutor Detail

| | |
|-----------------|-------------------|
| Manufacturer : | Thermo Scientific |
| Model : | 146i |
| Serial Number : | 1180540071 |

Multi-point gas test data

| Reference Value (ppb) | | | Analyzer Display (ppb) | Difference Error | Percent Error | [% Error] |
|------------------------------------|--------|-------|------------------------|------------------------|---------------|------------|
| Level 1 | Zero | 0.0 | 0.0 | 0.00 | 0.00 | 0.00 |
| Level 2 | 20.00% | 100.0 | 100.7 | 0.70 | 0.70 | 0.70 |
| Level 3 | 40.00% | 200.0 | 200.6 | 0.60 | 0.30 | 0.30 |
| Level 4 | 60.00% | 300.0 | 300.9 | 0.90 | 0.30 | 0.30 |
| Level 5 | 80.00% | 400.0 | 400.0 | 0.00 | 0.00 | 0.00 |
| Remark : Measuring Range 500.0 ppb | | | | Average Difference (%) | | 0.26 |

Multi-Point Gas Test Chart



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20 / Sep / 2024

MULTI-POINT GAS TEST REPORT

Test Date : Sep 17, 2024

Equipment : Gas Analyzer (NO₂)

Model : 42i

Manufacturer : Thermo Scientific

Serial Number : CM19050150

Standard Gas Concentration

| | |
|------------------------------------|--------------|
| Sulphur Dioxide (SO ₂) | 42.89 |
| Nitric Oxide (NO) | 46.77 |
| Methane (CH ₄) | - |
| Carbon Monoxide (CO) | 965.9 |
| Cylinder No. : | EB0159156 |
| Expiration Date : | Nov 06, 2026 |

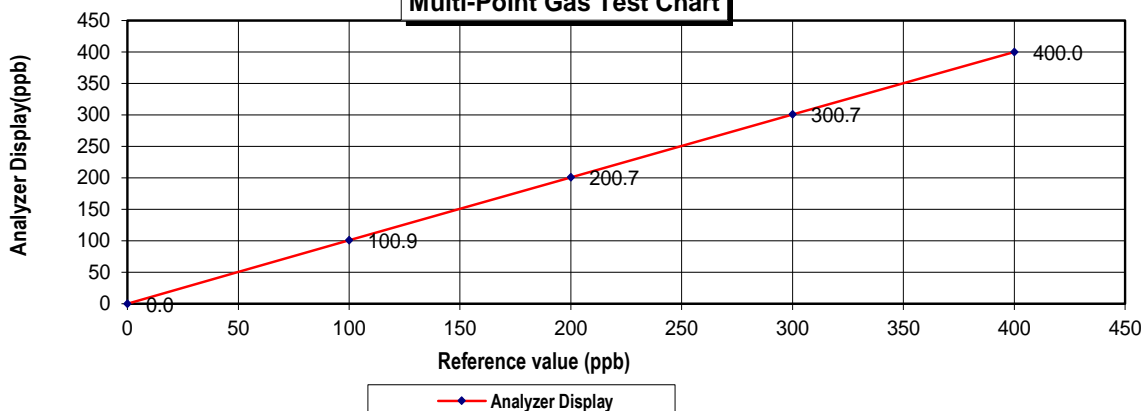
Dilutor Detail

| | |
|-----------------|-------------------|
| Manufacturer : | Thermo Scientific |
| Model : | 146i |
| Serial Number : | 1180540071 |

Multi-point gas test data

| | Reference Value (ppb) | | Analyzer Display (ppb) | Difference Error | Percent Error | [% Error] |
|----------------------------|-----------------------|-------|------------------------|------------------------|---------------|-----------|
| Level 1 | Zero | 0.0 | 0.0 | 0.00 | 0.00 | 0.00 |
| Level 2 | 20.00% | 100.0 | 100.9 | 0.90 | 0.89 | 0.89 |
| Level 3 | 40.00% | 200.0 | 200.7 | 0.70 | 0.35 | 0.35 |
| Level 4 | 60.00% | 300.0 | 300.7 | 0.70 | 0.23 | 0.23 |
| Level 5 | 80.00% | 400.0 | 400.0 | 0.00 | 0.00 | 0.00 |
| Remark : Measuring Range | | | 500.0 ppb | Average Difference (%) | | 0.29 |
| :Acceptable Limit \pm 5% | | | | | | |

Multi-Point Gas Test Chart



Calculate by

Grichai. G

17 / 9 / 2567

Approve by

P. K. K.

17 / Sep / 2024

MULTI-POINT GAS TEST REPORT

Test Date : Sep 26, 2024

Equipment : Gas Analyzer (NO₂)

Model : 42i

Manufacturer : Thermo Scientific

Serial Number : 1201778105

Standard Gas Concentration

| | |
|------------------------------------|-------------|
| Sulphur Dioxide (SO ₂) | 42.89 |
| Nitric Oxide (NO) | 46.77 |
| Methane (CH ₄) | - |
| Carbon Monoxide (CO) | 965.9 |
| Cylinder No. : | EB0159156 |
| Expiration Date : | Nov 6, 2026 |

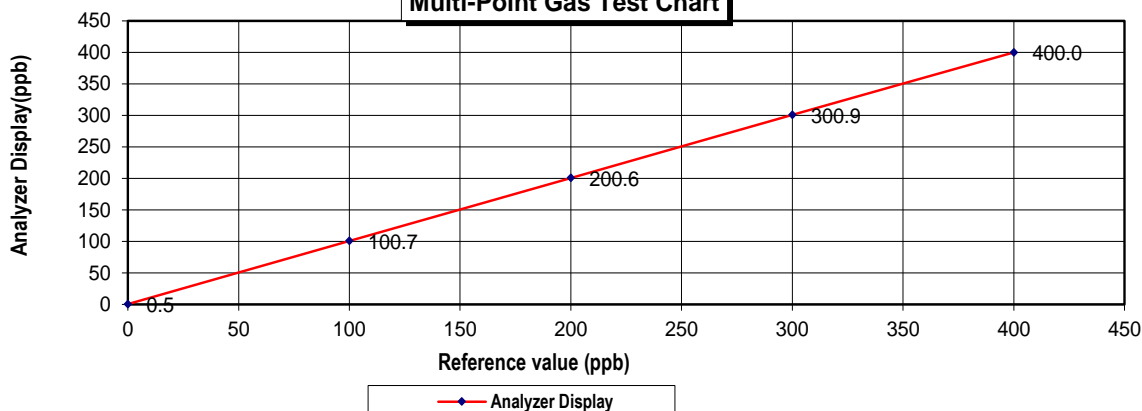
Dilutor Detail

| | |
|-----------------|-------------------|
| Manufacturer : | Thermo Scientific |
| Model : | 146i |
| Serial Number : | 1180540071 |

Multi-point gas test data

| | Reference Value (ppb) | | Analyzer Display (ppb) | Difference Error | Percent Error | [% Error] |
|----------------------------|-----------------------|-------|------------------------|------------------------|---------------|-----------|
| Level 1 | Zero | 0.0 | 0.5 | 0.50 | 0.50 | 0.50 |
| Level 2 | 20.00% | 100.0 | 100.7 | 0.70 | 0.70 | 0.70 |
| Level 3 | 40.00% | 200.0 | 200.6 | 0.60 | 0.30 | 0.30 |
| Level 4 | 60.00% | 300.0 | 300.9 | 0.90 | 0.30 | 0.30 |
| Level 5 | 80.00% | 400.0 | 400.0 | 0.00 | 0.00 | 0.00 |
| Remark : Measuring Range | | | 500.0 ppb | Average Difference (%) | | 0.36 |
| :Acceptable Limit \pm 5% | | | | | | |

Multi-Point Gas Test Chart



Calculate by

Girichai G.
26 / 9 / 2567

Approve by

Pattana K.
26 / Sep / 2024

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND)

LTD

Part Number: E05NI91E15A0014

Cylinder Number: EB0162121

Laboratory: 124 - Plumsteadville - PA

PGVP Number: A12023

Gas Code: CO,CO2,NO,NOX,SO2,BALN

Reference Number: 160-402772205-1

Cylinder Volume: 144.0 CF

Cylinder Pressure: 2016 PSIG

Valve Outlet: 660

Certification Date: Jul 06, 2023

Expiration Date: Jul 06, 2031

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items tested. The report shall not be reproduced except in full without approval of the laboratory. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

| Component | Requested Concentration | Actual Concentration | Protocol Method | Total Relative Uncertainty | Assay Dates |
|-----------------|-------------------------|----------------------|-----------------|----------------------------|------------------------|
| NOX | 100.0 PPM | 100.4 PPM | G1 | +/- 0.9% NIST Traceable | 06/27/2023, 07/06/2023 |
| NITRIC OXIDE | 100.0 PPM | 100.2 PPM | G1 | +/- 0.9% NIST Traceable | 06/27/2023, 07/06/2023 |
| SULFUR DIOXIDE | 100.0 PPM | 100.0 PPM | G1 | +/- 1.4% NIST Traceable | 06/27/2023, 07/06/2023 |
| CARBON MONOXIDE | 200.0 PPM | 199.2 PPM | G1 | +/- 0.3% NIST Traceable | 06/26/2023 |
| CARBON DIOXIDE | 8.000 % | 7.982 % | G1 | +/- 1.2% NIST Traceable | 06/27/2023 |
| NITROGEN | Balance | | | | |

CALIBRATION STANDARDS

| Type | Lot ID | Cylinder No | Concentration | Uncertainty | Expiration Date |
|------|--------------|-------------|-------------------------------------|-------------|-----------------|
| GMIS | 104202308 | CC754364 | 98.36 PPM NITRIC OXIDE/NITROGEN | +/- 0.4% | Jan 04, 2031 |
| PRM | C2219101 | APE1514048 | 100.19 PPM NITRIC OXIDE/NITROGEN | +/- 0.3% | Feb 28, 2025 |
| GMIS | 2023042525 | CC754381 | 98.52 PPM NITRIC OXIDE/NITROGEN | +/- 0.4% | Apr 25, 2031 |
| PRM | 12409 | D913660 | 15.01 PPM NITROGEN DIOXIDE/AIR | +/- 1.5% | Feb 17, 2023 |
| GMIS | 153400202002 | EB0130037 | 9.693 PPM NITROGEN DIOXIDE/NITROGEN | +/- 1.6% | Sep 29, 2025 |
| NTRM | 160102-22 | KAL003820 | 97.69 PPM SULFUR DIOXIDE/NITROGEN | +/- 0.8% | Nov 01, 2027 |
| CO | 230601 | CC745902 | 249.47 PPM CARBON MONOXIDE/NITROGEN | +/- 0.3% | Dec 09, 2028 |
| NTRM | 130606-02 | CC411730 | 13.359 % CARBON DIOXIDE/NITROGEN | +/- 0.6% | May 14, 2025 |

The SRM, NTRM, PRM, or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

| Instrument/Make/Model | Analytical Principle | Last Multipoint Calibration |
|----------------------------------|----------------------|-----------------------------|
| Nicolet iS50 FTIR AUP2010245 CO2 | FTIR | Jun 15, 2023 |
| SIEMENS ULTRAMAT6E N1-C8-180 | NDIR | Jun 14, 2023 |
| Nicolet iS50 FTIR AUP2010245 NO | FTIR | Jun 29, 2023 |
| Nicolet iS50 FTIR AUP2010245 NO2 | FTIR | Jun 15, 2023 |
| Nicolet iS50 FTIR AUP2010245 SO2 | FTIR | Jun 08, 2023 |


Approved for Release

MULTI-POINT GAS TEST REPORT

Test Date : Sep 6, 2024

Equipment : Gas Analyzer (SO₂)

Model : 43i

Manufacturer : Thermo SCIENTIFIC

Serial Number : CM22387061

Standard Gas Concentration

| | |
|------------------------------------|--------------|
| Sulphur Dioxide (SO ₂) | 42.89 |
| Nitric Oxide (NO) | 46.77 |
| Methane (CH ₄) | - |
| Carbon Monoxide (CO) | 965.9 |
| Cylinder No. : | EB01159156 |
| Expiration Date : | Nov 06, 2026 |

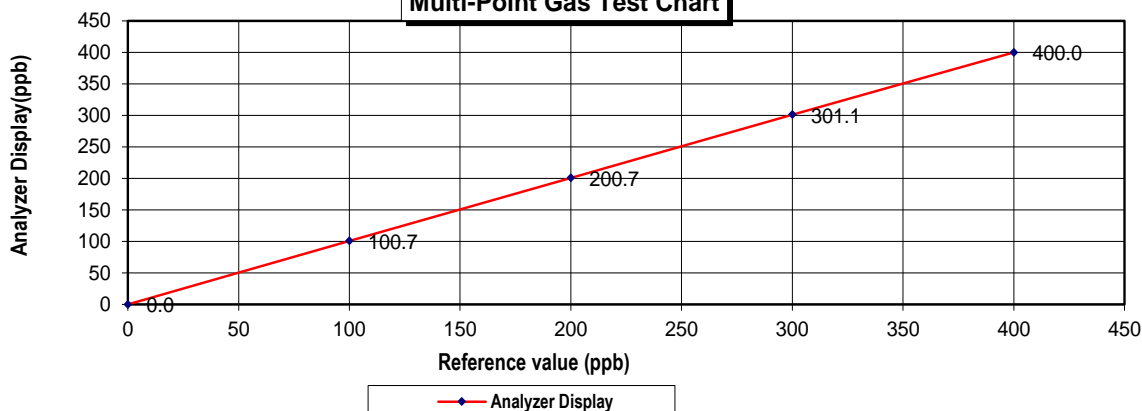
Dilutor Detail

| | |
|-----------------|-------------------|
| Manufacturer : | Thermo SCIENTIFIC |
| Model : | 146i |
| Serial Number : | 1180540071 |

Multi-point gas test data

| Reference Value (ppb) | | | Analyzer Display (ppb) | Difference Error | Percent Error | [% Error] |
|--------------------------|--------|-------|------------------------|------------------------|---------------|------------|
| Level 1 | Zero | 0.0 | 0.0 | 0.00 | 0.00 | 0.00 |
| Level 2 | 20.00% | 100.0 | 100.7 | 0.70 | 0.70 | 0.70 |
| Level 3 | 40.00% | 200.0 | 200.7 | 0.70 | 0.35 | 0.35 |
| Level 4 | 60.00% | 300.0 | 301.1 | 1.10 | 0.37 | 0.37 |
| Level 5 | 80.00% | 400.0 | 400.0 | 0.00 | 0.00 | 0.00 |
| Remark : Measuring Range | | | 500.0 ppb | Average Difference (%) | | 0.28 |

Multi-Point Gas Test Chart



Calculate by

6 / 9 / 2567

Approve by

6 / Sep / 2024

MULTI-POINT GAS TEST REPORT

Test Date : June 19, 2024

Equipment : Gas Analyzer (SO₂)

Model : 43i

Manufacturer : Thermo SCIENTIFIC

Serial Number : CM22387063

Standard Gas Concentration

| | |
|------------------------------------|--------------|
| Sulphur Dioxide (SO ₂) | 42.89 |
| Nitric Oxide (NO) | 46.77 |
| Methane (CH ₄) | - |
| Carbon Monoxide (CO) | 965.9 |
| Cylinder No. : | EB0159156 |
| Expiration Date : | Nov 06, 2026 |

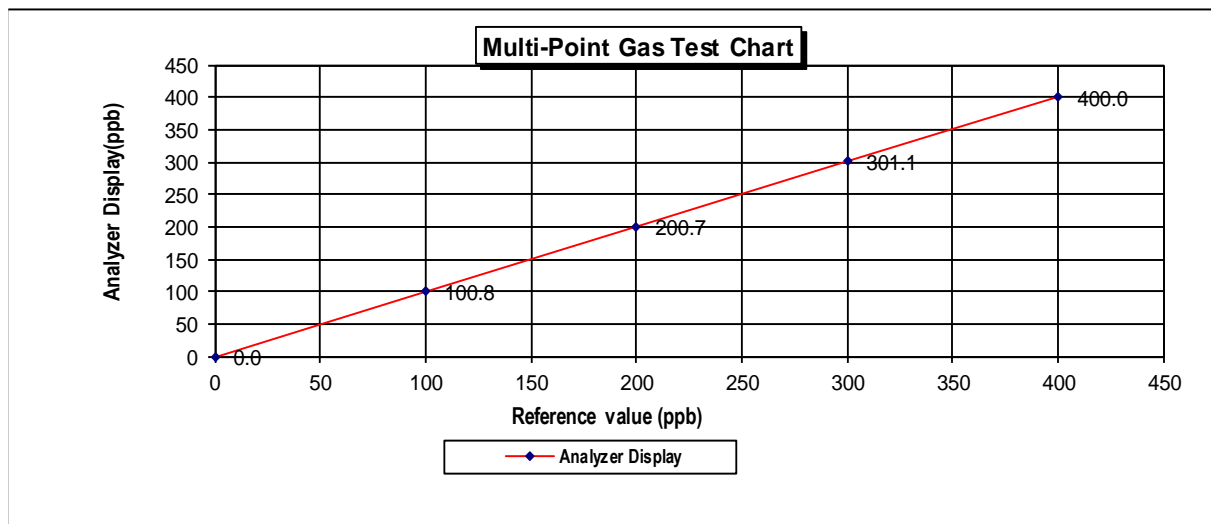
Dilutor Detail

| | |
|-----------------|-------------------|
| Manufacturer : | Thermo SCIENTIFIC |
| Model : | 146i |
| Serial Number : | 1180540071 |

Multi-point gas test data

| | Reference Value (ppb) | | Analyzer Display (ppb) | Difference Error | Percent Error | [% Error] |
|------------------------------------|-----------------------|-------|------------------------|------------------------|---------------|------------|
| Level 1 | Zero | 0.0 | 0.0 | 0.00 | 0.00 | 0.00 |
| Level 2 | 20.00% | 100.0 | 100.8 | 0.80 | 0.79 | 0.79 |
| Level 3 | 40.00% | 200.0 | 200.7 | 0.70 | 0.35 | 0.35 |
| Level 4 | 60.00% | 300.0 | 301.1 | 1.10 | 0.37 | 0.37 |
| Level 5 | 80.00% | 400.0 | 400.0 | 0.00 | 0.00 | 0.00 |
| Remark : Measuring Range 500.0 ppb | | | | Average Difference (%) | | 0.30 |

:Acceptable Limit $\pm 5\%$



Calculate by

Sirichai S.

19 / 06 / 2567

Approve by

Pattana A.

19 / June / 2024

MULTI-POINT GAS TEST REPORT

Test Date : Sep 6, 2024

Equipment : Gas Analyzer (SO₂)

Model : 43i

Manufacturer : Thermo SCIENTIFIC

Serial Number : CM22387065

Standard Gas Concentration

| | |
|------------------------------------|--------------|
| Sulphur Dioxide (SO ₂) | 42.89 |
| Nitric Oxide (NO) | 46.77 |
| Methane (CH ₄) | - |
| Carbon Monoxide (CO) | 965.9 |
| Cylinder No. : | EB01159156 |
| Expiration Date : | Nov 06, 2026 |

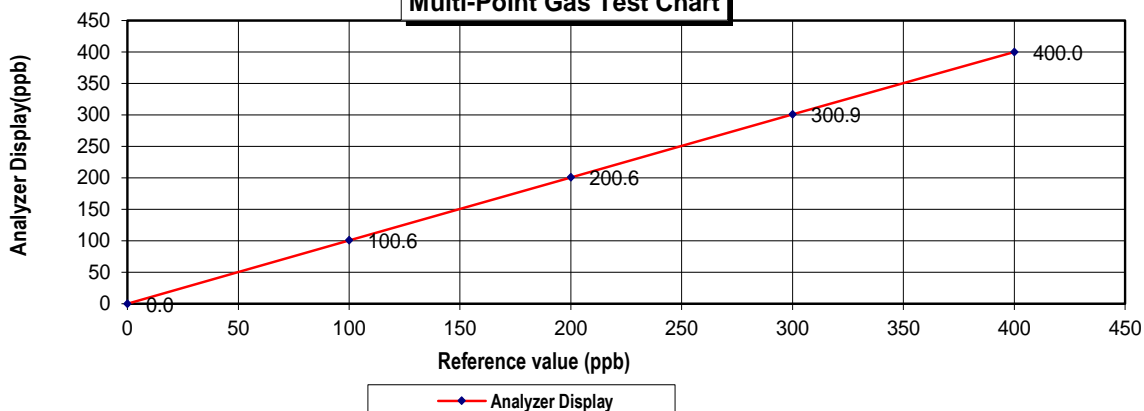
Dilutor Detail

| | |
|-----------------|-------------------|
| Manufacturer : | Thermo SCIENTIFIC |
| Model : | 146i |
| Serial Number : | 1180540071 |

Multi-point gas test data

| Reference Value (ppb) | | | Analyzer Display (ppb) | Difference Error | Percent Error | [% Error] |
|------------------------------------|--------|-------|------------------------|------------------------|---------------|------------|
| Level 1 | Zero | 0.0 | 0.0 | 0.00 | 0.00 | 0.00 |
| Level 2 | 20.00% | 100.0 | 100.6 | 0.60 | 0.60 | 0.60 |
| Level 3 | 40.00% | 200.0 | 200.6 | 0.60 | 0.30 | 0.30 |
| Level 4 | 60.00% | 300.0 | 300.9 | 0.90 | 0.30 | 0.30 |
| Level 5 | 80.00% | 400.0 | 400.0 | 0.00 | 0.00 | 0.00 |
| Remark : Measuring Range 500.0 ppb | | | | Average Difference (%) | | 0.24 |

Multi-Point Gas Test Chart



Calculate by

Grichai. G
.....
6 / 9 / 2567

Approve by

Petkom A.
.....
6 / Sep / 2024

MULTI-POINT GAS TEST REPORT

Test Date : Sep 4, 2024

Equipment : Gas Analyzer (SO₂)

Model : 43i

Manufacturer : Thermo SCIENTIFIC

Serial Number : 1182920014

Standard Gas Concentration

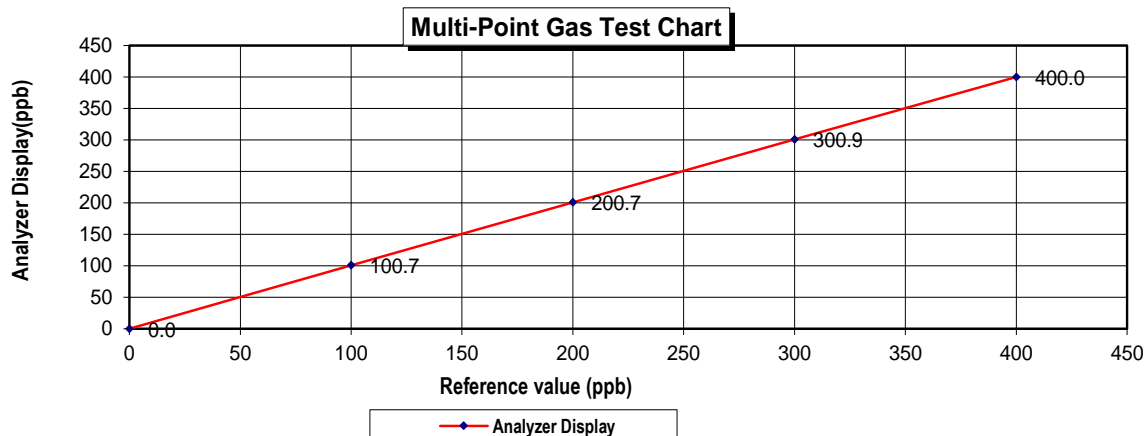
| | |
|------------------------------------|--------------|
| Sulphur Dioxide (SO ₂) | 42.89 |
| Nitric Oxide (NO) | 46.77 |
| Methane (CH ₄) | - |
| Carbon Monoxide (CO) | 965.9 |
| Cylinder No. : | EB01159156 |
| Expiration Date : | Nov 06, 2026 |

Dilutor Detail

| | |
|-----------------|-------------------|
| Manufacturer : | Thermo SCIENTIFIC |
| Model : | 146i |
| Serial Number : | 1180540071 |

Multi-point gas test data

| | Reference Value (ppb) | | Analyzer Display (ppb) | Difference Error | Percent Error | [% Error] |
|-----------------------------|-----------------------|-------|------------------------|------------------------|---------------|-----------|
| Level 1 | Zero | 0.0 | 0.0 | 0.00 | 0.00 | 0.00 |
| Level 2 | 20.00% | 100.0 | 100.7 | 0.70 | 0.70 | 0.70 |
| Level 3 | 40.00% | 200.0 | 200.7 | 0.70 | 0.35 | 0.35 |
| Level 4 | 60.00% | 300.0 | 300.9 | 0.90 | 0.30 | 0.30 |
| Level 5 | 80.00% | 400.0 | 400.0 | 0.00 | 0.00 | 0.00 |
| Remark : Measuring Range | | | 500.0 ppb | Average Difference (%) | | 0.27 |
| :Acceptable Limit $\pm 5\%$ | | | | | | |



Calculate by

4 / 9 / 2567

Approve by

4 / Sep / 2024

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CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: AIR LIQUIDE (THAILAND)

LTD

Part Number: E05NI91E15A0014

Cylinder Number: EB0162121

Laboratory: 124 - Plumsteadville - PA

PGVP Number: A12023

Gas Code: CO,CO2,NO,NOX,SO2,BALN

Reference Number: 160-402772205-1

Cylinder Volume: 144.0 CF

Cylinder Pressure: 2016 PSIG

Valve Outlet: 660

Certification Date: Jul 06, 2023

Expiration Date: Jul 06, 2031

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items tested. The report shall not be reproduced except in full without approval of the laboratory. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

| Component | Requested Concentration | Actual Concentration | Protocol Method | Total Relative Uncertainty | Assay Dates |
|-----------------|-------------------------|----------------------|-----------------|----------------------------|------------------------|
| NOX | 100.0 PPM | 100.4 PPM | G1 | +/- 0.9% NIST Traceable | 06/27/2023, 07/06/2023 |
| NITRIC OXIDE | 100.0 PPM | 100.2 PPM | G1 | +/- 0.9% NIST Traceable | 06/27/2023, 07/06/2023 |
| SULFUR DIOXIDE | 100.0 PPM | 100.0 PPM | G1 | +/- 1.4% NIST Traceable | 06/27/2023, 07/06/2023 |
| CARBON MONOXIDE | 200.0 PPM | 199.2 PPM | G1 | +/- 0.3% NIST Traceable | 06/26/2023 |
| CARBON DIOXIDE | 8.000 % | 7.982 % | G1 | +/- 1.2% NIST Traceable | 06/27/2023 |
| NITROGEN | Balance | | | | |

CALIBRATION STANDARDS

| Type | Lot ID | Cylinder No | Concentration | Uncertainty | Expiration Date |
|------|--------------|-------------|-------------------------------------|-------------|-----------------|
| GMIS | 104202308 | CC754364 | 98.36 PPM NITRIC OXIDE/NITROGEN | +/- 0.4% | Jan 04, 2031 |
| PRM | C2219101 | APE1514048 | 100.19 PPM NITRIC OXIDE/NITROGEN | +/- 0.3% | Feb 28, 2025 |
| GMIS | 2023042525 | CC754381 | 98.52 PPM NITRIC OXIDE/NITROGEN | +/- 0.4% | Apr 25, 2031 |
| PRM | 12409 | D913660 | 15.01 PPM NITROGEN DIOXIDE/AIR | +/- 1.5% | Feb 17, 2023 |
| GMIS | 153400202002 | EB0130037 | 9.693 PPM NITROGEN DIOXIDE/NITROGEN | +/- 1.6% | Sep 29, 2025 |
| NTRM | 160102-22 | KAL003820 | 97.69 PPM SULFUR DIOXIDE/NITROGEN | +/- 0.8% | Nov 01, 2027 |
| CO | 230601 | CC745902 | 249.47 PPM CARBON MONOXIDE/NITROGEN | +/- 0.3% | Dec 09, 2028 |
| NTRM | 130606-02 | CC411730 | 13.359 % CARBON DIOXIDE/NITROGEN | +/- 0.6% | May 14, 2025 |

The SRM, NTRM, PRM, or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

| Instrument/Make/Model | Analytical Principle | Last Multipoint Calibration |
|----------------------------------|----------------------|-----------------------------|
| Nicolet iS50 FTIR AUP2010245 CO2 | FTIR | Jun 15, 2023 |
| SIEMENS ULTRAMAT6E N1-C8-180 | NDIR | Jun 14, 2023 |
| Nicolet iS50 FTIR AUP2010245 NO | FTIR | Jun 29, 2023 |
| Nicolet iS50 FTIR AUP2010245 NO2 | FTIR | Jun 15, 2023 |
| Nicolet iS50 FTIR AUP2010245 SO2 | FTIR | Jun 08, 2023 |


Approved for Release



THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-0469

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 3 January, 2025

Certification No. 001/25

Page : 1 of 5

Object : Wind Speed & Wind Direction Data Logger

Manufacturer : SCARLET/TECH

Type : WL-21

Mfg Code : Wireless Receiver 2111DR0072

Wind Sensor 2111DR0072

Customer : United Analyst and Engineering Consultant Co.,Ltd.

81 Soi Udomsuk 41, Sukhumvit Road,

Bangchak, Prakanong, Bangkok 10260.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1012.1 hPa

NATIONAL STANDARD WIND TUNNEL : Wind Aloft Plotting Board

: Micromanometer Theodor Friedrichs FC014 Serial No. 9310119 : HOOK GAGE NO 1425

N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec

STANDARD THERMOMETER : Theodor Friedrich : Dry No.8390/94 Wet No. 8389/94

: testo, testo 645 Serial No. 02848057 : Thermoschneider No.918802

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. V1220015

: Digital Barometer Vaisala Type PTB330 No. K4320001

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

Signed :

Mr. Pisood Promsut



เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804,0-2399-0469

The Result of Calibration

Certification No. 001/25

3 January, 2025

Page : 2 of 5

| Standard Ultrasonic Anemometer | HOOK GAGE NO. 1425 | | | TESTED ANEMOMETER | |
|-----------------------------------|------------------------|----------------------|-------------------|-------------------|---------------------|
| | Pressure inches H2O | Vacumm inches H2O | Velocity m/sec | Velocity m/sec | Correction m/sec |
| 1.00 | - | - | - | 1.0 | 0.00 |
| 3.02 | - | - | - | 3.0 | 0.02 |
| 5.00 | - | - | - | 5.0 | 0.00 |
| 7.04 | - | - | - | 7.0 | 0.04 |
| 9.02 | - | - | - | 9.0 | 0.02 |
| 11.02 | - | - | - | 11.0 | 0.02 |
| 13.01 | - | - | - | 13.0 | 0.01 |
| 15.01 | - | - | - | 15.0 | 0.01 |
| 17.02 | - | - | - | 17.1 | -0.08 |
| 20.02 | - | - | - | 20.1 | -0.08 |

| | |
|------------------------------------|-----------------------|
| Vane Angel Bench Stand Model 18112 | |
| Young Meteorological Instruments | |
| WIND DIRETION | TESTED WIND DIRECTION |
| 0 | 0 |
| 90 | 90 |
| 180 | 180 |
| 270 | 270 |

Calibrated by :

Watcharapol

Mr. Watcharapol Subwat

Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau



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THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-0469

The Result of Calibration

Certification No. 001/25

3 January, 2025

Page : 3 of 5

| Standard Barometer | Tested Barometer | Correction |
|--------------------|------------------|------------|
| Pressure | Pressure | mbar |
| 1012.05 | 1012 | 0.05 |
| 1011.25 | 1011 | 0.25 |
| 1012.92 | 1013 | -0.08 |
| 1010.09 | 1010 | 0.09 |
| 1008.87 | 1009 | -0.13 |
| 1010.43 | 1010 | 0.43 |
| 1011.39 | 1011 | 0.39 |
| 1011.05 | 1011 | 0.05 |
| 1010.72 | 1011 | -0.28 |
| 1010.30 | 1010 | 0.30 |
| 1009.81 | 1010 | -0.19 |
| 1008.93 | 1009 | -0.07 |
| 1009.35 | 1009 | 0.35 |
| 1009.89 | 1010 | -0.11 |
| 1010.57 | 1011 | -0.43 |
| 1011.41 | 1011 | 0.41 |
| 1012.31 | 1012 | 0.31 |
| 1009.75 | 1010 | -0.25 |
| 1010.67 | 1011 | -0.33 |
| 1011.01 | 1011 | 0.01 |

Average

0.04

Calibrated by :

Watchapol

Mr. Watchapol Subwat

Mechanical Engineer



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THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-0469

The Result of Calibration

Certification No. 001/25

3 January, 2025

Page : 4 of 5

| Standard Barometer | Tested Barometer | Correction |
|--------------------|------------------|------------|
| Pressure | Pressure | mmHg |
| 759.10 | 759 | 0.10 |
| 758.50 | 759 | -0.50 |
| 759.75 | 760 | -0.25 |
| 757.63 | 758 | -0.37 |
| 756.71 | 757 | -0.29 |
| 757.88 | 758 | -0.12 |
| 758.60 | 759 | -0.40 |
| 758.35 | 758 | 0.35 |
| 758.10 | 758 | 0.10 |
| 757.79 | 758 | -0.21 |
| 757.42 | 757 | 0.42 |
| 756.76 | 757 | -0.24 |
| 757.07 | 757 | 0.07 |
| 757.48 | 757 | 0.48 |
| 757.99 | 758 | -0.01 |
| 758.62 | 759 | -0.38 |
| 759.29 | 759 | 0.29 |
| 757.37 | 757 | 0.37 |
| 758.06 | 758 | 0.06 |
| 758.32 | 758 | 0.32 |

Average

-0.01

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau



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THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804,0-2399-0469

The Result of Calibration

Certification No. 001/25

3 January, 2025

Page : 5 of 5

| Standard Temp. °C | Temperature Sensor Reading | |
|-------------------------|----------------------------|------------|
| | Reading | Correction |
| | °C | °C |
| 45.5 | 45 | 0.5 |
| 30.4 | 30 | 0.4 |
| 15.6 | 16 | -0.4 |

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer



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Certificate of Calibration

Customer

Name : UNITED ANALYST AND ENGINEERING
CONSULTANT CO.,LTD.
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Prakanong, Bangkok 10260

Certificate No : 24-ACT-087

Request No : Req-2024-1365

Unit Under Calibration Details

Measurement item : Acoustic Calibrator Class : 1
Manufacturer : 01dB Range : 94 dB / 1000 Hz
Model : CAL31 Instrument Status : Used
Serial Number : 84065
ID : UAE.EFM.167/2561

Calibration Environment and Details


Temperature : (23 ±2 °C)
Humidity : (50 ± 20 %RH)
Barometric Pressure : (1013 ±10.0 hPa)
Received Date : 20 June 2024
Calibration Date : 25 June 2024
Location of Calibration : LAB 1 Acoustic
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators


| Reference Standard | Model | Serial Number | Traceable | Due Calibration |
|--------------------|--------|---------------|-----------|-----------------|
| Sound Calibrator | SV 35A | 58079 | EEL | 12 June 2025 |
| THD Multimeter | 2015 | 1047765 | NIMT | 16 January 2025 |

Traceability : This certificate provides traceability of measurement to recognized national standard, and to the realization of the international System of Units (SI).

Note

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor $k=2$, providing a level of confidence approximately 95 %.

Calibrated By : 
Mr. Noppadon Luangart
Service Calibration Engineer

Approved By : 
Mr. Pacit Mathavorn
Calibration Engineer Supervisor

Issue Date : 25 June 2024

Certificate No : 24-ACT-087

Request No : Req-2024-1365

Sound pressure level

Calibration Results : Without Adjustment

| Calibration Range (dB) | Without Adjustment (dB) | | Adjustment (dB) | | Uncertainty (± dB) | Acceptance limit Class 1 (± dB) | Result |
|---------------------------|-------------------------|----------------|-----------------|----------------|------------------------|-------------------------------------|--------|
| | Measured | Deviated value | Measured | Deviated value | | | |
| 94 dB / 1000 Hz | 93.78 | -0.22 | - | - | 0.13 | 0.25 | Pass |

Frequency of Sound pressure level

| Calibration Range (Hz) | Without Adjustment | | Adjustment | | Uncertainty (± %) | Acceptance limit Class 1 (± %) | Result |
|---------------------------|--------------------|----------|---------------|----------|-----------------------|------------------------------------|--------|
| | Measured (Hz) | Deviated | Measured (Hz) | Deviated | | | |
| 94 dB / 1000 Hz | 1000.00 | 0.00 | - | - | 0.01 | 0.70 | Pass |

Total Harmonic Distortion plus Noise of Sound pressure level (THD+N %)

| Calibration Range (Hz) | Without Adjustment | Adjustment | Uncertainty (± %) | Acceptance limit Class 1 (± %) | Result |
|---------------------------|--------------------|--------------|-----------------------|------------------------------------|--------|
| | Measured (%) | Measured (%) | | | |
| 94 dB / 1000 Hz | 0.14 | - | 0.40 | 2.5 | Pass |

Note :

| Function | Maximum-permitted Uncertainty of measurement |
|------------------------|---|
| Sound pressure level | 0.15 dB |
| Frequency | 0.20% |
| Total distortion+noise | 0.50% |

- Acceptance limit was IEC60942:2017 Class 1

- The calibration results exclude the calibrator pressure correction

- The calibration results exclude the microphone volume correction

Certificate No : 24-ACT-087

Request No : Req-2024-1365

Decision Rule for Statements of Conformity

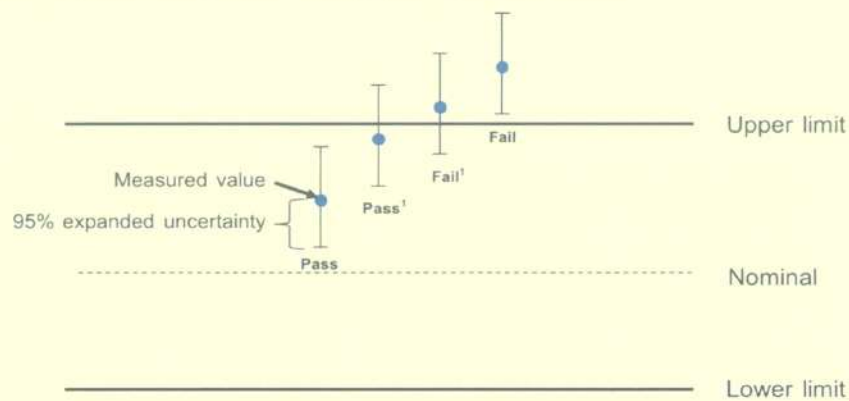
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09/2019: Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

Pass = The measurement result plus the expanded uncertainty with a 95% coverage probability were within the limit.

Pass¹ = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail¹ = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

Fail = The measurement result plus the expanded uncertainty with a 95% coverage probability were outside the limit.



End of Calibration

Certificate No.: CP20240287EA

Operation No.: CP2024070250

Certificate of Calibration

Equipment: Sound Level Meter

Manufacturer: Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)

Model/Type: LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)

Serial No.: 0007309 (Meter), 345239 (Microphone), 077644 (Preamplifier)

ID No.: UAE.EFM.041/2566

Customer: United Analyst and Engineering Consultant Co.,Ltd.

Address: 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak
Phrakhanong, Bangkok 10260

Received Date: 25 July 2024

Calibrated Date: 2 - 5 August 2024

Issued Date: 7 August 2024

Calibrated by: Ms. Juntaporn Kunhakom

Approved by: _____

(Mr. Sittichai Swaksuriyawong)

Group Manager

This report was prepared electronically using applicable electronic signature. Printing or copy of file are considered as a copy of the document.

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor (k) providing a level of confidence of approximately 95%. This certificate may not be reproduced other than in full except with the prior written approval of the Electrical and Electronics Institute, Foundation for Industrial Development.

Certificate No.: CP20240287EA

Calibration Report

Equipment: Sound Level Meter
Manufacturer: Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)
Model/Type: LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)
Serial No.: 0007309 (Meter), 345239 (Microphone), 077644 (Preamplifier)
ID No.: UAE.EFM.041/2566
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Pressure: (101.3 ± 1.5) kPa
Method of Calibration :-
IEC 61672-3:2013.

Condition of this result of calibration

1. Reference standards instrument :-

| | Instrument | Model | Serial No. | Cert. No. | Due Date |
|----|---|---------|------------|------------------------------|---------------------------------------|
| 1) | Standard microphone | 4180 | 2787490 | AA-1012-23 | 12 November 2024 |
| 2) | Arbitrary Function Generator | AFG2021 | C010063 | CK20240048EA | 23 June 2025 |
| 3) | Programmable Attenuator | PA5 | 2755 | EF-0040-23 | 1 October 2024 |
| 4) | 6.5 Digit precision multimeter | 8846A | 9610014 | CB20230200EA | 15 November 2024 |
| 5) | Pressure humidity and Temperature Transmitter | PTU301 | L3950483 | CL1-P240023 CD20240142EA | 24 March 2025 12 June 2025 |
| 6) | Pressure humidity and Temperature Transmitter | PTU301 | L3950484 | CL1-P240030 CD20240143EA | 11 April 2025 12 June 2025 |
| 7) | Performance Audio Analyzer | U8903B | MY56510003 | CB20240035EB CK20230072EA | 13 February 2025 13 September 2024 |

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

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

Reference standards instrument for Acoustic function

- National Institute of Metrology (Thailand)

Reference standards instrument for Electrical function

- National Institute of Metrology (Thailand)

- Electrical and Electronics Institute; NSC Accredited Calibration No.0119

Result of Calibration:-

Function : 1. Indication at the calibration check frequency

| Reference Acoustic Signal (dB) | Measured value (dB) | Deviation (dB) | Acceptance limits (dB) |
|-----------------------------------|------------------------|-------------------|---------------------------|
| - | - | - | - |

Certificate No.: CP20240287EA

Calibration Report

Function : 2. Self-generated Noise

2.1 Microphone Installed

| Measured value (dB) |
|------------------------|
| 30.5 |

2.2 Microphone replaced by the electrical input signal device

| Frequency Weighting | Measured value (dB) |
|------------------------|------------------------|
| A-weighting | 29.5 |
| C-weighting | 29.5 |
| Z-weighting | 35.5 |

Function : 3. Acoustical signal tests of frequency weightings (Without Windscreen)

Meter free-field acoustic response at a level of 84 dB.

| Frequency (Hz) | Deviation from various Frequency Weighting Response Curve | | | |
|-------------------|---|---------------------|---------------------|---------------------------|
| | C-Weighting (dB) | A-Weighting (dB) | Z-Weighting (dB) | Acceptance limits (dB) |
| 125 | 0.4 | 0.3 | 0.4 | ±1.0 |
| 1000 | 0.1 | 0.1 | 0.1 | ±0.7 |
| 8000 | -1.6 | -1.6 | -1.6 | +1.5; -2.5 |

Function : 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various Frequency Weighting Response Curve | | | |
|-------------------|---|---------------------|---------------------|---------------------------|
| | C-Weighting (dB) | A-Weighting (dB) | Z-Weighting (dB) | Acceptance limits (dB) |
| 63 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 125 | 0.0 | 0.0 | -0.1 | ±1.0 |
| 250 | 0.0 | 0.0 | -0.1 | ±1.0 |
| 500 | 0.0 | 0.0 | -0.1 | ±1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ±0.7 |
| 2000 | 0.0 | 0.0 | -0.1 | ±1.0 |
| 4000 | 0.0 | 0.0 | -0.1 | ±1.0 |
| 8000 | -0.1 | -0.1 | 0.0 | +1.5; -2.5 |
| 16000 | 0.0 | 0.0 | -0.1 | +2.5; -16.0 |

Certificate No.: CP20240287EA

Calibration Report

Function : 5. Frequency and time weighting at 1 kHz

5.1 Frequency weighting at 1 kHz

| Frequency Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---------------------|---------------------|---------------------|------------------------|
| C-weighting | 94.0 | 0.0 | ±0.2 |
| A-weighting | 94.0 | 0.0 | ±0.2 |
| Z-weighting | 94.0 | 0.0 | ±0.2 |

5.2 Time weighting at 1 kHz

| Time Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|----------------|---------------------|---------------------|------------------------|
| Fast | 94.0 | 0.0 | ±0.1 |
| Slow | 94.0 | 0.0 | ±0.1 |
| LAeq | 94.0 | 0.0 | ±0.1 |

Function : 6. Long-Term Stability

Long-term stability over 30 minutes, with steady 1 kHz signal at reference level.

| Time Period to Apply Signal (min) | Reference SPL (dB) | Record SPL at Conclusion of Time Period (dB) | Deviated value (dB) | Acceptance limits (dB) |
|-----------------------------------|--------------------|--|---------------------|------------------------|
| 30 | 94.0 | 94.0 | 0.0 | ±0.1 |

Function : 7. Level Linearity on the reference level range

7.1 Level Linearity on the reference level range, Upper

| Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|------------------------|---------------------|---------------------|------------------------|
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 99.0 | 99.0 | 0.0 | ±0.8 |
| 104.0 | 104.0 | 0.0 | ±0.8 |
| 109.0 | 109.0 | 0.0 | ±0.8 |
| 114.0 | 114.0 | 0.0 | ±0.8 |
| 119.0 | 119.0 | 0.0 | ±0.8 |
| 124.0 | 124.0 | 0.0 | ±0.8 |
| 129.0 | 129.0 | 0.0 | ±0.8 |
| 134.0 | 134.0 | 0.0 | ±0.8 |
| 139.0 | 139.0 | 0.0 | ±0.8 |
| 140.0 | 140.0 | 0.0 | ±0.8 |

Certificate No.: CP20240287EA

Calibration Report

7.2 Level Linearity on the reference level range, Lower

| Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|------------------------|---------------------|---------------------|------------------------|
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 89.0 | 89.0 | 0.0 | ±0.8 |
| 84.0 | 84.0 | 0.0 | ±0.8 |
| 79.0 | 79.0 | 0.0 | ±0.8 |
| 74.0 | 74.0 | 0.0 | ±0.8 |
| 69.0 | 69.0 | 0.0 | ±0.8 |
| 64.0 | 64.0 | 0.0 | ±0.8 |
| 59.0 | 59.0 | 0.0 | ±0.8 |
| 54.0 | 54.0 | 0.0 | ±0.8 |
| 49.0 | 49.0 | 0.0 | ±0.8 |
| 44.0 | 44.1 | 0.1 | ±0.8 |
| 39.0 | 39.4 | 0.4 | ±0.8 |

Function : 8. Tone burst response

| Time Weighting | Tone burst duration, Tb (ms) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|----------------|------------------------------|---------------------|---------------------|------------------------|
| Fast | 200 | 136.0 | 0.0 | ±0.5 |
| | 2 | 118.9 | -0.1 | +1.0 ; -1.5 |
| | 0.25 | 109.8 | -0.2 | +1.0 ; -3.0 |
| Slow | 200 | 129.5 | -0.1 | ±0.5 |
| | 2 | 109.9 | -0.1 | +1.0 ; -3.0 |
| | 0.25 | 101.0 | 0.0 | +1.0 ; -3.0 |
| LAE | 200 | 130.0 | 0.0 | ±0.5 |
| | 2 | 110.1 | 0.1 | +1.0 ; -1.5 |
| | 0.25 | 101.0 | 0.0 | +1.0 ; -3.0 |

Function : 9. Peak C sound level

| Number of cycles in test signal | Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---------------------------------|------------------------|---------------------|---------------------|------------------------|
| Complete cycle | 135.4 | 134.8 | -0.6 | ±2.0 |
| Positive half cycle | 134.4 | 134.0 | -0.4 | ±1.0 |
| Negative half cycle | 134.4 | 134.0 | -0.4 | ±1.0 |

Certificate No.: CP20240287EA

Calibration Report

Function : 10. Overload indication

| Measured value (dB) | | Deviated value (dB) | Acceptance limits (dB) |
|----------------------------|----------------------------|------------------------|---------------------------|
| Positive one-half cycle | Negative one-half cycle | | |
| 144.3 | 144.2 | -0.1 | ±1.5 |

Function : 11. High-Level Stability

High-level stability over 5 minutes, with steady 1 kHz signal, 1 dB below upper boundary.

| Time Period to Apply Signal (min) | Reference SPL (dB) | Record SPL at Conclusion of Time Period (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---|-----------------------|--|------------------------|---------------------------|
| 5 | 139.0 | 139.0 | 0.0 | ±0.1 |

Uncertainty of measurement

| Function | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|--|---------------------|---|
| 1) Indication at the calibration check frequency | 0.30 | Not applicable |
| 2) Self-generated Noise | 0.10 | Not applicable |
| 3) Acoustical signal tests of frequency weightings - Free-field sound pressure response level | 0.30 | 0.60 (10Hz to 4kHz) 0.70 (>4kHz to 10kHz) |
| 4) Electrical signal tests of frequency weightings | 0.20 | 0.20 |
| 5) Frequency and time weighting at 1 kHz | 0.20 | 0.20 |
| 6) Long-Term Stability | 0.10 | 0.10 |
| 7) Level Linearity on the reference level range | 0.30 | 0.30 |
| 8) Tone burst response | 0.20 | 0.30 |
| 9) Peak C sound level | 0.20 | 0.35 |
| 10) Overload indication | 0.20 | 0.25 |
| 11) High-Level Stability | 0.10 | 0.10 |

Remarks:

1. Indication at the calibration check frequency can not measured because customer does not provide a sound calibrator.
2. The acceptance limit is for the deviated value.
3. Acceptance limits was IEC61672-3:2013 Class 1.
4. The coverage factor $k = 2.00$

-- End of Report --

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**ELECTRICAL AND ELECTRONICS INSTITUTE
FOUNDATION FOR INDUSTRIAL DEVELOPMENT**

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Certificate No.: CP20240289EA
Operation No.: CP2024070252

Certificate of Calibration

Equipment: Sound Level Meter

Manufacturer: Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)

Model/Type: LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)

Serial No.: 0007310 (Meter), 345240 (Microphone), 077645 (Preamplifier)

ID No.: UAE.EFM.042/2566

Customer: United Analyst and Engineering Consultant Co.,Ltd.

Address: 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak
Phrakhanong, Bangkok 10260

Received Date: 25 July 2024

Calibrated Date: 5 - 6 August 2024

Issued Date: 7 August 2024

Calibrated by: Ms. Juntaporn Kunhakom

Approved by: _____

(Mr. Sittichai Swaksuriyawong)
Group Manager

This report was prepared electronically using applicable electronic signature. Printing or copy of file are considered as a copy of the document.

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor (k) providing a level of confidence of approximately 95%. This certificate may not be reproduced other than in full except with the prior written approval of the Electrical and Electronics Institute, Foundation for Industrial Development.

Certificate No.: CP20240289EA

Calibration Report

Equipment: Sound Level Meter
Manufacturer: Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)
Model/Type: LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)
Serial No.: 0007310 (Meter), 345240 (Microphone), 077645 (Preamplifier)
ID No.: UAE.EFM.042/2566
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Pressure: (101.3 ± 1.5) kPa
Method of Calibration :-
IEC 61672-3:2013.

Condition of this result of calibration

1. Reference standards instrument :-

| | Instrument | Model | Serial No. | Cert. No. | Due Date |
|----|---|---------|------------|------------------------------|---------------------------------------|
| 1) | Standard microphone | 4180 | 2787490 | AA-1012-23 | 12 November 2024 |
| 2) | Arbitrary Function Generator | AFG2021 | C010063 | CK20240048EA | 23 June 2025 |
| 3) | Programmable Attenuator | PA5 | 2755 | EF-0040-23 | 1 October 2024 |
| 4) | 6.5 Digit precision multimeter | 8846A | 9610014 | CB20230200EA | 15 November 2024 |
| 5) | Pressure humidity and Temperature Transmitter | PTU301 | L3950483 | CL1-P240023 CD20240142EA | 24 March 2025 12 June 2025 |
| 6) | Pressure humidity and Temperature Transmitter | PTU301 | L3950484 | CL1-P240030 CD20240143EA | 11 April 2025 12 June 2025 |
| 7) | Performance Audio Analyzer | U8903B | MY56510003 | CB20240035EB CK20230072EA | 13 February 2025 13 September 2024 |

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

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

Reference standards instrument for Acoustic function

- National Institute of Metrology (Thailand)

Reference standards instrument for Electrical function

- National Institute of Metrology (Thailand)

- Electrical and Electronics Institute; NSC Accredited Calibration No.0119

Result of Calibration:-

Function : 1. Indication at the calibration check frequency

| Reference Acoustic Signal (dB) | Measured value (dB) | Deviation (dB) | Acceptance limits (dB) |
|-----------------------------------|------------------------|-------------------|---------------------------|
| - | - | - | - |

Certificate No.: CP20240289EA

Calibration Report

Function : 2. Self-generated Noise

2.1 Microphone Installed

| Measured value (dB) |
|------------------------|
| 30.3 |

2.2 Microphone replaced by the electrical input signal device

| Frequency Weighting | Measured value (dB) |
|---------------------|------------------------|
| A-weighting | 30.1 |
| C-weighting | 30.0 |
| Z-weighting | 35.7 |

Function : 3. Acoustical signal tests of frequency weightings (Without Windscreen)

Meter free-field acoustic response at a level of 84 dB.

| Frequency (Hz) | Deviation from various Frequency Weighting Response Curve | | | |
|-------------------|---|---------------------|---------------------|---------------------------|
| | C-Weighting (dB) | A-Weighting (dB) | Z-Weighting (dB) | Acceptance limits (dB) |
| 125 | 0.3 | 0.2 | 0.3 | ±1.0 |
| 1000 | 0.2 | 0.2 | 0.2 | ±0.7 |
| 8000 | -0.2 | -0.1 | -0.1 | +1.5; -2.5 |

Function : 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various Frequency Weighting Response Curve | | | |
|-------------------|---|---------------------|---------------------|---------------------------|
| | C-Weighting (dB) | A-Weighting (dB) | Z-Weighting (dB) | Acceptance limits (dB) |
| 63 | -0.1 | 0.1 | 0.0 | ±1.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 500 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ±0.7 |
| 2000 | 0.0 | 0.1 | 0.0 | ±1.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 8000 | -0.1 | 0.0 | 0.0 | +1.5; -2.5 |
| 16000 | 0.0 | 0.0 | -0.1 | +2.5; -16.0 |

Certificate No.: CP20240289EA

Calibration Report

Function : 5. Frequency and time weighting at 1 kHz

5.1 Frequency weighting at 1 kHz

| Frequency Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---------------------|---------------------|---------------------|------------------------|
| C-weighting | 94.0 | 0.0 | ±0.2 |
| A-weighting | 94.0 | 0.0 | ±0.2 |
| Z-weighting | 94.0 | 0.0 | ±0.2 |

5.2 Time weighting at 1 kHz

| Time Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|----------------|---------------------|---------------------|------------------------|
| Fast | 94.0 | 0.0 | ±0.1 |
| Slow | 94.0 | 0.0 | ±0.1 |
| LAeq | 94.0 | 0.0 | ±0.1 |

Function : 6. Long-Term Stability

Long-term stability over 30 minutes, with steady 1 kHz signal at reference level.

| Time Period to Apply Signal (min) | Reference SPL (dB) | Record SPL at Conclusion of Time Period (dB) | Deviated value (dB) | Acceptance limits (dB) |
|-----------------------------------|--------------------|--|---------------------|------------------------|
| 30 | 94.0 | 94.0 | 0.0 | ±0.1 |

Function : 7. Level Linearity on the reference level range

7.1 Level Linearity on the reference level range, Upper

| Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|------------------------|---------------------|---------------------|------------------------|
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 99.0 | 99.0 | 0.0 | ±0.8 |
| 104.0 | 104.0 | 0.0 | ±0.8 |
| 109.0 | 109.0 | 0.0 | ±0.8 |
| 114.0 | 114.0 | 0.0 | ±0.8 |
| 119.0 | 119.0 | 0.0 | ±0.8 |
| 124.0 | 124.0 | 0.0 | ±0.8 |
| 129.0 | 129.0 | 0.0 | ±0.8 |
| 134.0 | 134.0 | 0.0 | ±0.8 |
| 139.0 | 139.0 | 0.0 | ±0.8 |
| 140.0 | 140.0 | 0.0 | ±0.8 |
| 141.0 | 141.0 | 0.0 | ±0.8 |

Certificate No.: CP20240289EA

Calibration Report

7.2 Level Linearity on the reference level range, Lower

| Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|------------------------|---------------------|---------------------|------------------------|
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 89.0 | 89.0 | 0.0 | ±0.8 |
| 84.0 | 84.0 | 0.0 | ±0.8 |
| 79.0 | 79.0 | 0.0 | ±0.8 |
| 74.0 | 74.0 | 0.0 | ±0.8 |
| 69.0 | 69.0 | 0.0 | ±0.8 |
| 64.0 | 64.0 | 0.0 | ±0.8 |
| 59.0 | 59.0 | 0.0 | ±0.8 |
| 54.0 | 54.0 | 0.0 | ±0.8 |
| 49.0 | 49.0 | 0.0 | ±0.8 |
| 44.0 | 44.1 | 0.1 | ±0.8 |
| 39.0 | 39.4 | 0.4 | ±0.8 |

Function : 8. Tone burst response

| Time Weighting | Tone burst duration, Tb (ms) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|----------------|------------------------------|---------------------|---------------------|------------------------|
| Fast | 200 | 135.9 | -0.1 | ±0.5 |
| | 2 | 118.8 | -0.2 | +1.0 ; -1.5 |
| | 0.25 | 109.8 | -0.2 | +1.0 ; -3.0 |
| Slow | 200 | 129.5 | -0.1 | ±0.5 |
| | 2 | 109.9 | -0.1 | +1.0 ; -3.0 |
| | 0.25 | 100.9 | -0.1 | +1.0 ; -3.0 |
| LAE | 200 | 130.0 | 0.0 | ±0.5 |
| | 2 | 110.0 | 0.0 | +1.0 ; -1.5 |
| | 0.25 | 100.9 | -0.1 | +1.0 ; -3.0 |

Function : 9. Peak C sound level

| Number of cycles in test signal | Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---------------------------------|------------------------|---------------------|---------------------|------------------------|
| Complete cycle | 135.4 | 134.8 | -0.6 | ±2.0 |
| Positive half cycle | 134.4 | 134.0 | -0.4 | ±1.0 |
| Negative half cycle | 134.4 | 134.0 | -0.4 | ±1.0 |

Certificate No.: CP20240289EA

Calibration Report

Function : 10. Overload indication

| Measured value (dB) | | Deviated value (dB) | Acceptance limits (dB) |
|----------------------------|----------------------------|------------------------|---------------------------|
| Positive one-half cycle | Negative one-half cycle | | |
| 144.3 | 144.2 | -0.1 | ±1.5 |

Function : 11. High-Level Stability

High-level stability over 5 minutes, with steady 1 kHz signal, 1 dB below upper boundary.

| Time Period to Apply Signal (min) | Reference SPL (dB) | Record SPL at Conclusion of Time Period (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---|-----------------------|--|------------------------|---------------------------|
| 5 | 139.0 | 139.0 | 0.0 | ±0.1 |

Uncertainty of measurement

| Function | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|--|---------------------|---|
| 1) Indication at the calibration check frequency | 0.30 | Not applicable |
| 2) Self-generated Noise | 0.10 | Not applicable |
| 3) Acoustical signal tests of frequency weightings - Free-field sound pressure response level | 0.30 | 0.60 (10Hz to 4kHz) 0.70 (>4kHz to 10kHz) |
| 4) Electrical signal tests of frequency weightings | 0.20 | 0.20 |
| 5) Frequency and time weighting at 1 kHz | 0.20 | 0.20 |
| 6) Long-Term Stability | 0.10 | 0.10 |
| 7) Level Linearity on the reference level range | 0.30 | 0.30 |
| 8) Tone burst response | 0.20 | 0.30 |
| 9) Peak C sound level | 0.20 | 0.35 |
| 10) Overload indication | 0.20 | 0.25 |
| 11) High-Level Stability | 0.10 | 0.10 |

Remarks:

1. Indication at the calibration check frequency can not measured because customer does not provide a sound calibrator.
2. The acceptance limit is for the deviated value.
3. Acceptance limits was IEC61672-3:2013 Class 1.
4. The coverage factor $k = 2.00$

-- End of Report --

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**ELECTRICAL AND ELECTRONICS INSTITUTE
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Certificate No.: CP20240288EA

Operation No.: CP2024070251

Certificate of Calibration

Equipment: Sound Level Meter

Manufacturer: Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)

Model/Type: LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)

Serial No.: 0007312 (Meter), 345818 (Microphone), 077647 (Preamplifier)

ID No.: UAE.EFM.044/2566

Customer: United Analyst and Engineering Consultant Co.,Ltd.

Address: 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak
Phrakhanong, Bangkok 10260

Received Date: 25 July 2024

Calibrated Date: 5 - 6 August 2024

Issued Date: 7 August 2024

Calibrated by: Ms. Juntaporn Kunhakom

Approved by: _____

(Mr. Sittichai Swaksuriyawong)
Group Manager

This report was prepared electronically using applicable electronic signature. Printing or copy of file are considered as a copy of the document.

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor (k) providing a level of confidence of approximately 95%. This certificate may not be reproduced other than in full except with the prior written approval of the Electrical and Electronics Institute, Foundation for Industrial Development.

Certificate No.: CP20240288EA

Calibration Report

Equipment: Sound Level Meter
Manufacturer: Larson Davis (Meter), PCB (Microphone), PCB (Preamplifier)
Model/Type: LxT1 (Meter), 377B02 (Microphone), PRMLxT1 (Preamplifier)
Serial No.: 0007312 (Meter), 345818 (Microphone), 077647 (Preamplifier)
ID No.: UAE.EFM.044/2566
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Pressure: (101.3 ± 1.5) kPa
Method of Calibration :-
 IEC 61672-3:2013.

Condition of this result of calibration

1. Reference standards instrument :-

| | <u>Instrument</u> | <u>Model</u> | <u>Serial No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|----|---|--------------|-------------------|------------------------------|---------------------------------------|
| 1) | Standard microphone | 4180 | 2787490 | AA-1012-23 | 12 November 2024 |
| 2) | Arbitrary Function Generator | AFG2021 | C010063 | CK20240048EA | 23 June 2025 |
| 3) | Programmable Attenuator | PA5 | 2755 | EF-0040-23 | 1 October 2024 |
| 4) | 6.5 Digit precision multimeter | 8846A | 9610014 | CB20230200EA | 15 November 2024 |
| 5) | Pressure humidity and Temperature Transmitter | PTU301 | L3950483 | CL1-P240023 CD20240142EA | 24 March 2025 12 June 2025 |
| 6) | Pressure humidity and Temperature Transmitter | PTU301 | L3950484 | CL1-P240030 CD20240143EA | 11 April 2025 12 June 2025 |
| 7) | Performance Audio Analyzer | U8903B | MY56510003 | CB20240035EB CK20230072EA | 13 February 2025 13 September 2024 |

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

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

- Reference standards instrument for Acoustic function
 - National Institute of Metrology (Thailand)
- Reference standards instrument for Electrical function
 - National Institute of Metrology (Thailand)
 - Electrical and Electronics Institute; NSC Accredited Calibration No.0119

Result of Calibration:-

Function : 1. Indication at the calibration check frequency

| Reference Acoustic Signal (dB) | Measured value (dB) | Deviation (dB) | Acceptance limits (dB) |
|-----------------------------------|------------------------|-------------------|---------------------------|
| - | - | - | - |

Certificate No.: CP20240288EA

Calibration Report

Function : 2. Self-generated Noise

2.1 Microphone Installed

| Measured value (dB) |
|------------------------|
| 28.5 |

2.2 Microphone replaced by the electrical input signal device

| Frequency Weighting | Measured value (dB) |
|---------------------|------------------------|
| A-weighting | 28.4 |
| C-weighting | 28.3 |
| Z-weighting | 34.1 |

Function : 3. Acoustical signal tests of frequency weightings (Without Windscreen)

Meter free-field acoustic response at a level of 84 dB.

| Frequency (Hz) | Deviation from various Frequency Weighting Response Curve | | | |
|-------------------|---|---------------------|---------------------|---------------------------|
| | C-Weighting (dB) | A-Weighting (dB) | Z-Weighting (dB) | Acceptance limits (dB) |
| 125 | 0.2 | 0.1 | 0.1 | ±1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ±0.7 |
| 8000 | -0.9 | -0.9 | -0.8 | +1.5; -2.5 |

Function : 4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various Frequency Weighting Response Curve | | | |
|-------------------|---|---------------------|---------------------|---------------------------|
| | C-Weighting (dB) | A-Weighting (dB) | Z-Weighting (dB) | Acceptance limits (dB) |
| 63 | 0.0 | 0.1 | 0.0 | ±1.0 |
| 125 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 250 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 500 | 0.0 | -0.1 | 0.0 | ±1.0 |
| 1000 | 0.0 | 0.0 | 0.0 | ±0.7 |
| 2000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 8000 | -0.1 | 0.0 | 0.0 | +1.5; -2.5 |
| 16000 | 0.0 | 0.0 | -0.1 | +2.5; -16.0 |

Certificate No.: CP20240288EA

Calibration Report

Function : 5. Frequency and time weighting at 1 kHz

5.1 Frequency weighting at 1 kHz

| Frequency Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---------------------|---------------------|---------------------|------------------------|
| C-weighting | 94.0 | 0.0 | ±0.2 |
| A-weighting | 94.0 | 0.0 | ±0.2 |
| Z-weighting | 94.0 | 0.0 | ±0.2 |

5.2 Time weighting at 1 kHz

| Time Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|----------------|---------------------|---------------------|------------------------|
| Fast | 94.0 | 0.0 | ±0.1 |
| Slow | 94.0 | 0.0 | ±0.1 |
| LAeq | 94.0 | 0.0 | ±0.1 |

Function : 6. Long-Term Stability

Long-term stability over 30 minutes, with steady 1 kHz signal at reference level.

| Time Period to Apply Signal (min) | Reference SPL (dB) | Record SPL at Conclusion of Time Period (dB) | Deviated value (dB) | Acceptance limits (dB) |
|-----------------------------------|--------------------|--|---------------------|------------------------|
| 30 | 94.0 | 94.0 | 0.0 | ±0.1 |

Function : 7. Level Linearity on the reference level range

7.1 Level Linearity on the reference level range, Upper

| Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|------------------------|---------------------|---------------------|------------------------|
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 99.0 | 99.0 | 0.0 | ±0.8 |
| 104.0 | 104.0 | 0.0 | ±0.8 |
| 109.0 | 109.0 | 0.0 | ±0.8 |
| 114.0 | 114.0 | 0.0 | ±0.8 |
| 119.0 | 119.0 | 0.0 | ±0.8 |
| 124.0 | 124.0 | 0.0 | ±0.8 |
| 129.0 | 129.0 | 0.0 | ±0.8 |
| 134.0 | 134.0 | 0.0 | ±0.8 |
| 139.0 | 139.0 | 0.0 | ±0.8 |

Certificate No.: CP20240288EA

Calibration Report

7.2 Level Linearity on the reference level range, Lower

| Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|------------------------|---------------------|---------------------|------------------------|
| 94.0 | 94.0 | 0.0 | ±0.8 |
| 89.0 | 89.0 | 0.0 | ±0.8 |
| 84.0 | 84.0 | 0.0 | ±0.8 |
| 79.0 | 79.0 | 0.0 | ±0.8 |
| 74.0 | 74.0 | 0.0 | ±0.8 |
| 69.0 | 69.0 | 0.0 | ±0.8 |
| 64.0 | 64.0 | 0.0 | ±0.8 |
| 59.0 | 59.0 | 0.0 | ±0.8 |
| 54.0 | 54.0 | 0.0 | ±0.8 |
| 49.0 | 49.0 | 0.0 | ±0.8 |
| 44.0 | 44.1 | 0.1 | ±0.8 |
| 39.0 | 39.3 | 0.3 | ±0.8 |

Function : 8. Tone burst response

| Time Weighting | Tone burst duration, Tb (ms) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|----------------|------------------------------|---------------------|---------------------|------------------------|
| Fast | 200 | 136.0 | 0.0 | ±0.5 |
| | 2 | 118.8 | -0.2 | +1.0 ; -1.5 |
| | 0.25 | 109.7 | -0.3 | +1.0 ; -3.0 |
| Slow | 200 | 129.5 | -0.1 | ±0.5 |
| | 2 | 109.9 | -0.1 | +1.0 ; -3.0 |
| | 0.25 | 100.9 | -0.1 | +1.0 ; -3.0 |
| LAE | 200 | 130.0 | 0.0 | ±0.5 |
| | 2 | 110.0 | 0.0 | +1.0 ; -1.5 |
| | 0.25 | 100.9 | -0.1 | +1.0 ; -3.0 |

Function : 9. Peak C sound level

| Number of cycles in test signal | Anticipated Value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---------------------------------|------------------------|---------------------|---------------------|------------------------|
| Complete cycle | 135.4 | 134.8 | -0.6 | ±2.0 |
| Positive half cycle | 134.4 | 134.0 | -0.4 | ±1.0 |
| Negative half cycle | 134.4 | 134.0 | -0.4 | ±1.0 |

Certificate No.: CP20240288EA

Calibration Report

Function : 10. Overload indication

| Measured value (dB) | | Deviated value (dB) | Acceptance limits (dB) |
|----------------------------|----------------------------|------------------------|---------------------------|
| Positive one-half cycle | Negative one-half cycle | | |
| 142.4 | 142.3 | -0.1 | ±1.5 |

Function : 11. High-Level Stability

High-level stability over 5 minutes, with steady 1 kHz signal, 1 dB below upper boundary.

| Time Period to Apply Signal (min) | Reference SPL (dB) | Record SPL at Conclusion of Time Period (dB) | Deviated value (dB) | Acceptance limits (dB) |
|---|-----------------------|--|------------------------|---------------------------|
| 5 | 139.0 | 139.0 | 0.0 | ±0.1 |

Uncertainty of measurement

| Function | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|--|---------------------|---|
| 1) Indication at the calibration check frequency | 0.30 | Not applicable |
| 2) Self-generated Noise | 0.10 | Not applicable |
| 3) Acoustical signal tests of frequency weightings - Free-field sound pressure response level | 0.30 | 0.60 (10Hz to 4kHz) 0.70 (>4kHz to 10kHz) |
| 4) Electrical signal tests of frequency weightings | 0.20 | 0.20 |
| 5) Frequency and time weighting at 1 kHz | 0.20 | 0.20 |
| 6) Long-Term Stability | 0.10 | 0.10 |
| 7) Level Linearity on the reference level range | 0.30 | 0.30 |
| 8) Tone burst response | 0.20 | 0.30 |
| 9) Peak C sound level | 0.20 | 0.35 |
| 10) Overload indication | 0.20 | 0.25 |
| 11) High-Level Stability | 0.10 | 0.10 |

- Remarks:
1. Indication at the calibration check frequency can not measured because customer does not provide a sound calibrator.
 2. The acceptance limit is for the deviated value.
 3. Acceptance limits was IEC61672-3:2013 Class 1.
 4. The coverage factor $k = 2.00$

-- End of Report --

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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.: 24CH1153/1

Page.: 1 of 3

This Certificate was issued to replace to the Certificate No. 24CH1153

Equipment : pH Meter
Manufacturer : Horiba
Model : LAQUA-PH210
Serial No. : HA1G0008
ID No. : UAE.EFM.201/2564(EFM.pH.09/64)
Condition As-Received: Used Item
Received Date : 17 September 2024
Calibration Date : 18 September , 25 October 2024
Reference : 2409-0632WSC-1
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260

Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with DC voltage
standard and direct measurement with
certified reference material (CRM)
- CP-CH8 by comparison with temperature standard

Calibrated by : Warakorn Lernagtrakul

Approved by : _____
Approved Signatory

() Unnophol Harachai
() Ponpan Paipim
(✓) Saithip Meangmai

Issue Date : 28 October 2024

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.



Cert.No.: 24CH1153/1

Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument

| <u>Instrument</u> | <u>Serial No.</u> | <u>ID No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|-------------------------------|-------------------|---------------|------------------|-----------------|
| 1)Document Process Calibrator | 54030049 | 130RC116 | 24E2759 | 25 Aug 2025 |
| 2)Ref. Standard Thermometer | 4982054 | 110RC044 | 24I757 | 14 July 2025 |

- This Certification is traceable to SI Through Technology Promotion Association (Thailand - Japan)

2. Certified Reference Materials :The measurement results are traceable to SI through Hach Lenge GmbH Ltd.,
Deutsche Akkreditierungsstelle, Accredited No.D-RM-15184-01-00
:The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

| <u>Buffer Solution</u> | <u>Manufacturer</u> | <u>Lot No.</u> | <u>Exp. date</u> |
|------------------------|---------------------|----------------|------------------|
| pH 4.006 | Hach Lenge GmbH | C03146 | 23 Feb 2026 |
| pH 7.000 | Hach Lenge GmbH | C03020 | 13 Dec 2024 |
| pH 9.997 | CPA chem | 970853 | 25 Apr 2025 |

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

Calibration Results

Function : mV Measurement

Performing standard curve by Document Process Calibrator at pH (4,7)(7,10)

| Unit Under Calibration | Nominal Value | Standard Voltage Input | Actual Reading | | Uncertainty of Measurement (±mV) | Coverage factor <i>k</i> |
|----------------------------|---------------|------------------------|----------------|-------|---------------------------------------|-----------------------------|
| | pH | mV | mV | pH | | |
| pH Meter S/N.: HA1G0008 | 4.00 | 177.48 | 177.5 | 4.01 | 0.058 | 2.00 |
| | 7.00 | 0.00 | 0.0 | 7.02 | 0.058 | 2.00 |
| | 7.00 | 0.00 | 0.0 | 7.02 | 0.058 | 2.00 |
| | 10.00 | -177.48 | -177.5 | 10.01 | 0.058 | 2.00 |



Cert.No.: 24CH1153/1

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Calibration Results

Function : pH Measurement

Calibration Date : 18 September 2024

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

| Unit Under Calibration | Standard pH Buffer Solution | Actual pH Reading | Actual mV Reading (mV) | Uncertainty of pH Measurement (\pm) | Coverage factor k |
|-------------------------|-----------------------------|-------------------|------------------------|---|---------------------|
| pH Electrode S/N.: - | 4.006 | 4.01 | 168.7 | 0.0077 | 2.00 |
| | 7.000 | 6.99 | -3.2 | 0.0084 | 2.00 |
| | 7.000 | 7.00 | -3.4 | 0.0092 | 2.05 |
| | 9.997 | 10.01 | -174.4 | 0.011 | 2.05 |

Function : Temperature Measurement

Calibration Date : 25 October 2024

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : 9652
- Serial No. : -
Dimension of probe
- Length : 103 mm.
- Diameter : 16 mm.
- Immersion Depth : 90 mm.

| Calibration Point ($^{\circ}\text{C}$) | Standard Temperature ($^{\circ}\text{C}$) | UUC* Reading ($^{\circ}\text{C}$) | Error ($^{\circ}\text{C}$) | Uncertainty of measurement (\pm $^{\circ}\text{C}$) | Coverage factor k |
|--|---|-------------------------------------|------------------------------|---|---------------------|
| 20.0 | 20.001 | 20.0 | -0.001 | 0.13 | 2.00 |
| 25.0 | 25.005 | 25.0 | -0.005 | 0.13 | 2.00 |
| 45.0 | 45.004 | 44.9 | -0.104 | 0.13 | 2.00 |

Remark - 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 of approximately 95 %.



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

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

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

Certificate of Testing

Cert.No.: 24TW200

Page.: 1 of 2

| | |
|---|---|
| Equipment : | DO Meter |
| Manufacturer : | Horiba |
| Model : | LAQUA-DO210 |
| Serial No. : | HE1D0010 |
| ID No. : | UAE.EFM.208/2564(EFM.DO.10/64) |
| Received Date : | 17 September 2024 |
| Test Date : | 18 September 2024 |
| Reference : | 2409-0633WSC-1 |
| Submitted by : | United Analyst and Engineering Consultant Co.,Ltd. 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260 |
| Laboratory Condition : | Temperature (25 ± 5) °C Humidity (50 ± 20) % |
| Test Procedure : | In - house method : CP-CH9 by Comparison Technique with Azide Modification Method |
| Tested by : | Walalak Sirithean  |
| Approved by : |  Approved Signatory |
| () Unnopphol Harachai () Ponpan Paipim (✓) Saithip Meangmai | |
| Issue Date : | 18 September 2024 |

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Cert.No.: 24TW200

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

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

| <u>Instruments</u> | <u>Serial No.</u> | <u>ID No.</u> | <u>Certificate No.</u> | <u>Due Date</u> |
|--------------------|-------------------|---------------|------------------------|-----------------|
| 1. Burette | - | 130BU10 | 23CG1172 | 22 Mar 2025 |
| 2. Balance | 14233821 | 110RC001 | 24MM131 | 04 July 2025 |

2. Standard Material :-

| <u>Material</u> | <u>Manufacturer</u> | <u>Lot.No.</u> | <u>Assay</u> |
|---------------------------------|---------------------|----------------|--------------|
| Sodium Thiosulfate 5-Hydrate AR | KEMAUS | 2203162447 | 99.6% |

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 9K1B0023

| Titration Method (Azide Modification Method) (mg/L) | DO Meter Reading (mg/L) | Standard Deviation (mg/L) |
|---|---------------------------------------|-------------------------------------|
| 8.18 | 8.19 | 0.0055 |

This report was certified only for the instrument we tested. It is allowable to use for study
Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced
other in full, without written approval of the laboratory

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Certificate of Calibration

Cert. No.: 24LM150

Page.: 1 of 2

Equipment : DO Meter with Sensor

Manufacturer : Horiba

Model : LAQUA-DO210

Serial No. : HE1D0010

ID No. : UAE.EFM.208/2564(EFM.DO.10/64)

Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260

Location : TPA On Site Calibration Laboratory

Received Order : 17 September 2024
Calibrated Date : 18 September 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V

Calibrated by : Warakorn Lernagatrakul

Approved by :

Kunchit

Approved Signatory

- () Ponpan Paipim
() Suwit Imjai
(✓) Kunchit Promprat

Issue Date : 21 September 2024

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2409-0633WSC-2
Procedure Used :-

Cert. No.: 24LM150
Page.: 2 of 2

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

| <u>Instrument</u> | <u>Serial No.</u> | <u>Cert. No.</u> | <u>Traceable</u> | <u>Due Date</u> |
|------------------------|-------------------|------------------|------------------|-----------------|
| 1) Digital Thermometer | 2188080 | 2311216 | TPA | 11 Oct 2024 |

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

3. This certification is traceable to the International System of Unit.

Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 9K1B0023

| <u>Calibration Point</u> (°C) | <u>Immersion Depth</u> (mm) | <u>Standard Temperature</u> (°C) | <u>UUC* Reading</u> (°C) | <u>Error</u> (°C) | <u>Uncertainty</u> (± °C) | <u>Coverage Factor</u> <i>k</i> |
|------------------------------------|----------------------------------|---------------------------------------|-------------------------------|------------------------|--------------------------------|------------------------------------|
| 25.0 | 80 | 25.002 | 25.0 | -0.002 | 0.16 | 2.00 |
| 30.0 | 80 | 30.003 | 30.0 | -0.003 | 0.16 | 2.00 |
| 35.0 | 80 | 35.004 | 35.0 | -0.004 | 0.16 | 2.00 |

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 of approximately 95 %.

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL.0-2717-3000-29 FAX.0-2719-9484



Certificate of Calibration

Cert.No.: 24CH1158

Page.: 1 of 3

Equipment : Conductivity Meter
Manufacturer : YSI
Model : Pro30
Serial No. : 17A102921
ID No. : UAE.EFM.123/2560(ENV.SCT.03/60)
Condition As-Received: Used Item
Received Date : 17 September 2024
Calibration Date : 18 September 2024
Reference : 2409-0635WSC-2
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260
Ambient Temperature : $(25 \pm 2.5) ^\circ\text{C}$
Relative Humidity : $(50 \pm 15) \%$
Calibration Procedure: In -house method :
- CP-CH6 by direct measurement
with certified reference material (CRM)
- CP-CH8 by comparison with temperature standard
Calibrated by : Warakorn Lerngagtrakul
Approved by : _____
Approved Signatory
() Unnopphol Harachai
() Ponpan Paipim
(✓) Saithip Meangmai
Issue Date : 23 September 2024

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

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Cert.No.: 24CH1158

Page.: 2 of 3

Condition of this result of calibration

1. Reference Standard Instrument :-

| <u>Instrument</u> | <u>Serial No.</u> | <u>ID No.</u> | <u>Certificate No.</u> | <u>Due date</u> |
|-------------------------|-------------------|---------------|------------------------|-----------------|
| 1) Thermometer | 9549224 | 130RC003 | 24I426 | 24 Apr 2025 |
| 2) Ref. Std.Thermometer | 2188080 | 130RC044 | 231216 | 10 Oct 2024 |

- This Certification is traceable to SI Through Technology Promotion Association (Thailand - Japan)

2. Certified Reference Materials :-

- Conductivity calibration solution, CPA chem Ltd., The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

| <u>Conductivity Solution</u> | <u>Manufacturer</u> | <u>Lot No.</u> | <u>Exp. date</u> |
|------------------------------|---------------------|----------------|------------------|
| 1412.9 $\mu\text{S/cm}$ | CPA Chem | 1005307 | 15 June 2025 |
| 12.880 mS/cm | CPA Chem | 940112 | 02 Nov 2024 |

- Control Conductivity calibration solution temperature by Water bath (25 ± 0.1) $^{\circ}\text{C}$

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

Calibration results

Function : Conductivity Measurement

(*) After Adjustment at 1412.9 $\mu\text{S/cm}$

Conductivity Electrode Serial No.: 17A100315

| Standard Conductivity Solution | Before Adjustment UUC* Reading | After Adjustment UUC* Reading | Uncertainty of Measurement (\pm) | Coverage factor k |
|--------------------------------|--------------------------------|-------------------------------|--------------------------------------|---------------------|
| 1412.9 $\mu\text{S/cm}$ | 1317 $\mu\text{S/cm}$ | 1414 $\mu\text{S/cm}$ | 9.2 $\mu\text{S/cm}$ | 2.00 |
| 12.880 mS/cm | 10.60 mS/cm | 11.99 mS/cm | 0.086 mS/cm | 2.00 |

Remark : - UUC* = Unit Under Calibration

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Cert.No.: 24CH1158

Page.: 3 of 3

Calibration Results

Function : Temperature Measurement

This equipment was connected with Temperature Probe;

- Model : PRO 30 COND-T
- Serial No. : 17A100315

Dimension of probe;

- Length : 95 mm
- Diameter : 2.5 mm
- Immersion Depth : 90 mm

Calibration Result : Without adjustment

| Calibration Point (°C) | Standard Temperature (°C) | UUC* Reading (°C) | Error (°C) | Uncertainty of Measurement (± °C) | Coverage factor <i>k</i> |
|-----------------------------|--------------------------------|---------------------------|-----------------|--|-----------------------------|
| 25.0 | 25.003 | 24.7 | -0.303 | 0.13 | 2.00 |
| 30.0 | 30.002 | 29.7 | -0.302 | 0.13 | 2.00 |
| 35.0 | 35.002 | 34.7 | -0.302 | 0.13 | 2.00 |

Remark : - 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 of approximately 95 %.

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Certificate of Calibration

Customer

Name : UNITED ANALYST AND ENGINEERING
CONSULTANT CO.,LTD.
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Prakanong, Bangkok 10260

Certificate No : 24-ACT-122
Request No : Req-2024-1898

Unit Under Calibration Details

Measurement item : Acoustic Calibrator Class : 2
Manufacturer : LARSON DAVIS Range : 94 , 114 dB / 1000 Hz
Model : CAL150 Instrument Status : Used
Serial Number : 6695
ID : UAE.EFM.140/2565

Calibration Environment and Details


Temperature : (23 \pm 2 °C)
Humidity : (50 \pm 20 %RH)
Barometric Pressure : (1013 \pm 10.0 hPa)
Received Date : 26 August 2024
Calibration Date : 10 September 2024
Location of Calibration : LAB 1 Acoustic
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators


| Reference Standard | Model | Serial Number | Traceable | Due Calibration |
|--------------------|--------|---------------|-----------|-----------------|
| Sound Calibrator | SV 35A | 58079 | EEI | 12 June 2025 |
| THD Multimeter | 2015 | 1047765 | NIMT | 16 January 2025 |

Traceability : This certificate provides traceability of measurement to recognized national standard, and to the realization of the international System of Units (SI).

Note

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor $k=2$, providing a level of confidence approximately 95 %.

Calibrated By : 
Mr. Noppadon Luangart
Service Calibration Engineer

Approved By : 
Mr. Pacit Mathavorn
Calibration Engineer Supervisor

Issue Date : 10 September 2024

Certificate No : 24-ACT-122

Request No : Req-2024-1898

Sound pressure level

Calibration Results : Without Adjustment

| Calibration Range (dB) | Without Adjustment (dB) | | Adjustment (dB) | | Uncertainty (± dB) | Acceptance limit Class 2 (± dB) | Result |
|---------------------------|-------------------------|----------------|-----------------|----------------|------------------------|-------------------------------------|--------|
| | Measured | Deviated value | Measured | Deviated value | | | |
| 94 dB / 1000 Hz | 93.89 | -0.11 | - | - | 0.13 | 0.40 | Pass |
| 114 dB / 1000 Hz | 113.93 | -0.07 | - | - | 0.13 | 0.40 | Pass |

Frequency of Sound pressure level

| Calibration Range (Hz) | Without Adjustment | | Adjustment | | Uncertainty (± %) | Acceptance limit Class 2 (± %) | Result |
|---------------------------|--------------------|----------|---------------|----------|-----------------------|------------------------------------|--------|
| | Measured (Hz) | Deviated | Measured (Hz) | Deviated | | | |
| 94 dB / 1000 Hz | 1000.00 | 0.00 | - | - | 0.01 | 1.7 | Pass |
| 114 dB / 1000 Hz | 1000.00 | 0.00 | - | - | 0.01 | 1.7 | Pass |

Total Harmonic Distortion plus Noise of Sound pressure level (THD+N %)

| Calibration Range (Hz) | Without Adjustment | Adjustment | Uncertainty (± %) | Acceptance limit Class 2 (± %) | Result |
|---------------------------|--------------------|--------------|-----------------------|------------------------------------|--------|
| | Measured (%) | Measured (%) | | | |
| 94 dB / 1000 Hz | 0.28 | - | 0.40 | 3.0 | Pass |
| 114 dB / 1000 Hz | 0.32 | - | 0.40 | 3.0 | Pass |

Note :

| Function | Maximum-permitted Uncertainty of measurement |
|------------------------|---|
| Sound pressure level | 0.35 dB |
| Frequency | 0.20% |
| Total distortion+noise | 1.00% |

- Acceptance limit was IEC60942:2017 Class 1

- The calibration results exclude the calibrator pressure correction

- The calibration results exclude the microphone volume correction

Certificate No : 24-ACT-122

Request No : Req-2024-1898

Decision Rule for Statements of Conformity

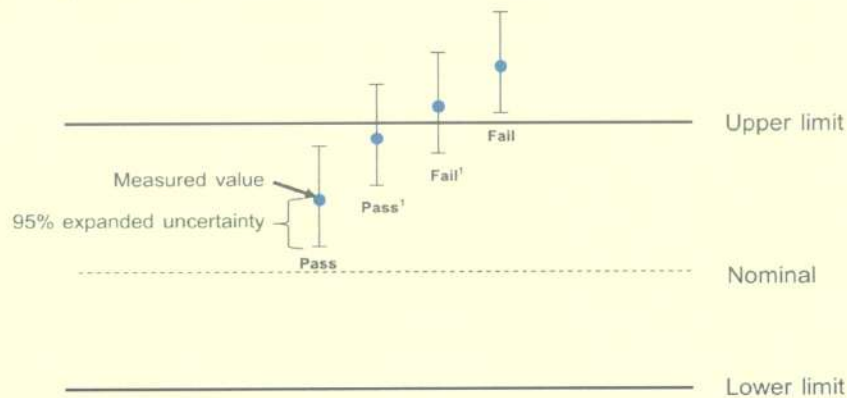
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09/2019: Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

Pass = The measurement result plus the expanded uncertainty with a 95% coverage probability were within the limit.

Pass¹ = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail¹ = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

Fail = The measurement result plus the expanded uncertainty with a 95% coverage probability were outside the limit.



End of Calibration

Cert. No. : ACL25026

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00558208 / 200079 / 11458
ID No.: UAE.EFM.040/2558

Condition As Found : GOOD

Customer : UNITED ANALYST AND ENGINEERING CONSULTANT (UAE)
81 SOI UDOMSUK 41, SUKHUMVIT ROAD,
BANGCHAK SUB-DISTRICT,
PHRAKHANONG DISTRICT, BANGKOK 10260
THAILAND.

Location : -

Ambient Temperature : (23.0 \pm 3) °C
Pressure : (101.3 \pm 3) kPa
Relative Humidity : (50.0 \pm 20) %

Received Date : 03 JANUARY 2025
Calibration Date : 13 - 14 JANUARY 2025
Date of Issue : 15 JANUARY 2025

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.

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Cert. No. : ACL25026
Job No. : VC68AC0056
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by follow on IEC-61672-3 (2013) Standard for sound level meter (SLM).

The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

| <u>Instrument</u> | <u>Model</u> | <u>Serial No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|-------------------------|--------------|-------------------|------------------|-----------------|
| Waveform Generator | 33210A | MY48017076 | EF-0009-24 | 05-FEB-25 |
| Waveform Generator | 33511B | MY52302742 | EF-0007-24 | 05-FEB-25 |
| Digital Multimeter | 33461A | MY53220104 | EEL.BP 21/0267 | 13-FEB-25 |
| Digital Multimeter | 33461A | MY53220076 | EEL.BP 20/0267 | 15-FEB-25 |
| Digital Multimeter | 34461A | MY60024273 | EEL.BP 22/0267 | 15-FEB-25 |
| Programmable Attenuator | MAT-1070 | 62100114 | EF-0008-24 | 05-FEB-25 |
| Condenser Microphone | 4180 | 2977900 | AA-1001-24 | 12-FEB-25 |
| Measuring Amplifier | NA-42KAI | 34560495 | AA-3001-24 | 05-FEB-25 |

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

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

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

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T. Ketchan

Cert. No. : ACL25026
Job No. : VC68AC0056
Pages : 3 of 8

Summary of Measurement Result :

| Parameter | Uncertainty (dB) | Maximum-permitted uncertainty of measurement (dB) |
|--|---------------------|---|
| 1. Absolute sensitivity | 0.2 | N/A |
| 2. Self-generated noise | 0.2 | N/A |
| 3. Acoustical signal tests of frequency weightings | | |
| 125 Hz | 0.3 | 0.6 |
| 1000 Hz | 0.3 | 0.6 |
| 8000 Hz | 0.3 | 0.7 |
| 4. Electrical signal tests of frequency weightings | | |
| For 10 Hz to 4 kHz | 0.3 | 0.6 |
| For > 4 kHz to 10 kHz | 0.3 | 0.7 |
| For > 10 kHz to 20 kHz | 0.3 | 1.0 |
| 5. Frequency and time weightings at 1 kHz | 0.2 | 0.2 |
| 6. Long - term stability | 0.1 | 0.1 |
| 7. Level linearity on the reference level range | 0.2 | 0.3 |
| 8. Level linearity including the level range control | 0.2 | 0.3 |
| 9. Tone burst response | 0.2 | 0.3 |
| 10. Peak C sound level | 0.2 | 0.35 |
| 11. Overload indication | 0.2 | 0.25 |
| 12. High level stability | 0.1 | 0.1 |

Cert. No. : ACL25026
Job No. : VC68AC0056
Page : 4 of 8

Result of calibration :

1. Absolute sensitivity

| Reference Acoustic Signal (dB) | Measured Value (dB) | Deviation (dB) | Acceptance Limit (dB) |
|--|-----------------------------|---------------------|-------------------------------|
| 93.9 (93.94) | 93.9 | 0.0 | ±0.3 |

2. Self-generated noise

2.1 Normal test

| Measured Value (dB) |
|--------------------------|
| 14.4 |

2.2 The microphone of the sound level meter was replaced by electrical signal input device.

| Frequency Weighting | Weighting (dB) |
|------------------------|---------------------|
| A - weight | 11.3 |
| C - weight | 17.5 |
| Flat | 23.5 |

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---------------------|--|----------|----------|----------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 125 | 0.5 | 0.5 | 0.5 | ± 1.5 |
| 1000 | 0.1 | 0.1 | 0.1 | ± 1.0 |
| 8000 | 0.8 | 0.9 | 0.9 | ±5.0 |

Cert. No. : ACL25026
Job No. : VC68AC0056
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

| Frequency (Hz) | Deviation from various frequency weighting response curve (dB) | | | |
|---------------------|--|----------|----------|----------------------|
| | Flat | C-weight | A-weight | Acceptance Limits |
| 63 | 0.0 | 0.0 | 0.0 | ±2.0 |
| 125 | 0.1 | 0.1 | 0.1 | ±1.5 |
| 250 | 0.1 | 0.0 | 0.0 | ±1.5 |
| 500 | 0.0 | 0.1 | 0.0 | ±1.5 |
| 1000 | 0.0 | 0.0 | 0.0 | ±1.0 |
| 2000 | 0.0 | 0.1 | 0.0 | ±2.0 |
| 4000 | 0.0 | 0.0 | 0.0 | ±3.0 |
| 8000 | 0.0 | 0.1 | 0.1 | ±5.0 |

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

| Frequency Weighting | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| A - weight | 94.0 | 94.0 | 0.0 | ± 0.2 |
| C - weight | 94.0 | 94.0 | 0.0 | ± 0.2 |
| Flat | 94.0 | 94.0 | 0.0 | ± 0.2 |

5.2 Time weighting at 1 kHz

| Frequency Weighting | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| Fast | 94.0 | 94.0 | 0.0 | ± 0.1 |
| Slow | 94.0 | 94.0 | 0.0 | ± 0.1 |
| Leq | 94.0 | 94.0 | 0.0 | ± 0.1 |

6. Long - term stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|-------------------------------------|-----------------------------------|-----------------------------|--------------------------------|
| A - weight | 94.0 | 94.1 | 0.1 | |

เอกสารไม่ควบคุม

[Signature]

Cert. No. : ACL25026

Job No. : VC68AC0056

Pages : 6 of 8

7. Level linearity on the reference level range

| Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| 137.0 | 137.0 | 0.0 | ± 1.1 |
| 136.0 | 136.0 | 0.0 | ± 1.1 |
| 135.0 | 135.0 | 0.0 | ± 1.1 |
| 134.0 | 134.0 | 0.0 | ± 1.1 |
| 133.0 | 133.0 | 0.0 | ± 1.1 |
| 132.0 | 132.0 | 0.0 | ± 1.1 |
| 131.0 | 131.0 | 0.0 | ± 1.1 |
| 129.0 | 129.0 | 0.0 | ± 1.1 |
| 124.0 | 124.0 | 0.0 | ± 1.1 |
| 119.0 | 119.0 | 0.0 | ± 1.1 |
| 114.0 | 114.0 | 0.0 | ± 1.1 |
| 109.0 | 109.0 | 0.0 | ± 1.1 |
| 104.0 | 104.0 | 0.0 | ± 1.1 |
| 99.0 | 99.0 | 0.0 | ± 1.1 |
| 94.0 | 94.0 | 0.0 | ± 1.1 |
| 89.0 | 89.0 | 0.0 | ± 1.1 |
| 84.0 | 84.0 | 0.0 | ± 1.1 |
| 79.0 | 79.0 | 0.0 | ± 1.1 |
| 74.0 | 74.0 | 0.0 | ± 1.1 |
| 69.0 | 69.0 | 0.0 | ± 1.1 |
| 64.0 | 64.0 | 0.0 | ± 1.1 |
| 59.0 | 59.0 | 0.0 | ± 1.1 |
| 54.0 | 54.0 | 0.0 | ± 1.1 |
| 49.0 | 49.0 | 0.0 | ± 1.1 |
| 44.0 | 44.0 | 0.0 | ± 1.1 |
| 39.0 | 39.0 | 0.0 | ± 1.1 |
| 34.0 | 34.0 | 0.0 | ± 1.1 |
| 30.0 | 30.0 | 0.0 | ± 1.1 |
| 29.0 | 29.0 | 0.0 | ± 1.1 |
| 28.0 | 28.1 | 0.1 | ± 1.1 |
| 27.0 | 27.1 | 0.1 | ± 1.1 |
| 26.0 | 26.1 | 0.1 | ± 1.1 |
| 25.0 | 25.0 | 0.0 | ± 1.1 |

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T. Kelch

Cert. No. : ACL25026
Job No. : VC68AC0056
Pages : 7 of 8

8. Level linearity including the level range control

| Range | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|-------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| 130 | 94.0 | 94.0 | 0.0 | ±1.1 |

| Range | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|-------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| 130 | 29.0 | 29.0 | 0.0 | ±1.1 |

9. Tone burst response

| Time Weighting | Tone burst duration, Tb (ms) | Cycle | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|-------------------|--------------------------------------|-------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| Fast | 0.25 | 1 | 108.0 | 107.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 117.0 | 117.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 134.0 | 134.1 | 0.1 | ±1.0 |
| Slow | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.5 ; -5.0 |
| | 200 | 800 | 127.6 | 127.6 | 0.0 | ±1.0 |
| SEL | 0.25 | 1 | 99.0 | 98.9 | -0.1 | 1.5 ; -5.0 |
| | 2 | 8 | 108.0 | 108.0 | 0.0 | 1.0 ; -2.5 |
| | 200 | 800 | 128.0 | 128.1 | 0.1 | ±1.0 |

Cert. No. : ACL25026
Job No. : VC68AC0056
Pages : 8 of 8

10. Peak C sound level

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value, Lcpeak (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------------|--------------------------------|-------------------------------------|-----------------------------|--------------------------------|
| Continuous | 130.0 | 130.0 | 0.0 | ±3.0 |
| One | 133.4 | 133.3 | -0.1 | ±3.0 |

| Number of cycle in test signal | Anticipated Value (dB) | Measured Value (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|--------------------------------------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| Continuous | 133.0 | 132.9 | -0.1 | ±2.0 |
| Positive half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |
| Negative half cycle | 135.4 | 135.1 | -0.3 | ±2.0 |

11. Overload indication

| Measured value (dB) | | Deviated Value (dB) | Acceptance Limits (dB) |
|----------------------------|----------------------------|-----------------------------|--------------------------------|
| Positive one-half cycle | Negative one-half cycle | | |
| 89.5 | 89.5 | 0.0 | ±1.5 |

12. High level stability

| Frequency Weighting | SLM Display at initial (dB) | SLM Display at final (dB) | Deviated Value (dB) | Acceptance Limits (dB) |
|------------------------|-------------------------------------|-----------------------------------|-----------------------------|--------------------------------|
| A - weight | 137.0 | 137.0 | 0.0 | ±0.3 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$
or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

เอกสารไม่ควบคุม
T. Ketchin



Certificate of Calibration

Customer

Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD. Certificate No : 24-NDM-177
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260 Request No : Req-2024-1551

Unit Under Calibration Details

Measurement item : Noise Dosimeter Microphone Class : 2
Manufacturer : SVANTEK Microphone Model : SV27
Model : SV 104 Microphone S/N : 139831
Serial Number : 143225 Preamplifier Model : -
ID : UAE.EFM.143/2566 Preamplifier S/N : -
Resolution : 0.1 dB Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 2 °C
Humidity : 50 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 5 July 2024
Calibrated Date : 16 July 2024
Calibration Procedure : In-house method CP-NDM-01 based on IEC 61252 : 2017
Location of Calibration : Lab Acoustic

Reference Standard

| Instrument | Brand | Model | SN. | Due calibration | Traceability |
|---------------------------|---------|-----------|-----------|-----------------|--------------|
| Multifrequency Calibrator | Quest | Quest-cal | EFA000234 | 25 July 2024 | TSI |
| Standard Microphone | GRAS | 40AN | 188273 | 21 August 2024 | GRAS |
| Sine Generator | Svantek | Svan401 | 131 | 9 October 2024 | WK Electric |
| Timer | EXTECH | - | 05-ACT | 14 March 2025 | TPA |

Note

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor $k = 2$, providing a level of confidence approximately 95 %.

Calibrated By : me
Mr. Noppadon Luangart
Service Calibration Engineer

Approved By : พจิรา
Mr. Pacit Mathavorn
Calibration Engineer Supervisor
Issue Date : 16 July 2024

Certificate No : 24-NDM-177

Request No : Req-2024-1551

1. Absolute acoustical sensitivity

| UUC Setting | Time | | Exposure Measurement | | | UNCERTAINTY | Tolerances Limit | Result |
|--------------------|------|-----|----------------------|---------------------|-------|-------------|---------------------|--------|
| FAST / A / 55-140 | Ref | UUC | Ref | UUC | Error | | | |
| Calibrator Setting | (s) | (s) | (Pa ² h) | (Pa ² h) | (%) | (%) | (%) | |
| 1000 Hz 114 dB | 120 | 120 | 3.17 | 3.20 | +0.9 | 3.1 | -21, +26 | Pass |

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 35A, SN. 58079

2. Frequency weightings

| UUC Setting | Deviation from various Frequency Weighting | | UNCERTAINTY | Tolerances Limit | Result |
|---------------|---|------|-------------|---------------------|--------|
| FAST / 55-140 | A | C | (± dB) | (± dB) | |
| STD Setting | (dB) | (dB) | | | |
| *63 Hz | 0.5 | 0.3 | 0.40 | 2.0 | Pass |
| 125 Hz | 0.4 | 0.5 | 0.40 | 1.5 | Pass |
| 250 Hz | 0.3 | 0.4 | 0.40 | 1.5 | Pass |
| 500 Hz | 0.3 | 0.4 | 0.40 | 1.5 | Pass |
| 1000 Hz | 0.0 | 0.0 | 0.40 | - | - |
| 2000 Hz | -0.7 | -0.6 | 0.40 | 2.0 | Pass |
| 4000 Hz | 2.4 | 2.4 | 0.40 | 3.0 | Pass |
| 8000 Hz | 1.9 | 1.9 | 0.40 | 5.0 | Pass |

Certificate No : 24-NDM-177

Request No : Req-2024-1551

3. Linearity of response to steady signals

a. Sound exposure meter, linearity of response for changes of input sinusoidal signal level

| UUC Setting | | FAST / A / High | | | | | | | | | |
|------------------|---------|-----------------|------|------|------|-------|-------|-------|-------|-------|-------|
| 1000 Hz | Ref | (dB) | 55.0 | 80.0 | 90.0 | 100.0 | 110.0 | 114.0 | 120.0 | 130.0 | 140.0 |
| | Level A | (dB) | 54.8 | 80.1 | 90.1 | 100.0 | 110.0 | 114.0 | 119.9 | 129.9 | 139.9 |
| | Error | (dB) | -0.2 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | -0.1 | -0.1 | -0.1 |
| 8000 Hz | Ref | (dB) | | | | 88.9 | 98.9 | 108.9 | 112.9 | 118.9 | 128.9 |
| | Level A | (dB) | | | | 89.0 | 98.9 | 108.9 | 112.9 | 118.9 | 128.9 |
| | Error | (dB) | | | | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | -0.1 |
| 63 Hz | Ref | (dB) | | | | | | 87.8 | 93.8 | 103.8 | 113.8 |
| | Level A | (dB) | | | | | | 87.8 | 93.8 | 103.8 | 113.8 |
| | Error | (dB) | | | | | | 0.0 | 0.0 | 0.0 | 0.0 |
| Tolerances Limit | | (±dB) | 1.0 | | | | | | | | |
| UNCERTAINTY | | (±dB) | 0.3 | | | | | | | | |
| Result | | | Pass | | | | | | | | |

b. Sound exposure meter linearity of error

| UUC Setting | Time | | Exposure Measurement | | | UNCERTAINTY | Tolerances | Result |
|--------------------|------|-----|----------------------|---------------------|-------|-------------|------------|--------|
| FAST / A / 55-140 | Ref | UUC | Ref | UUC | Error | | Limit | |
| Calibrator Setting | (s) | (s) | (Pa ² h) | (Pa ² h) | (%) | (%) | (%) | |
| 1000 Hz 110 dB | 27 | 27 | 0.30 | 0.30 | 0.00 | 5.6 | -21, +26 | Pass |
| 1000 Hz 110 dB | 45 | 45 | 0.50 | 0.50 | 0.00 | | | Pass |
| 1000 Hz 110 dB | 90 | 90 | 1.00 | 0.99 | -1.00 | | | Pass |
| 1000 Hz 110 dB | 180 | 180 | 2.00 | 1.98 | -1.00 | | | Pass |
| 1000 Hz 120 dB | 36 | 36 | 4.00 | 4.03 | +0.75 | | | Pass |
| 1000 Hz 120 dB | 72 | 72 | 8.00 | 8.05 | +0.63 | 5.6 | | Pass |
| 1000 Hz 120 dB | 90 | 90 | 10.00 | 10.13 | +1.30 | | | Pass |
| 1000 Hz 120 dB | 180 | 180 | 20.00 | 20.22 | +1.10 | | | Pass |
| 1000 Hz 120 dB | 360 | 360 | 40.00 | 40.34 | +0.85 | | | Pass |
| 1000 Hz 120 dB | 720 | 720 | 80.00 | 80.49 | +0.61 | | | Pass |

Certificate No : 24-NDM-177

Request No : Req-2024-1551

4. Response to short duration

a. Response for sinusoidal signals - reference level

| UUC Setting | Time | | Exposure Measurement | | | UNCERTAINTY (Pa ² h) | Tolerances | Result |
|--------------------|------|------|----------------------|---------------------|---------------------|------------------------------------|---------------------|--------|
| | Ref | UUC | Ref | UUC | Error | | Limit | |
| Calibrator Setting | (s) | (s) | (Pa ² h) | (Pa ² h) | (Pa ² h) | | (Pa ² h) | |
| 4000 Hz 95 dB | 2846 | 2846 | 1.00 | 0.98 | -0.02 | 0.052 | -0.29 - +0.41 | Pass |

b. Sound exposure meter response for series of toneburst impulses

| UUC Setting | Time | | Exposure Measurement | | | UNCERTAINTY (%) | Tolerances | Result |
|--------------------|------|------|----------------------|---------------------|-------|--------------------|------------|--------|
| | Ref | UUC | Ref | UUC | Error | | Limit | |
| Calibrator Setting | (s) | (s) | (Pa ² h) | (Pa ² h) | (%) | | (%) | |
| Burst 1 ms, 95 dB | 2846 | 2846 | 1.00 | 0.98 | -2.00 | 5.6 | -21 - +26 | Pass |
| Burst 1 ms, 100 dB | 900 | 900 | 1.00 | 0.98 | -2.00 | | -29 - +41 | Pass |
| Burst 1 ms, 108 dB | 143 | 143 | 1.00 | 0.99 | -1.00 | | -29 - +41 | Pass |

5. Response to unipolar pulse

| UUC Setting | Time | Exposure Measurement | | UNCERTAINTY (%) | Tolerances | Result |
|------------------------|------|----------------------|-----------|--------------------|------------|--------|
| | UUC | UUC | Different | | Limit | |
| Calibrator Setting | (s) | (Pa ² h) | (%) | | (%) | |
| Continuous Rectangle + | 29 | 10.37 | 0.00 | 3.7 | -21 - +26 | Pass |
| Continuous Rectangle - | | 10.37 | | | | Pass |

* Indicates non accredited

Certificate No : 24-NDM-177

Request No : Req-2024-1551

Decision Rule for Statements of Conformity

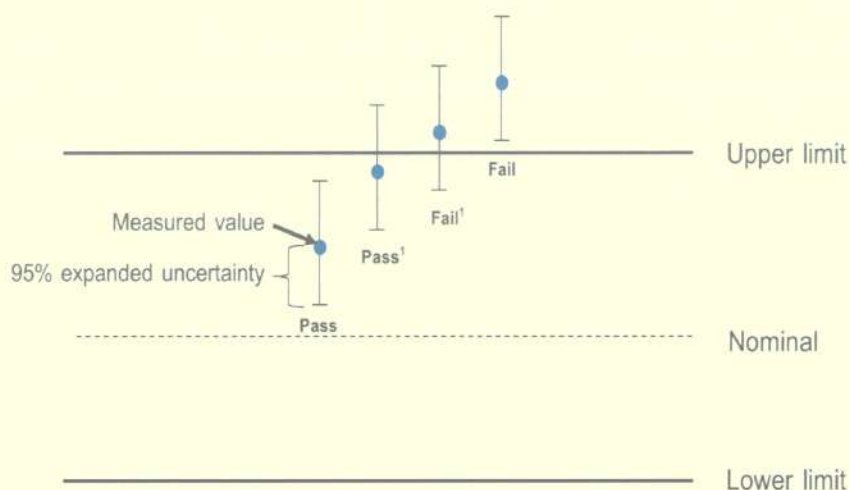
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09/2019: Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

Pass = The measurement result plus the expanded uncertainty with a 95% coverage probability were within the limit.

Pass¹ = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail¹ = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

Fail = The measurement result plus the expanded uncertainty with a 95% coverage probability were outside the limit.



End of Certificate

Certificate of Calibration

Customer

Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok
10260

Certificate No : 24-AFM-156

Request No : Req-2024-1575

Unit Under Calibration Details

Measurement Item : Air Flow Meter
Manufacturer : TSI Accuracy : 2% of Reading
Model : 4146 Sensor Model : -
Serial Number : 41462327002 Sensor Serial Number : -
ID : UAE.EFM.125/2566 Instrument Status : Used
Location of Calibration : LAB 4 AIR VELOCITY METER

Calibration Environment and Details

Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 15 July 2024
Calibration Date : 19 August 2024
Calibration Procedure : In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator

| Reference Standard | Model | Serial Number | Traceble | Due Calibration |
|--------------------|----------------------------|-----------------|-----------|-----------------|
| Air Flow Meter | Gilibrator 3 Low flow | 18501010006 | Sensidyne | 6 August 2025 |
| Air Flow Meter | Gilibrator 3 Standard flow | 19031011003 | Sensidyne | 2 August 2025 |
| Temperature meter | GT 11 | 08000057 | Qreborn | 1 March 2025 |
| Pressure meter | CPG2400 | 41000KDU/651882 | TPA | 9 November 2024 |

Traceability :

This Certificate is traceable to SI Unit through Sensidyne A2LA Accreditation No. 3943.01

Note :

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor $k = 2$, providing a level of confidence approximately 95 %.

Calibration By : me
Mr. Noppadon Luangart
Service Calibration Engineer

Approved By : ป. 57
Mr. Pacit Mathavorn
Calibration Engineer Supervisor
Issue Date : 27 August 2024

เอกสารไม่ควบคุม

Certificate No : 24-AFM-156

Request No : Req-2024-1575

Result of Calibration : Without Adjustment

| Temperature (°C) | Pressure (kPa) | STD (l/min) | UUC (l/min) | Error (l/min) | Uncertainty (l/min) | MPE (l/min) | Result |
|---------------------|-------------------|----------------|----------------|------------------|------------------------|----------------|--------|
| 21.50 | 100.55 | 0.020 | 0.021 | 0.001 | 0.0013 | 0.005 | N/A |
| 21.30 | 100.53 | 0.050 | 0.052 | 0.002 | 0.0033 | 0.005 | N/A |
| 21.40 | 100.56 | 0.099 | 0.101 | 0.002 | 0.0028 | 0.005 | N/A |
| 21.30 | 100.58 | 0.200 | 0.204 | 0.004 | 0.0056 | 0.005 | N/A |
| 21.50 | 100.54 | 0.500 | 0.505 | 0.005 | 0.007 | 0.010 | N/A |
| 21.60 | 100.52 | 1.000 | 1.019 | 0.019 | 0.014 | 0.020 | N/A |
| 21.40 | 100.58 | 1.698 | 1.731 | 0.033 | 0.024 | 0.034 | N/A |
| 21.70 | 100.63 | 1.999 | 2.037 | 0.038 | 0.029 | 0.040 | N/A |
| 21.60 | 100.64 | 2.998 | 3.057 | 0.059 | 0.043 | 0.060 | N/A |
| 22.00 | 100.80 | 4.002 | 4.079 | 0.077 | 0.056 | 0.080 | N/A |
| 22.30 | 100.96 | 5.001 | 5.094 | 0.093 | 0.072 | 0.100 | N/A |

Note STD : Standard UUC : Unit Under Calibration
 - UUC Reference Condition : 21.1 °C, 101.3 kPa, Air
 - Flow Rate was corrected for non-standard operating condition by using equation :

$$Q_{\text{meas}} = Q_{\text{ref}} \times \frac{P_{\text{ref}}}{P_{\text{meas}}} \times \frac{T_{\text{meas}}}{T_{\text{ref}}}$$

where Q = Flow Rate P = Absolute Pressure T = Absolute Temperature
 Meas = Measurement Condition ref = Standard Condition

* Indicates non accredited

MPE = Maximum Permissible Error (Specified in Manufacturer's Specifications)

N/A = Not Available, Customer does not require a statement of conformity.

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The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

Certificate No : 24-AFM-156

Request No : Req-2024-1575

Decision Rule for Statements of Conformity

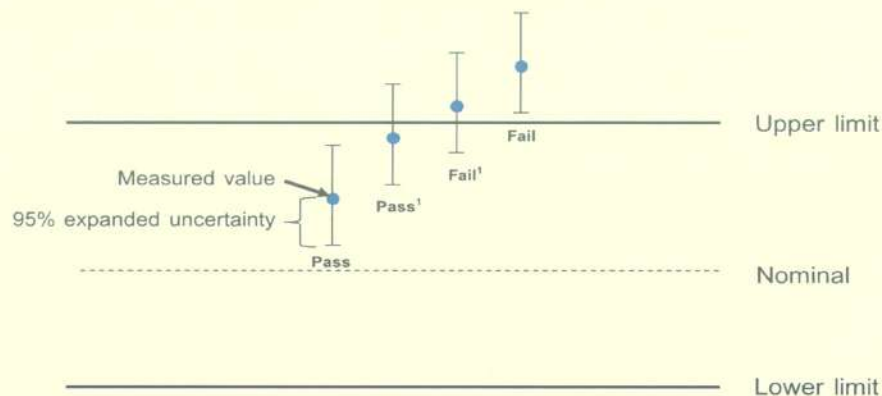
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09/2019: Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

Pass = The measurement result plus the expanded uncertainty with a 95% coverage probability were within the limit.

Pass¹ = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail¹ = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

Fail = The measurement result plus the expanded uncertainty with a 95% coverage probability were outside the limit.



End of Certificate

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484



Certificate of Calibration

Certificate No. : 24P1370

Page : 1 of 2

Equipment : Aneroid Barometer
Manufacturer: Barigo
Model : 111MS
Serial No.: -
ID No.: UAE.EMA2.065/2552

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

Condition As-Received: Used Item

Received Date: 05 April 2024

Calibration Date: 22 April 2024

Reference: 2404-0243WSC

Submitted by: United Analyst and Engineering Consultant Co.,Ltd.

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

Atmospheric Pressure: 1007 mbar

81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to calibration procedure CP-P10, using " DKD-R 6-1 ; Calibration of Pressure Gauges " as a guidelines.

Condition of this result of calibration

1.Reference standards instruments :

| <u>Instrument</u> | <u>Model</u> | <u>Serial No.</u> | <u>Certificate No.</u> | <u>Due Date</u> |
|-----------------------|--------------|-------------------|------------------------|-----------------|
| 1) Standard Barometer | DPI142 | 1422505046 | MP-0094-23 | 03 May 2024 |

2.This instrument was installed in vertical orientation and center of the dial was used as the reference level.

3.This result of calibration was made on requested at the point specified by customer.

4.Scale and conversion factor is 1 kPa = 7.50062 mmHg

5.This result of calibration instrument was in absolute pressure.

6.This instrument was used clean air as pressure media.

7.The certificate is valid only to the item calibrated on date and place of calibration.

8.This Certification is traceable to the International System of Unit maintained through:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suksan Khankaew
Issue Date : 23 April 2024

Approved Signatory : _____
[] Phalinee Prabpaipal
[] Sura Suwannasri
[✓] Attapol Panurach

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Cert.No.: 24P1370

Page: 2 of 2

Result of calibration:- Without adjustment

Range : 720 mmHg to 770 mmHg

Function:- Absolute Pressure Measurement

Scale Interval : 1 mmHg (The Fifth Estimate)

Increasing Pressure

| | | | | | | |
|-------------------------|--------|--------|--------|--------|--------|--------|
| Applied Pressure (mmHg) | 715.75 | 726.88 | 738.53 | 749.84 | 761.99 | 774.19 |
| UUC* Indication (mmHg) | 720.0 | 730.0 | 740.0 | 750.0 | 760.0 | 770.0 |
| Error (mmHg) | 4.25 | 3.12 | 1.47 | 0.16 | -1.99 | -4.19 |

Decreasing Pressure

| | | | | | | |
|-------------------------|--------|--------|--------|--------|--------|--------|
| Applied Pressure (mmHg) | 774.19 | 761.85 | 749.40 | 738.00 | 726.53 | 715.75 |
| UUC* Indication (mmHg) | 770.0 | 760.0 | 750.0 | 740.0 | 730.0 | 720.0 |
| Error (mmHg) | -4.19 | -1.85 | 0.60 | 2.00 | 3.47 | 4.25 |

The uncertainty of measurement was ± 0.24 mmHg

* UUC = Unit Under Calibration

The 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 %.

-oOo-

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484



Certificate of Calibration

Certificate No. : 25P1359

Page : 1 of 2

Equipment : Aneroid Barometer
Manufacturer: Barigo
Model : 111MS
Serial No.: -
ID No.: UAE.EMA2.067/2552

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

Condition As-Received: Used Item

Received Date: 10 April 2025

Calibration Date: 17 April 2025

Reference: 2504-0315WSC

Submitted by: United Analyst and Engineering Consultant Co.,Ltd.

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

81 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260

Atmospheric Pressure: 1009 mbar

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to calibration procedure CP-P10, using " DKD-R 6-1 ; Calibration of Pressure Gauges " as a guidelines.

Condition of this result of calibration

1.Reference standards instruments :

| <u>Instrument</u> | <u>Model</u> | <u>Serial No.</u> | <u>Certificate No.</u> | <u>Due Date</u> |
|-----------------------|--------------|-------------------|------------------------|-----------------|
| 1) Standard Barometer | DPI142 | 1422505046 | MP-0133-24 | 15 May 2025 |

2.This instrument was installed in vertical orientation and center of the dial was used as the reference level.

3.This result of calibration was made on requested at the point specified by customer.

4.Scale and conversion factor is 1 kPa = 7.50062 mmHg

5.This result of calibration instrument was in absolute pressure.

6.This instrument was used clean air as pressure media.

7.The certificate is valid only to the item calibrated on date and place of calibration.

8.This Certification is traceable to the International System of Unit maintained through:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Kaerkpon Saivichai
Issue Date : 21 April 2025

Approved Signatory :

Attapol P.

[] Phalinee Prabpaipal

[] Sura Suwannasri

[✓] Attapol Panurach

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Result of calibration:- Without adjustment

Range : 720 mmHg to 780 mmHg

Function:- Absolute Pressure Measurement

Scale Interval : 1 mmHg (The Fifth Estimate)

Increasing Pressure

| | | | | | | | |
|-------------------------|--------|--------|--------|--------|--------|--------|--------|
| Applied Pressure (mmHg) | 717.92 | 728.95 | 739.74 | 750.28 | 761.55 | 773.52 | 784.47 |
| UUC* Indication (mmHg) | 720.0 | 730.0 | 740.0 | 750.0 | 760.0 | 770.0 | 780.0 |
| Error (mmHg) | 2.08 | 1.05 | 0.26 | -0.28 | -1.55 | -3.52 | -4.47 |

Decreasing Pressure

| | | | | | | | |
|-------------------------|--------|--------|--------|--------|--------|--------|--------|
| Applied Pressure (mmHg) | 784.47 | 773.53 | 761.51 | 750.35 | 739.81 | 729.05 | 718.10 |
| UUC* Indication (mmHg) | 780.0 | 770.0 | 760.0 | 750.0 | 740.0 | 730.0 | 720.0 |
| Error (mmHg) | -4.47 | -3.53 | -1.51 | -0.35 | 0.19 | 0.95 | 1.90 |

The uncertainty of measurement was ± 0.24 mmHg

* UUC = Unit Under Calibration

The 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 %.

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484



Certificate of Calibration

Certificate No. : 24H1487

Page : 1 of 2

Equipment : Digital Thermo-Hygrometer
Manufacturer: Digicon
Model : TH-02A
Serial No.: 435031148
ID No.: UAE.EFM.006/2567

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

Condition As-Received: New Item

Received Date: 10 July 2024

Calibration Date: 15 July 2024
to 17 July 2024

Reference: 2407-0393WSC

Submitted by: United Analyst and Engineering Consultant Co.,Ltd.

Ambient Temperature: (25 ± 3) °C

Relative Humidity: (50 ± 20) %

81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260

Procedure used: Calibration were conducted using in-house calibration procedure CP-H03 according to comparison with standard chilled mirror sensor for humidity measurement function and comparison with standard temperature probe for temperature measurement function into humidity / temperature chamber.

Condition of this result of calibration

1.Reference standards instruments :

| <u>Instrument</u> | <u>Model</u> | <u>Serial No.</u> | <u>Certificate No.</u> | <u>Due Date</u> |
|--|--------------|-------------------|------------------------|-----------------|
| 1) Standard Chilled Mirror Hygrometer Sensor | Dew Prime II | 31863 | 21819 | 25 Sep 2024 |
| 2) Handheld Thermometer With Sensor | 1523 | 5717096 | 2311321 | 08 Nov 2024 |

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

3.This Certification is traceable to the International System of Unit maintained through:-

-Thunder Scientific Corporation, NVLAB Accreditation No. Calibration 200582-0

-Technology Promotion Association (Thailand-Japan), NSC-ONSC Accredited No. Calibration 0008

Calibrated by : Surasit Phansudnoi
Issue Date : 17 July 2024

Approved Signatory :

Viporn

[] Chakrit Waewwanjua

[✓] Viporn Tantiyawutti

[] Unnopphol Harachai

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Cert. No.: 24H1487

Page.: 2 of 2

Result of Calibration:- Without Adjustment

Function: Humidity Measurement.

| <u>Reference</u> <u>Temperature</u> (°C) | <u>Standard</u> <u>Humidity</u> (%R.H.) | <u>UUC*</u> <u>Reading</u> (%R.H.) | <u>Error</u> (%R.H.) | <u>Uncertainty</u> <u>of Measurement</u> (±%R.H.) |
|--|---|--|-------------------------|---|
| 25.0 | 40.1 | 39 | -1.1 | 1.4 |
| 25.0 | 50.1 | 48 | -2.1 | 1.6 |
| 25.0 | 60.0 | 58 | -2.0 | 1.6 |
| 25.0 | 70.2 | 68 | -2.2 | 1.6 |

Result of Calibration:- Without Adjustment

Function: Temperature Measurement.

| <u>Standard</u> <u>Temperature</u> (°C) | <u>UUC*</u> <u>Reading</u> (°C) | <u>Error</u> (°C) | <u>Uncertainty</u> <u>of Measurement</u> (±°C) |
|---|---------------------------------------|----------------------|--|
| 20.014 | 20.3 | 0.286 | 0.42 |
| 24.984 | 25.2 | 0.216 | 0.42 |
| 30.050 | 30.1 | 0.050 | 0.42 |
| 40.027 | 40.0 | -0.027 | 0.42 |

UUC* : Unit Under Calibration

The reported uncertainty of measurement was base on standard uncertainty multiplied by coverage factor $k = 2.00$, providing confidence level approximately 95%.

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Certificate of Calibration

Customer

Name : UNITED ANALYST AND ENGINEERING CONSULTANT
CO.,LTD.
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong,
Bangkok 10260

Certificate No : 24-LXM-199

Request No : Req-2024-1492

Page : 1/3

Unit Under Calibration Details

| | | | |
|-----------------|--------------------|-------------------|-----------------------------|
| Instrument Name | : Light Meter | Range Calibration | : 2000 , 20000 lx |
| Manufacturer | : EXTECH | Accuracy | : 4 % of Reading + 2 digits |
| Model | : 407026 | Instrument Status | : Used |
| Serial Number | : A062335 | | |
| Resolution | : 1 , 10 lx | | |
| ID Number | : UAE.EFM.108/2566 | | |

Calibration Environment and Details

Temperature : 25 °C ± 2 °C
Humidity : 60 %RH ± 20 %RH
Received Date : 3 July 2024
Calibrated Date : 1 August 2024
Calibration Procedure : The measurement was done in accordance with CP-LXM-01

Reference Standard : Photometer and Illuminance Sensor, Serial No.: 30662/2, 30592/2, which was calibrated on 31 October 2023,
Certificate No.: TP-1045-23

Traceability : This Certificate is traceable to International System of Unit (SI) Unit through National Institute
of Metrology (Thailand)

Note

The reported uncertainty is based on a standard uncertainty multiplied by the Coverage Factor $k = 2$, providing a level of confidence approximately 95 %.

Approved By :



Mr. Pacit Mathavorn

Calibration Engineer Supervisor

Issue Date :

1 August 2024

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Calibration Note

UUC Adjustment : Zero adjustment before use

Certificate No : 24-LXM-199

Request No : Req-2024-1492

Page : 2/3

Result of Calibration :

| UUC Range (Ix) | Standard (Ix) | UUC Reading (Ix) | Correction (Ix) | Uncertainty (\pm Ix) | MPE (Ix) | Reslt |
|----------------|---------------|------------------|-----------------|-------------------------|----------|-------|
| 2000 | * 0 | 0 | 0 | 0.58 | 2 | N/A |
| | 50 | 50 | 0 | 2.5 % of Reading | 4 | N/A |
| | 100 | 99 | 1 | 2.3 % of Reading | 6 | N/A |
| | 200 | 199 | 1 | 2.2 % of Reading | 10 | N/A |
| | 300 | 302 | -2 | 2.2 % of Reading | 14 | N/A |
| | 400 | 403 | -3 | 2.2 % of Reading | 18 | N/A |
| | 600 | 604 | -4 | 2.2 % of Reading | 26 | N/A |
| | 800 | 803 | -3 | 2.2 % of Reading | 34 | N/A |
| | 1000 | 1005 | -5 | 2.2 % of Reading | 42 | N/A |
| | 1200 | 1206 | -6 | 2.2 % of Reading | 50 | N/A |
| | 1400 | 1409 | -9 | 2.2 % of Reading | 58 | N/A |
| | 1600 | 1611 | -11 | 2.2 % of Reading | 66 | N/A |
| | 1800 | 1808 | -8 | 2.2 % of Reading | 74 | N/A |
| | 2000 | 1990 | 10 | 2.2 % of Reading | 82 | N/A |
| 20000 | 3000 | 2970 | 30 | 2.2 % of Reading | 121 | N/A |
| | 4000 | 3960 | 40 | 2.2 % of Reading | 160 | N/A |
| | 5000 | 4950 | 50 | 2.2 % of Reading | 200 | N/A |

* Indicates non accredited

MPE = Maximum Permissible Error (Specified in Manufacturer's Specification)

N/A = Not Aavailable, Customer does not require a statement of conformity.

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Certificate No : 24-LXM-199

Request No : Req-2024-1492

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Decision Rule for Statements of Conformity

The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09/2019;

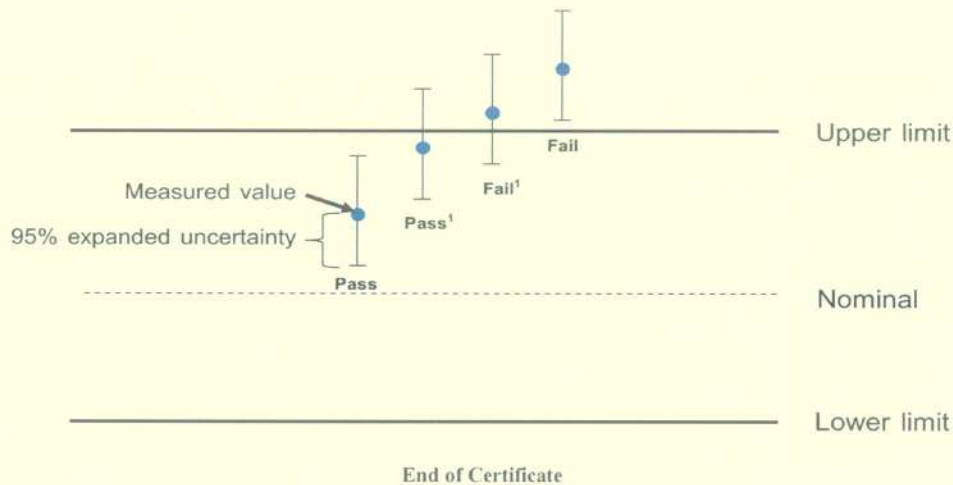
Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

Pass = The measurement result plus the expanded uncertainty with a 95% coverage probability were within the limit.

Pass¹ = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail¹ = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

Fail = The measurement result plus the expanded uncertainty with a 95% coverage probability were outside the limit.



Calibrated By :

me

Mr. Noppadon Luangart

เอกสารไม่ควบคุม

Certificate of Calibration

Customer

Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok
10260

Certificate No : 24-TPM-371

Request No : Req-2024-1693

Page : 1/2

Unit Under Calibration Details

| | | | |
|-----------------------|-------------------------------|---------------------------|------------------|
| Calibration Parameter | : Temperature | Range Calibration | : 20 °C to 60 °C |
| Instrument Name | : Thermal Environment Monitor | Type of Sensor | : RTD |
| Manufacturer | : TSI QUEST | Sensor Diameter (mm) | : 4.5 |
| Model | : QT-34 | Calibration Position (mm) | : 67.5 |
| Serial Number | : TEK120020 | Instrument Status | : Used |
| Resolution | : 0.1 °C | | |
| ID Number | : UAE.EMA2.023/2555 | | |

Calibration Environment and Details

Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 15 %RH
Received Date : 2 August 2024
Calibrated Date : 15 August 2024
Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

Reference Standard : Digital Thermometer with Sensor, Manufacturer: GINGO/GINGO, Model: GT11/ RTD100, SN: 08000057, ID: 02-TPM
Which was calibrated on 1 March 2024, Calibration Certificate No. : QR24-0478

Traceability : This Certificate is traceable to SI Unit through Quality Reborn Co., Ltd., NSC-ONSC Accreditation No.: Calibration 0292

Note

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor $k=2$, providing a level of confidence approximately 95 %.

Approved By :



Mr. Noppadon Luangart

Technical Manager

Issue Date :

19 August 2024

เอกสารไม่ควบคุม

Calibration Note

UUC Adjustment : Not Adjust

Certificate No : 24-TPM-371

Request No : Req-2024-1693

Page : 2/2

Result of Calibration :

| UUC Sensor | Standard Temperature (°C) | UUC Reading (°C) | Correction (°C) | Uncertainty (± °C) |
|------------|---------------------------|------------------|-----------------|--------------------|
| WET | 20.031 | 20.0 | 0.0 | 0.13 |
| | 25.031 | 25.1 | - 0.1 | 0.13 |
| | 30.034 | 30.0 | 0.0 | 0.13 |
| | 35.036 | 35.0 | 0.0 | 0.13 |
| | 40.035 | 40.0 | 0.0 | 0.13 |
| | 45.038 | 45.2 | - 0.2 | 0.13 |
| | 50.041 | 50.0 | 0.0 | 0.13 |
| | 60.046 | 60.0 | 0.0 | 0.13 |
| DRY | 20.032 | 19.9 | + 0.1 | 0.13 |
| | 25.031 | 25.1 | - 0.1 | 0.13 |
| | 30.034 | 29.9 | + 0.1 | 0.13 |
| | 35.036 | 35.1 | - 0.1 | 0.13 |
| | 40.037 | 39.9 | + 0.1 | 0.13 |
| | 45.038 | 45.1 | - 0.1 | 0.13 |
| | 50.041 | 48.9 | + 1.1 | 0.13 |
| | 60.046 | 59.9 | + 0.1 | 0.13 |
| GLOBE | 20.032 | 19.9 | + 0.1 | 0.13 |
| | 25.030 | 25.2 | - 0.2 | 0.13 |
| | 30.035 | 29.9 | + 0.1 | 0.13 |
| | 35.035 | 35.1 | - 0.1 | 0.13 |
| | 40.037 | 39.9 | + 0.1 | 0.13 |
| | 45.040 | 45.1 | - 0.1 | 0.13 |
| | 50.040 | 50.0 | 0.0 | 0.13 |
| | 60.045 | 60.0 | 0.0 | 0.13 |

End of Certificate

Calibrated By :



Mr. Sittichok Jirapukdeesakul

เอกสารไม่ควบคุม



Certificate of Calibration

Customer

Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok
10260

Certificate No : 24-TPM-369

Request No : Req-2024-1692

Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature
Instrument Name : Thermal Environment Monitor
Manufacturer : 3M
Model : QT-32
Serial Number : TPQ020022
Resolution : 0.1 °C
ID Number : UAE.EFM.005/2559
Range Calibration : 20 °C to 60 °C
Type of Sensor : RTD
Sensor Diameter (mm) : 4.5
Calibration Position (mm) : 67.5
Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 15 %RH
Received Date : 2 August 2024
Calibrated Date : 15 August 2024
Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

Reference Standard

Digital Thermometer with Sensor, Manufacturer: GINGO/GINGO, Model: GT11/ RTD100, SN: 08000057, ID: 02-TPM
Which was calibrated on 1 March 2024, Calibration Certificate No. : QR24-0478

Traceability

This Certificate is traceable to SI Unit through Quality Reborn Co., Ltd., NSC-ONSC Accreditation No.: Calibration 0292

Note

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor $k=2$, providing a level of confidence approximately 95 %.

Approved By :

me

Mr. Noppadon Luangart

Technical Manager

Issue Date :

19 August 2024

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Calibration Note

UUC Adjustment : Not Adjust

Certificate No : 24-TPM-369

Request No : Req-2024-1692

Page : 2/2

Result of Calibration :

| UUC Sensor | Standard Temperature (°C) | UUC Reading (°C) | Correction (°C) | Uncertainty (± °C) |
|------------|---------------------------|------------------|-----------------|--------------------|
| WET | 20.031 | 20.0 | 0.0 | 0.13 |
| | 25.031 | 25.1 | - 0.1 | 0.13 |
| | 30.031 | 30.0 | 0.0 | 0.13 |
| | 35.037 | 35.1 | - 0.1 | 0.13 |
| | 40.037 | 40.0 | 0.0 | 0.13 |
| | 45.038 | 45.1 | - 0.1 | 0.13 |
| | 50.041 | 50.1 | - 0.1 | 0.13 |
| | 60.044 | 60.1 | - 0.1 | 0.13 |
| DRY | 20.032 | 20.0 | 0.0 | 0.13 |
| | 25.030 | 25.1 | - 0.1 | 0.13 |
| | 30.033 | 30.0 | 0.0 | 0.13 |
| | 35.035 | 35.2 | - 0.2 | 0.13 |
| | 40.037 | 40.0 | 0.0 | 0.13 |
| | 45.038 | 45.1 | - 0.1 | 0.13 |
| | 50.041 | 50.1 | - 0.1 | 0.13 |
| | 60.045 | 60.1 | - 0.1 | 0.13 |
| GLOBE | 20.032 | 20.0 | 0.0 | 0.13 |
| | 25.030 | 25.0 | 0.0 | 0.13 |
| | 30.034 | 30.0 | 0.0 | 0.13 |
| | 35.035 | 35.2 | - 0.2 | 0.13 |
| | 40.038 | 40.0 | 0.0 | 0.13 |
| | 45.039 | 45.2 | - 0.2 | 0.13 |
| | 50.040 | 50.1 | - 0.1 | 0.13 |
| | 60.045 | 60.1 | - 0.1 | 0.13 |

End of Certificate

Calibrated By :

Mr. Sittichok Jirapukdeesakul

เอกสารไม่ควบคุม