



บริษัท ปตท. น้ำมันและการค้าปลีก จำกัด (มหาชน)

รายงานผลการปฏิบัติตามมาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม  
และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม

โครงการทำเทียบเรือขนถ่ายน้ำมันและก๊าซปิโตรเลียมเหลวสุราษฎร์ธานี แห่งที่ 2

ระหว่างเดือนมกราคมถึงมิถุนายน พ.ศ. 2566

ภาคผนวก จ

ใบรับรองการสอบเทียบเครื่องมือ



right solutions.  
right partner.

รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

| Sample Name  | Parameter                    | Equipment Name                 | ID No.     | Calibrated Date | Next Cal  | Freq. Calibrate<br>(Months) |
|--------------|------------------------------|--------------------------------|------------|-----------------|-----------|-----------------------------|
| Ambient      | Total Hydrocarbon            | Total Hydrocarbon Analyzer     | BKK_EN0057 | 9-Aug-22        | 9-Feb-24  | 18                          |
| Ambient      | Volatile Organic Compounds   | GC-MSD                         | RYG_EN0136 | 7-Jul-22        | 7-Jan-24  | 18                          |
| Ambient      | Wind Speed / Wind Direction  | Wind Speed / Wind Direction    | SGK_FS0036 | 13-Jul-22       | 12-Jan-24 | 18                          |
| Ambient      | Wind Speed / Wind Direction  | Wind Speed / Wind Direction    | SGK_FS0089 | 13-Jan-23       | 13-Jul-24 | 18                          |
| Noise        | Leq 24 hrs                   | Sound Calibrator               | SGK_FS0114 | 14-Nov-22       | 14-Nov-23 | 12                          |
| Noise        | Leq 24 hrs                   | Sound Level Meter              | SGK_FS0015 | 11-Jul-22       | 11-Jul-23 | 12                          |
| Noise        | Noise Annoyance              | Sound Calibrator               | SGK_FS0114 | 14-Nov-22       | 14-Nov-23 | 12                          |
| Noise        | Noise Annoyance              | Sound Level Meter              | SGK_FS0015 | 11-Jul-22       | 11-Jul-23 | 12                          |
| Songkhla Lab | BOD                          | Incubator                      | SGK_CL0028 | 25-Jan-22       | 26-Jul-23 | 18                          |
| Songkhla Lab | BOD                          | DO/BOD Analyser                | SGK_CL0073 | 21-Nov-22       | 21-May-24 | 18                          |
| Songkhla Lab | pH at 25 °C                  | pH meter                       | SGK_CL0030 | 28-Apr-23       | 28-Oct-24 | 18                          |
| Songkhla Lab | Oil & Grease                 | Electronic Top-Loading Balance | SGK_CL0045 | 25-Jan-23       | 25-Jan-24 | 12                          |
| Songkhla Lab | Oil & Grease                 | Oven                           | SGK_CL0024 | 28-Apr-23       | 28-Oct-24 | 18                          |
| Songkhla Lab | Oil & Grease                 | Water Bath                     | SGK_CL0035 | 5-Feb-22        | 6-Aug-23  | 18                          |
| Songkhla Lab | Total Dissolved Solids 180°C | Electronic Top-Loading Balance | SGK_CL0045 | 25-Jan-23       | 25-Jan-24 | 12                          |
| Songkhla Lab | Total Dissolved Solids 180°C | Oven                           | SGK_CL0024 | 28-Apr-23       | 28-Oct-24 | 18                          |
| Songkhla Lab | Total Suspended Solids       | Electronic Top-Loading Balance | SGK_CL0045 | 25-Jan-23       | 25-Jan-24 | 12                          |
| Songkhla Lab | Total Suspended Solids       | Oven                           | SGK_CL0024 | 28-Apr-23       | 28-Oct-24 | 18                          |
| Songkhla Lab | Total Coliform               | Autoclave                      | SGK_ML0001 | 5-Jan-23        | 5-Jul-24  | 18                          |
| Songkhla Lab | Total Coliform               | Incubator                      | SGK_ML0013 | 6-Aug-22        | 6-Feb-24  | 18                          |
| Songkhla Lab | Total Coliform               | pH Meter                       | SGK_ML0016 | 5-Jan-23        | 5-Jul-24  | 18                          |
| Songkhla Lab | Total Coliform               | Water Bath                     | SGK_ML0021 | 30-Jan-23       | 30-Jul-24 | 18                          |
| Songkhla Lab | Fecal Coliform               | Autoclave                      | SGK_ML0001 | 5-Jan-23        | 5-Jul-24  | 18                          |
| Songkhla Lab | Fecal Coliform               | Incubator                      | SGK_ML0013 | 6-Aug-22        | 6-Feb-24  | 18                          |
| Songkhla Lab | Fecal Coliform               | pH Meter                       | SGK_ML0016 | 5-Jan-23        | 5-Jul-24  | 18                          |
| Songkhla Lab | Fecal Coliform               | Water Bath                     | SGK_ML0021 | 30-Jan-23       | 30-Jul-24 | 18                          |



JIRANATEE ASSOCIATES CO., LTD.

## CALIBRATION REPORT

REVIEW BY Vichuta N.

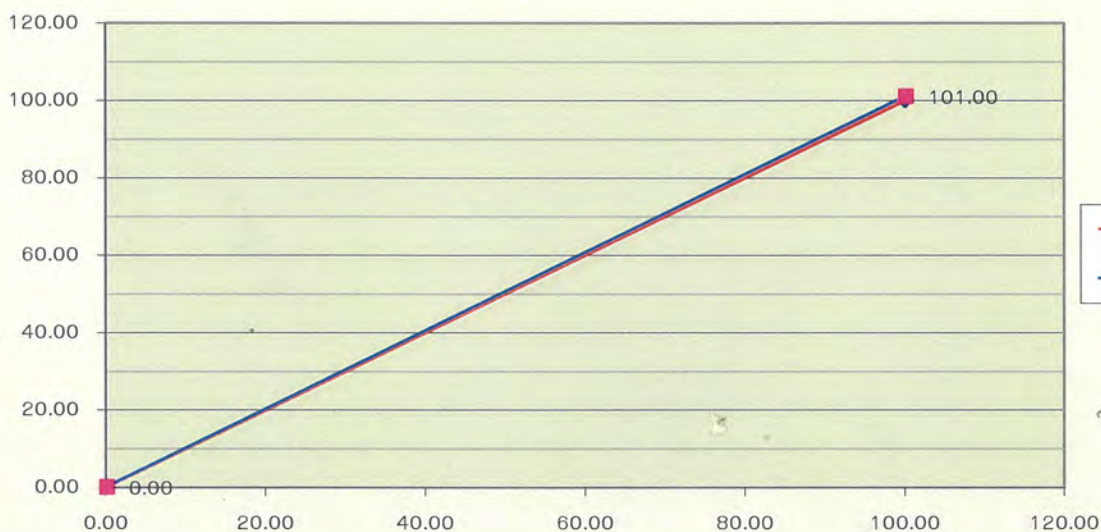
APPROVED BY Sararat M.

NEXT CAL. DATE 9/2/67

|   |                   |
|---|-------------------|
| CUSTOMER NAME : ALS Laboratory Group (Thailand) Co., Ltd. |                   |
| EQUIPMENT NAME : Total Hydrocarbon Analyzer               |                   |
| MANUFACTURER : Baseline                                   | MODEL : 9000 NMHC |
| SERIAL NO : 0314DR0170                                    |                   |
| STANDARD GAS CONCENTRATION (PPM) : 100 PPM (Methane)      |                   |
| CYLINDER NO : ND55981                                     |                   |
| CYLINDER PRESSURE (psig) : 900 PSI                        |                   |
| CERTIFIED DATE : 12/02/2022                               |                   |
| CERTIFIED BY : AIRGAS                                     |                   |
| EXPIRED DATE : 12/02/2025                                 |                   |

## CALIBRATION RESULTS

| POINT NO    | CALIBRATION RESULTS |        |       |        |
|-------------|---------------------|--------|-------|--------|
|             | IDEAL               | ACTUAL | ERROR | %ERROR |
| ZERO        | 0.00                | 0.00   | 0.00  | -      |
| 1           | 100.00              | 101.00 | 1.0   | -1.00  |
| AVERAGE (%) |                     |        |       | 0.25   |



CALIBRATED BY : วรพอล ดุสิตใจ

DATE : 9/8/65

CHECKED BY : ศศิธร อังคาร

DATE : 9/8/65



ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : เจ้าหน้าที่ฝ่ายบริการหลังการขาย , โทร 02-868-0812 # 31 , E-Mail : Engineer@Jiranatee.com

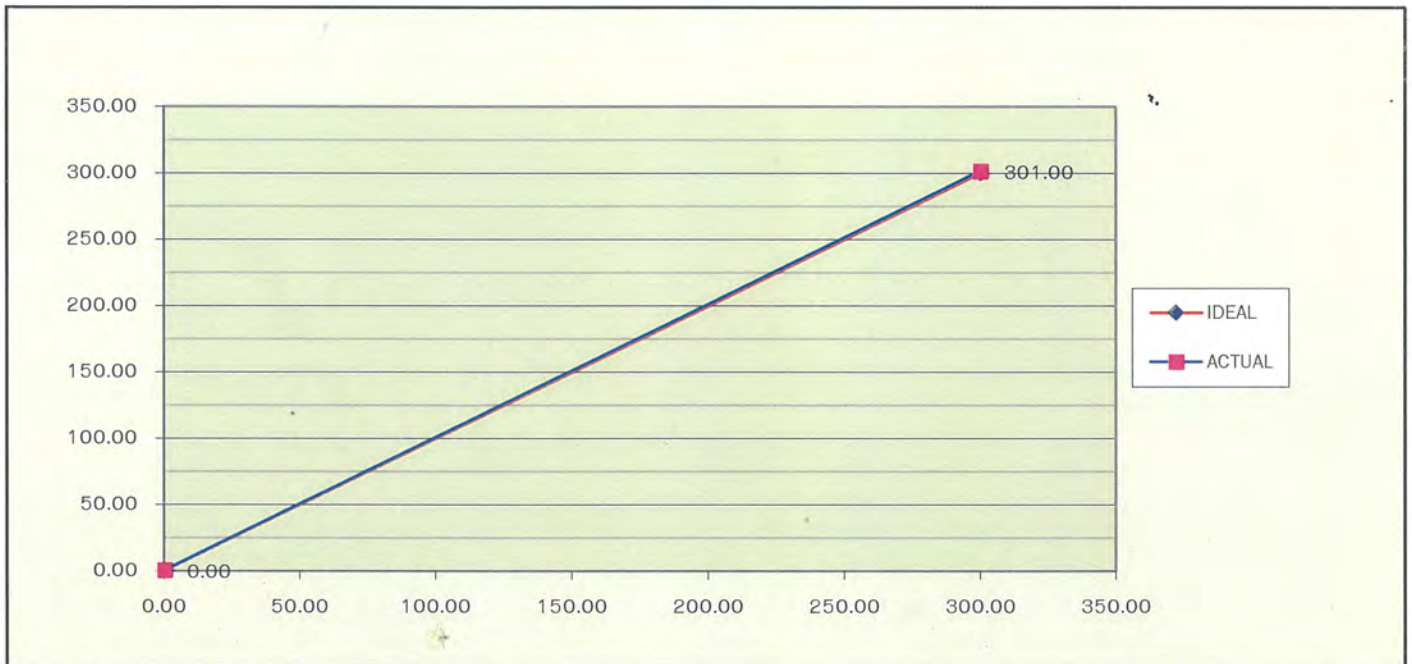
เลขที่ 63/14-15,67/35-36 ถนน เพชรเกษม 7,7/1 แขวง วัดท่าพระ เขต บางกอกใหญ่ กรุงเทพฯ 10600 โทร 02-868-0812-13 โทรสาร 02868-1889

## CALIBRATION REPORT

|   |  |
|---|--|
| CUSTOMER NAME : ALS Laboratory Group (Thailand) Co., Ltd. |  |
| EQUIPMENT NAME : Total Hydrocarbon Analyzer               |  |
| MANUFACTURER : Baseline                                   | MODEL : 9000 NMHC SERIAL NO : 0314DR0170 |
| STANDARD GAS CONCENTRATION (PPM) : 100 PPM ( Propane )    |  |
| CYLINDER NO : ND55981                                     |  |
| CYLINDER PRESSURE (psig) : 900 PSI                        | CERTIFIED DATE : 12/02/2022              |
| CERTIFIED BY : AIRGAS                                     | EXPIRED DATE : 12/02/2025                |

### CALIBRATION RESULTS

| POINT NO    | CALIBRATION RESULTS |        |       |        |
|-------------|---------------------|--------|-------|--------|
|             | IDEAL               | ACTUAL | ERROR | %ERROR |
| ZERO        | 0.00                | 0.00   | 0.00  | -      |
| 1           | 300.00              | 301.00 | 1.0   | 0.33   |
| AVERAGE (%) |                     |        |       | 0.08   |



CALIBRATED BY : วรณล ศักดิ์เจริญ DATE : 9/18/65

CHECKED BY : ศิษฐ์ วัฒนา DATE : 9/18/65



ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : เจ้าหน้าที่ฝ่ายบริการหลังการขาย , โทร 02-868-0812 # 31 , E-Mail : Engineer@jiranatee.com

เลขที่ 63/14-15,67/35-36 ถนนเพชรเกษม 7,7/1 แขวง วัดท่าพระ เขต บางกอกใหญ่ กรุงเทพฯ 10600 โทร 02-868-0812-13 โทรสาร 02868-1889

**FLOW CALIBRATE**

|                |   |   |               |                    |
|----------------|---|---|---------------|--------------------|
| CUSTOMER NAME  | : | ALS Laboratory Group (Thailand) Co., Ltd. |               |                    |
| EQRIPMENT NAME | : | Flow Calibrator                           |               |                    |
| MANUFACTURER   | : | Bios                                      | MODEL : 510 L | SERIAL NO : 129549 |

| Flow Parameter | Step   | Set | Display | Flow Meter  |
|----------------|--------|-----|---------|-------------|
| Sample         | Before | 40  | 38      | 15 cc/min   |
|                | After  | 40  | 40      | 39.7 cc/min |
| Air            | Before | 175 | 175     | 190 cc/min  |
|                | After  | 175 | 175     | 176 cc/min  |
| Fuel           | Before | 35  | 32      | 36 cc/min   |
|                | After  | 35  | 35      | 35 cc/min   |

**CALIBRATED BY :** วราพล ดวกิ่งเจริญ **DATE :** 9/8/65  
**CHECKED BY :** สันติ วัฒนา **DATE :** 9/8/65



ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : เจ้าหน้าที่ฝ่ายบริการหลังการขาย , โทร 02-868-0812 # 15-16 , E-Mail : Engineer@jiranatee.com  
 เลขที่ 63/14-15,67/35-36 ถนน เพชรเกษม 7,7/1 แขวง วัดท่าพระ เขต บางกอกใหญ่ กรุงเทพฯ 10600 โทร 02-868-0812-13 โทรสาร 02868-1889

# Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID: RYG\_EN0136  
Organization Name: ALS Laboratory Group ( Thailand ) Co Ltd.  
Organization Location: 616/10 Moo 5, Tambol Mae Nam Koo, A.Pluakdaeng, Rayong, 21140, Thailand  
Date: July 7, 2022 11:27:53 AM  
EQP Name: AgilentRecommended , AgilentRecommended  
EQP Revision: GC.02.52, GCMS.02.52  
Overall Qualification Status: Pass

REVIEW BY N. Banniy  
APPROVED BY [Signature]  
NEXT CAL. DATE 07/01/24

## CDS Logon Verification - GC

Logon: dej.changchon

## Overall CDS Logon Verification - GC Test Status

Pass

## System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

## Overall System Inspection and Basic Safety and Operation Test Status

Pass

## Inlet Pressure Accuracy

Name: 7890

Front SSL

Setpoint Status: Pass

|                      | Setpoint | Actual   |
|----------------------|----------|----------|
| Inlet Pressure:      | 25.0 psi | 25.1 psi |
| Accuracy:            |          | 0.1 psi  |
| Agilent Recommended: |          | <= 1.2   |

Date: July 7, 2022 11:27:53 AM  
System ID: RYG\_EN0136

## Overall Inlet Pressure Accuracy Test Status

Pass

## GC Oven Temperature Accuracy

Name: 7890

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 230.0 230.6 °C

Accuracy: 0.6 °C

Agilent Recommended:  $\geq -1.0$  % setpoint in K ( -5.0 °C )  
 $\leq 1.0$  % setpoint in K ( 5.0 °C )

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 100.0 99.9 °C

Accuracy: -0.1 °C

Agilent Recommended:  $\geq -1.0$  % setpoint in K ( -3.7 °C )  
 $\leq 1.0$  % setpoint in K ( 3.7 °C )

## Overall GC Oven Temperature Accuracy Test Status

Pass

## GC Oven Temperature Stability

Name: 7890

Setpoint Status: Pass

Setpoint/Average

Temperature: 100.0 99.91667 °C

Stability: 0.1 °C

Agilent Recommended:  $\leq 0.5$ 

## Overall GC Oven Temperature Stability Test Status

Pass

---

**Log Amp**

---

| Tested Combination1 | Front | SSL | / External | SQ |
|---------------------|-------|-----|------------|----|
|---------------------|-------|-----|------------|----|

|       |       |  |  |  |
|-------|-------|--|--|--|
| Name: | 5977B |  |  |  |
|-------|-------|--|--|--|

|                  |      |  |  |  |
|------------------|------|--|--|--|
| Setpoint Status: | Pass |  |  |  |
|------------------|------|--|--|--|

**Overall Log Amp Test Status**

|      |
|------|
| Pass |
|------|

---

**RFPA**

---

| Tested Combination1 | Front | SSL | / External | SQ |
|---------------------|-------|-----|------------|----|
|---------------------|-------|-----|------------|----|

|       |       |  |  |  |
|-------|-------|--|--|--|
| Name: | 5977B |  |  |  |
|-------|-------|--|--|--|

|                  |      |  |  |  |
|------------------|------|--|--|--|
| Setpoint Status: | Pass |  |  |  |
|------------------|------|--|--|--|

|      |      |     |
|------|------|-----|
| Amu: | 1050 | m/z |
|------|------|-----|

|                           |
|---------------------------|
| Drift After Five Minutes: |
|---------------------------|

|               |
|---------------|
| RFPA Voltage: |
|---------------|

|                      |    |      |     |     |      |
|----------------------|----|------|-----|-----|------|
|                      | -1 | mV   |     | 479 | mV   |
| Agilent Recommended: | >= | -100 | and | <=  | 100  |
|                      |    |      |     | <=  | 1100 |

**Overall RFPA Test Status**

|      |
|------|
| Pass |
|------|

---

**Tune EI**

---

| Tested Combination1 | Front | SSL | / External | SQ |
|---------------------|-------|-----|------------|----|
|---------------------|-------|-----|------------|----|

|       |       |  |  |  |
|-------|-------|--|--|--|
| Name: | 5977B |  |  |  |
|-------|-------|--|--|--|

|                  |      |  |  |  |
|------------------|------|--|--|--|
| Setpoint Status: | Pass |  |  |  |
|------------------|------|--|--|--|

|           |   |
|-----------|---|
| Filament: | 1 |
|-----------|---|

|                  |      |  |  |  |
|------------------|------|--|--|--|
| Setpoint Status: | Pass |  |  |  |
|------------------|------|--|--|--|

|           |   |
|-----------|---|
| Filament: | 2 |
|-----------|---|

**Overall Tune EI Test Status**

|      |
|------|
| Pass |
|------|

---

**Signal to Noise EI**

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|            |                          |
|------------|--------------------------|
| Date:      | July 7, 2022 11:27:53 AM |
| System ID: | RYG_EN0136               |

---

| Tested Combination1 | Front | SSL | / External | SQ |
|---------------------|-------|-----|------------|----|
| Name:               | 5977B |     |            |    |

---

|         |                |           |   |
|---------|----------------|-----------|---|
| Source: | EI - Extractor | Filament: | 1 |
|---------|----------------|-----------|---|

|                  |      |
|------------------|------|
| Setpoint Status: | Pass |
|------------------|------|

|                  |      |
|------------------|------|
| Signal to Noise: | 7485 |
|------------------|------|

|                      |         |
|----------------------|---------|
| Agilent Recommended: | >= 1200 |
|----------------------|---------|

---

|         |                |           |   |
|---------|----------------|-----------|---|
| Source: | EI - Extractor | Filament: | 2 |
|---------|----------------|-----------|---|

|                  |      |
|------------------|------|
| Setpoint Status: | Pass |
|------------------|------|

|                  |      |
|------------------|------|
| Signal to Noise: | 2097 |
|------------------|------|

|                      |         |
|----------------------|---------|
| Agilent Recommended: | >= 1200 |
|----------------------|---------|

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This test's 2 comment(s) and 7 deviation(s) are available in the Attachments section.

**Overall Signal to Noise EI Test Status**

|      |
|------|
| Pass |
|------|

## Instrument Details

### Purpose

This section describes the as found system configuration.

### Details

#### System

|                        |                                   |
|------------------------|-----------------------------------|
| System ID              | RYG_EN0136                        |
| Manufacturer           | Agilent Technologies              |
| Name                   | 7890                              |
| Flow Data Input        | Manual Data                       |
| Temperature Data Input | Manual Data or Other Data Logging |

#### Tested Combination1

|                     |                  |
|---------------------|------------------|
| Injection Technique | Manual Injection |
| Inlet               | Front            |
| Detector            | External         |
| LTM Included?       | No               |

#### Sampler 1

|                     |                      |
|---------------------|----------------------|
| Manufacturer        | Agilent Technologies |
| Type                | Manual Injection     |
| Usage               | Sample Injection     |
| Syringe Volume (µL) | 10                   |

#### Mainframe 1

|                        |                      |
|------------------------|----------------------|
| Manufacturer           | Agilent Technologies |
| Name                   | 7890                 |
| Model Number           | G3442B               |
| Serial Number          | CN16463238           |
| Firmware Revision      | B.02.04.3            |
| Component ID/Asset No. | 081117000236         |
| Oven Type              | Standard             |

## Inlet 1

|              |                                   |
|--------------|-----------------------------------|
| Manufacturer | Agilent Technologies              |
| Name         | 7890                              |
| Type         | SSL                               |
| Location     | Front                             |
| Carrier Gas  | Helium                            |
| Control Type | Electronic Pressure Control (EPC) |
| Purged Inlet | Yes                               |

## Detector 1

|              |                      |
|--------------|----------------------|
| Manufacturer | Agilent Technologies |
| Name         | Mass Spectrometer    |
| Type         | Mass Spectrometer    |
| Location     | External             |

## Mass Spectrometer 1

|                        |                      |
|------------------------|----------------------|
| Manufacturer           | Agilent Technologies |
| Type                   | SQ                   |
| Name                   | 5977B                |
| Serial Number          | US1701M008           |
| Firmware Revision      | 5977 6.00.34         |
| High Vacuum System     | Turbo Pump           |
| Scouting Run Standard  | OFN Std              |
| Component ID/Asset No. | 081117000236         |

## MS EI Source 1

|                     |                      |
|---------------------|----------------------|
| Manufacturer        | Agilent Technologies |
| Source Type         | EI - Extractor       |
| Number of filaments | 2                    |

# Electronic Signature

## Purpose

This signature page was created and published because the ACE sign-off action was executed, which is valid for the entire document, including attachments. The ACE sign-off is an electronic signature that requires two distinct identification components: unique username and personal password. The Agilent representative who has delivered this service understands the meaning and legal status of an electronic signature. As a trained official operator, the Agilent representative has a unique password and logon to access ACE and electronically sign this document. (Other e-signatures can be applied to this document using a Document Content Management or other suitable method defined in your data access and control procedures.)

## Details

|                          |   |
|--------------------------|---|
| Full Name of Signer:     | Eaknarin Puangsopa  |
| Logged On User Name:     | eaknarin_puangsopa@agilent.com                                    |
| Signature Creation Date: | July 7, 2022  |
| Reason for Signature:    | Executed protocol and published this original version of document |

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---

|            |                          |
|------------|--------------------------|
| Date:      | July 7, 2022 11:27:53 AM |
| System ID: | RYG_EN0136               |

User Name: eaknarin\_puangsoa  
 Hostname: ASRYGW7002

System Id: RYG\_EN0136  
 Print Date: July 7, 2022 11:27:56 AM

ALS\_RYG\_EN0136 Transaction log :

| Time                    | Transaction State | Activity Performed | Type of Transaction  | Optional Information   |
|-------------------------|-------------------|--------------------|--|--|
| July 6, 2022 1:11:54 PM | Audit             | SessionCreated     | Session  | None   |
| July 6, 2022 1:11:54 PM | Start             | Configuration      | Session  | None   |
| July 6, 2022 1:11:54 PM | Audit             | Entitlement        | Licensing  | User is Nonpaying and does not require an unlock code  |
| July 6, 2022 1:17:19 PM | Audit             | EqpLoaded          | Session  | EQP details for primary technique [Gc] -<br>File path:<br>[ProtocolPacks/Gc/Configurations/02.52/Gc.02.52.eqp],<br>EQP File Name:<br>[Gc.02.52.eqp], EQP Name:<br>[AgilentRecommended]<br>EQP details for hyphenated technique [GcMs] -<br>File path:<br>[ProtocolPacks/GcMs/Configurations/02.52/GcMs.02.52.eqp], EQP File Name:<br>[GcMs.02.52.eqp], EQP Name:<br>[AgilentRecommended] |
| July 6, 2022 1:17:25 PM | End               | Configuration      | Session  | None   |
| July 6, 2022 1:17:29 PM | Start             | Qualification      | Session  | OQ   |
| July 6, 2022 1:17:30 PM | Start             | Execution          | CDS Logon Verification - GC :<br>- Qualitative test  | None   |
| July 6, 2022 1:19:43 PM | End               | Execution          | CDS Logon Verification - GC :<br>- Qualitative test  | Run Count : 1  |
| July 6, 2022 1:19:46 PM | Start             | Execution          | System Inspection and Basic Safety and Operation - 7890: -<br>Qualitative Test - No setpoints associated | None   |

User Name: eaknarin\_puangsoa  
 Hostname: ASRYGW7002

System Id: RYG\_EN0136  
 Print Date: July 7, 2022 11:27:56 AM

ALS\_RYG\_EN0136 Transaction log :

| Time                    | Transaction State | Activity Performed | Type of Transaction  | Optional Information |
|-------------------------|-------------------|--------------------|--|----------------------|
| July 6, 2022 1:19:59 PM | End               | Execution          | System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated          | Run Count : 1        |
| July 6, 2022 1:20:15 PM | Start             | Execution          | Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi                 | None                 |
| July 6, 2022 1:21:43 PM | End               | Execution          | Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi                 | Run Count : 1        |
| July 6, 2022 1:21:45 PM | Start             | Execution          | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | None                 |
| July 6, 2022 1:25:12 PM | Audit             | Data               | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Manual Data Entry    |
| July 6, 2022 1:25:15 PM | End               | Execution          | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Run Count : 1        |
| July 6, 2022 1:25:17 PM | Start             | Execution          | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | None                 |
| July 6, 2022 1:25:32 PM | Start             | Execution          | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | None                 |
| July 6, 2022 1:33:42 PM | Audit             | Data               | GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K | Manual Data Entry    |

Page 2 / 10

User Name: eaknarin\_puangsoa  
 Hostname: ASRYGW7002

System Id: RYG\_EN0136  
 Print Date: July 7, 2022 11:27:56 AM

## ALS\_RYG\_EN0136 Transaction log :

| Time                    | Transaction State | Activity Performed | Type of Transaction   | Optional Information |
|-------------------------|-------------------|--------------------|---|----------------------|
| July 6, 2022 1:33:43 PM | End               | Execution          | GC Oven Temperature<br>Accuracy - 7890: - Temperature<br>: Oven - S: 100.0°C - L: >= -1.0<br>AND <= 1.0 % setpoint in K | Run Count : 1        |
| July 6, 2022 1:33:45 PM | Start             | Execution          | GC Oven Temperature Stability<br>- 7890: - Temperature : Oven -<br>S: 100.0°C - L: <= 0.5°C                             | None                 |
| July 6, 2022 1:53:05 PM | Audit             | Data               | GC Oven Temperature Stability<br>- 7890: - Temperature : Oven -<br>S: 100.0°C - L: <= 0.5°C                             | Manual Data Entry    |
| July 6, 2022 1:53:07 PM | End               | Execution          | GC Oven Temperature Stability<br>- 7890: - Temperature : Oven -<br>S: 100.0°C - L: <= 0.5°C                             | Run Count : 1        |
| July 6, 2022 1:53:11 PM | Start             | Execution          | Log Amp - 5977B SQ: - Source: None<br>EI - Extractor  |                      |
| July 6, 2022 1:57:10 PM | End               | Execution          | Log Amp - 5977B SQ: - Source: EI<br>EI - Extractor  | Run Count : 1        |
| July 6, 2022 1:57:24 PM | Start             | Execution          | RFPA - 5977B SQ: - Source: EI<br>- Extractor  | None                 |
| July 6, 2022 2:09:24 PM | End               | Execution          | RFPA - 5977B SQ: - Source: EI<br>- Extractor  | Run Count : 1        |
| July 6, 2022 2:09:28 PM | Start             | Execution          | Tune EI - 5977B SQ: - Source: - None<br>EI - Extractor Filament 1<br>(Qualitative - No setpoints associated)            |                      |
| July 6, 2022 2:24:46 PM | End               | Qualification      | Session   | OQ                   |
| July 6, 2022 2:24:46 PM | Start             | Reporting          | Session   | None                 |
| July 6, 2022 2:41:39 PM | End               | Reporting          | Session   | None                 |
| July 6, 2022 2:41:39 PM | Start             | Configuration      | Session   | None                 |
| July 6, 2022 2:41:40 PM | End               | Configuration      | Session   | None                 |

User Name: eaknarin\_puangsoa  
 Hostname: ASRYGW7002

System Id: RYG\_EN0136  
 Print Date: July 7, 2022 11:27:56 AM

ALS\_RYG\_EN0136 Transaction log :

| Time                    | Transaction State | Activity Performed | Type of Transaction   | Optional Information |
|-------------------------|-------------------|--------------------|---|----------------------|
| July 6, 2022 2:41:40 PM | Start             | Qualification      | Session   | OQ                   |
| July 6, 2022 2:41:40 PM | Start             | Execution          | Tune EI - 5977B SQ: - Source: - None<br>EI - Extractor Filament 1<br>(Qualitative - No setpoints associated)          |                      |
| July 6, 2022 2:41:56 PM | End               | Execution          | Tune EI - 5977B SQ: - Source: - Run Count : 1<br>EI - Extractor Filament 1<br>(Qualitative - No setpoints associated) |                      |
| July 6, 2022 2:41:58 PM | Start             | Execution          | Tune EI - 5977B SQ: - Source: - None<br>EI - Extractor Filament 2<br>(Qualitative - No setpoints associated)          |                      |
| July 6, 2022 2:42:48 PM | End               | Qualification      | Session   | OQ                   |
| July 6, 2022 2:42:48 PM | Start             | Reporting          | Session   | None                 |
| July 6, 2022 2:50:52 PM | End               | Reporting          | Session   | None                 |
| July 6, 2022 2:50:52 PM | Start             | Qualification      | Session   | OQ                   |
| July 6, 2022 2:50:52 PM | Start             | Execution          | Tune EI - 5977B SQ: - Source: - None<br>EI - Extractor Filament 2<br>(Qualitative - No setpoints associated)          |                      |
| July 6, 2022 2:51:12 PM | End               | Qualification      | Session   | OQ                   |
| July 6, 2022 2:51:12 PM | Start             | Reporting          | Session   | None                 |
| July 6, 2022 2:55:29 PM | End               | Reporting          | Session   | None                 |
| July 6, 2022 2:55:29 PM | Start             | Qualification      | Session   | OQ                   |
| July 6, 2022 2:55:29 PM | Start             | Execution          | Tune EI - 5977B SQ: - Source: - None<br>EI - Extractor Filament 2<br>(Qualitative - No setpoints associated)          |                      |

User Name: eaknarin\_puangsoapa  
 Hostname: ASRYGW7002

System Id: RYG\_EN0136  
 Print Date: July 7, 2022 11:27:56 AM

ALS\_RYG\_EN0136 Transaction log :

| Time                    | Transaction State | Activity Performed | Type of Transaction   | Optional Information                         |
|-------------------------|-------------------|--------------------|---|--|
| July 6, 2022 2:55:40 PM | End               | Execution          | Tune EI - 5977B SQ: - Source: - Run Count : 1<br>EI - Extractor Filament 2<br>(Qualitative - No setpoints associated) |  |
| July 6, 2022 2:55:45 PM | Start             | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200          | None   |
| July 6, 2022 3:21:52 PM | End               | Qualification      | Session   | QQ   |
| July 6, 2022 3:21:52 PM | Start             | Reporting          | Session   | None   |
| July 6, 2022 3:25:04 PM | End               | Reporting          | Session   | None   |
| July 6, 2022 3:25:04 PM | Start             | Qualification      | Session   | QQ   |
| July 6, 2022 3:25:04 PM | Start             | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200          | None   |
| July 6, 2022 4:06:40 PM | Audit             | AceClosed          | Session   | None   |
| July 7, 2022 9:13:47 AM | Audit             | AceRestarted       | Session   | None   |
| July 7, 2022 9:13:49 AM | Audit             | SessionReloaded    | Session   | None   |
| July 7, 2022 9:13:54 AM | Start             | Qualification      | Session   | QQ   |
| July 7, 2022 9:13:54 AM | Start             | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200          | None   |
| July 7, 2022 9:58:06 AM | Audit             | Data               | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200          | Data files Path :<br>D:\OQ2022\OQFN_SN_F01.D |

User Name: eaknarin\_puangsoa  
 Hostname: ASRYGW7002

System Id: RYG\_EN0136  
 Print Date: July 7, 2022 11:27:56 AM

ALS\_RYG\_EN0136 Transaction log :

| Time                     | Transaction State | Activity Performed | Type of Transaction   | Optional Information                        |
|--------------------------|-------------------|--------------------|---|---|
| July 7, 2022 9:59:53 AM  | End               | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 1 - L: >= 1200 | Run Count : 1                               |
| July 7, 2022 10:01:46 AM | Audit             | TestUnlocked       | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 1 - L: >= 1200 | Deviation filed for Run Count : 1           |
| July 7, 2022 10:01:46 AM | Start             | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 1 - L: >= 1200 | None  |
| July 7, 2022 10:02:00 AM | Audit             | Data               | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 1 - L: >= 1200 | Data files Path :<br>D:\OQ2022\OFN_SN_F01.D |
| July 7, 2022 10:04:55 AM | End               | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 1 - L: >= 1200 | Run Count : 2                               |
| July 7, 2022 10:07:30 AM | Audit             | TestUnlocked       | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 1 - L: >= 1200 | Deviation filed for Run Count : 2           |
| July 7, 2022 10:07:30 AM | Start             | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 1 - L: >= 1200 | None  |
| July 7, 2022 10:07:44 AM | Audit             | Data               | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 1 - L: >= 1200 | Data files Path :<br>D:\OQ2022\OFN_SN_F01.D |

User Name: eaknarin\_puangsoa  
 Hostname: ASRYGW7002

System Id: RYG\_EN0136  
 Print Date: July 7, 2022 11:27:56 AM

ALS\_RYG\_EN0136 Transaction log :

| Time                     | Transaction State | Activity Performed | Type of Transaction  | Optional Information                     |
|--------------------------|-------------------|--------------------|--|--|
| July 7, 2022 10:08:18 AM | End               | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | Run Count : 3                            |
| July 7, 2022 10:10:28 AM | Audit             | TestUnlocked       | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | Deviation filed for Run Count : 3        |
| July 7, 2022 10:10:28 AM | Start             | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | None                                     |
| July 7, 2022 10:10:55 AM | Audit             | Data               | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | Data files Path : D:\OQ2022\OFN_SN_F01.D |
| July 7, 2022 10:14:03 AM | End               | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | Run Count : 4                            |
| July 7, 2022 10:14:54 AM | Audit             | TestUnlocked       | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | Deviation filed for Run Count : 4        |
| July 7, 2022 10:14:54 AM | Start             | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | None                                     |
| July 7, 2022 10:15:15 AM | Audit             | Data               | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200 | Data files Path : D:\OQ2022\OFN_SN_F01.D |

User Name: eaknarin\_puangsoa  
 Hostname: ASRYGW7002

System Id: RYG\_EN0136  
 Print Date: July 7, 2022 11:27:56 AM

ALS\_RYG\_EN0136 Transaction log :

| Time                     | Transaction State | Activity Performed | Type of Transaction   | Optional Information                        |
|--------------------------|-------------------|--------------------|---|---|
| July 7, 2022 10:15:27 AM | End               | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 1 - L: >= 1200 | Run Count : 5                               |
| July 7, 2022 10:16:48 AM | Audit             | TestUnlocked       | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 1 - L: >= 1200 | Deviation filed for Run Count : 5           |
| July 7, 2022 10:16:48 AM | Start             | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 1 - L: >= 1200 | None  |
| July 7, 2022 10:17:05 AM | Audit             | Data               | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 1 - L: >= 1200 | Data files Path :<br>D:\OQ2022\OFN_SN_F01.D |
| July 7, 2022 10:17:14 AM | End               | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 1 - L: >= 1200 | Run Count : 6                               |
| July 7, 2022 10:18:40 AM | End               | Qualification      | Session   | OQ  |
| July 7, 2022 10:18:40 AM | Start             | Reporting          | Session   | None  |
| July 7, 2022 10:21:10 AM | End               | Reporting          | Session   | None  |
| July 7, 2022 10:21:10 AM | Start             | Qualification      | Session   | OQ  |
| July 7, 2022 10:21:17 AM | Start             | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 2 - L: >= 1200 | None  |
| July 7, 2022 10:56:49 AM | End               | Qualification      | Session   | OQ  |
| July 7, 2022 10:56:49 AM | Start             | Reporting          | Session   | None  |
| July 7, 2022 10:57:38 AM | End               | Reporting          | Session   | None  |

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Date: July 7, 2022 11:27:53 AM  
 System ID: RYG\_EN0136

User Name: eaknarin\_puangsoa

System id: RYG\_EN0136

Hostname: ASRYGW7002

Print Date: July 7, 2022 11:27:56 AM

## ALS\_RYG\_EN0136 Transaction log :

| Time                     | Transaction State | Activity Performed | Type of Transaction  | Optional Information                      |
|--------------------------|-------------------|--------------------|--|---|
| July 7, 2022 10:57:38 AM | Start             | Qualification      | Session  | OQ  |
| July 7, 2022 10:57:38 AM | Start             | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | None                                      |
| July 7, 2022 11:06:50 AM | Audit             | Data               | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Data files Path : D:\OQ2022\OFN_SN_F021.D |
| July 7, 2022 11:11:47 AM | Start             | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | None                                      |
| July 7, 2022 11:13:13 AM | End               | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Run Count : 1                             |
| July 7, 2022 11:14:29 AM | Audit             | TestUnlocked       | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Deviation filed for Run Count : 1         |
| July 7, 2022 11:14:29 AM | Start             | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | None                                      |
| July 7, 2022 11:14:47 AM | Audit             | Data               | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Data files Path : D:\OQ2022\OFN_SN_F021.D |
| July 7, 2022 11:16:34 AM | End               | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200 | Run Count : 2                             |

User Name: eaknarin\_puangsoa

System Id: RYG\_EN0136

Hostname: ASRYGW7002

Print Date: July 7, 2022 11:27:56 AM

## ALS\_RYG\_EN0136 Transaction log :

| Time                     | Transaction State | Activity Performed | Type of Transaction   | Optional Information                         |
|--------------------------|-------------------|--------------------|---|--|
| July 7, 2022 11:19:56 AM | Audit             | TestUnlocked       | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 2 - L: >= 1200 | Deviation filed for Run Count : 2            |
| July 7, 2022 11:19:56 AM | Start             | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 2 - L: >= 1200 | None   |
| July 7, 2022 11:20:13 AM | Audit             | Data               | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 2 - L: >= 1200 | Data files Path :<br>D:\OQ2022\OFN_SN_F021.D |
| July 7, 2022 11:21:52 AM | End               | Execution          | Signal to Noise EI - Liquid Injection, Front SSL, SQ: -<br>Source: EI - Extractor using Filament 2 - L: >= 1200 | Run Count : 3                                |
| July 7, 2022 11:22:49 AM | End               | Qualification      | Session   | OQ   |
| July 7, 2022 11:22:49 AM | Start             | Reporting          | Session   | None   |
| July 7, 2022 11:26:46 AM | Audit             | Reporting          | Session   | Report Generated :<br>Certificate            |

## CERTIFICATE OF CALIBRATION

Certificate No.: WD-03072022

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Novalynx.  
: Wind direction sensor: Novalynx.

Model/Type : Data logger: 200-WS-25LB  
: Wind direction sensor: WS-02F

Serial Number : Data logger: A5193  
: Wind direction sensor: -

ID No : Data logger: SGK\_FS0036  
: Wind direction sensor: -

Customer : ALS laboratory group (Thailand) co., ltd.  
: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250  
Thailand.

### Environmental Condition:

The measurement was carried out in an ambient temperature of  $(23 \pm 3) ^\circ\text{C}$ , and relative humidity of  $(40 \pm 10) \%$ .

### Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and line laser is used for axis control. The measurement were taken at  $45^\circ$  intervals in clockwise and counterclockwise directions.

Note: The UUC was warmed up for 1 hour prior to the calibration being performed

### Traceability:

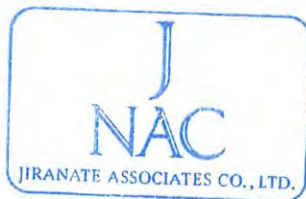
The measurement results are traceable to the international system of units (SI) through Certificate No.: Q21086014, Certificate No.: KWS64/0025.

Measurement Date : Jul 13, 2022.


Issued Date : Jul 14, 2022.

### Calibrated by

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn Lertsomphol



Approved Signatory:.....

  
Mr. Parinya Booncharoen.  
Calibration Department Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-03072022

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

Calibration in the range of 0 – 360 ° at a calibration interval of 45°.

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

| NO | Turning Direction | Nominal Angle<br>(°) | Standard Reading<br>(°) | UUC* Reading<br>(°) | Error<br>(°) | Uncertainty<br>±(°) |
|----|-------------------|----------------------|-------------------------|---------------------|--------------|---------------------|
| 1  | Clockwise         | 0/360                | 360                     | 359                 | -1           | 3.0                 |
| 2  |                   | 45                   | 45                      | 42                  | -3           | 3.0                 |
| 3  |                   | 90                   | 90                      | 87                  | -3           | 3.0                 |
| 4  |                   | 135                  | 135                     | 131                 | -4           | 3.0                 |
| 5  |                   | 180                  | 180                     | 178                 | -2           | 3.0                 |
| 6  |                   | 225                  | 225                     | 226                 | 1            | 3.0                 |
| 7  |                   | 270                  | 270                     | 272                 | 2            | 3.0                 |
| 8  |                   | 315                  | 315                     | 317                 | 2            | 3.0                 |
| 9  | Counter Clockwise | 0/360                | 360                     | 359                 | -1           | 3.0                 |
| 10 |                   | 45                   | 45                      | 42                  | -3           | 3.0                 |
| 11 |                   | 90                   | 90                      | 87                  | -3           | 3.0                 |
| 12 |                   | 135                  | 135                     | 131                 | -4           | 3.0                 |
| 13 |                   | 180                  | 180                     | 178                 | -2           | 3.0                 |
| 14 |                   | 225                  | 225                     | 226                 | 1            | 3.0                 |
| 15 |                   | 270                  | 270                     | 272                 | 2            | 3.0                 |
| 16 |                   | 315                  | 315                     | 317                 | 2            | 3.0                 |

UUC\*: Unit Under Calibration The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%

\*\*\*End of Certificate of Calibration\*\*\*



## CERTIFICATE OF CALIBRATION

Certificate No: WS-03072022

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx  
: Cup anemometer: Novalynx

Model/Type : Data logger: 200-WS-25LB  
: Cup anemometer: WS-02F

Serial Number : Data logger: A5193  
: Cup anemometer: -

ID No : Data logger: SGK\_FS0036  
: Cup anemometer: -

Customer : ALS laboratory group (Thailand) co., ltd.  
: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Test Conditions : Wind tunnel cross test section area 900 cm<sup>2</sup>  
: Anemometer frontal area 100 cm<sup>2</sup>  
: Diameter of mounting pipe - mm  
: Blockage ratio of test object 0.111 [-]

Test Conditions : Air temperature 23.5 ±0.8 °C  
: Air pressure 1004.2 ±0.4 hPa  
: Relative air humidity 44.5 ±3.5 %RH

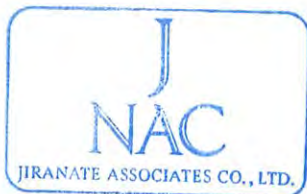
Calibration Procedure Calibration was carried out base on;  
IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines;  
MEASNET Anemometer Calibration Procedure – Version 2: 2009;

Traceability This calibration documents the traceable to national standard, Which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).

Measurement Date : Jul 13, 2022.  
Issued Date : Jul 14, 2022.

**Calibrated by**

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jittraporn Lertsomphol



Approved Signatory: .....

Mr. Parinya Booncharoen  
Calibration Department Manager

Continuation of Certificate of Calibration Number

Certificate No: WS-03072022

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

Calibration in the range of 1 – 16 m/s at a calibration interval of 1 m/s.

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

| V <sub>STD</sub> Reading<br>m/s | V <sub>UUC*</sub> Reading<br>m/s | Error<br>(m/s) | Uncertainty<br>(%) |
|---------------------------------|----------------------------------|----------------|--------------------|
| 2.061                           | 1.9                              | -0.2           | 2.6                |
| 4.123                           | 3.9                              | -0.2           | 1.3                |
| 6.02                            | 5.9                              | -0.1           | 1.3                |
| 7.99                            | 8.0                              | 0.0            | 0.86               |
| 9.98                            | 10.0                             | 0.0            | 0.87               |
| 12.01                           | 12.1                             | 0.1            | 0.57               |
| 14.00                           | 14.1                             | 0.1            | 0.83               |
| 15.98                           | 16.3                             | 0.3            | 0.61               |
| 15.00                           | 15.1                             | 0.1            | 0.56               |
| 13.01                           | 13.2                             | 0.2            | 0.74               |
| 10.98                           | 11.1                             | 0.1            | 0.53               |
| 8.99                            | 9.0                              | 0.0            | 0.70               |
| 6.98                            | 7.0                              | 0.0            | 1.1                |
| 5.152                           | 5.0                              | -0.2           | 1.0                |
| 3.012                           | 2.8                              | -0.2           | 1.7                |
| 1.044                           | 0.8                              | -0.2           | 4.8                |

UUC\*: Unit Under Calibration

The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%

#### Appendix 1: Instrumentations

| NO | Sensor                                | Manufacturer | Model/Type | Calibration Date | Certificate Report Number | Range          |
|----|---------------------------------------|--------------|------------|------------------|---------------------------|----------------|
| 1  | Pitot static                          | TESTO INC.   | 06352145   | Aug 07, 2021     | MW-0034-21                | 5 – 30 m/s     |
| 2  | Precision Differential Pressure Meter | Zoglab       | DPM2500    | Aug 07, 2021     | MW-0034-21                | 5 – 30 m/s     |
| 3  | Air velocity transducer (hot wire)    | TSI INC.     | 8455-12    | Aug 08, 2021     | MW-0035-21                | 0 – 5 m/s      |
| 4  | Temperature                           | Zoglab       | DSR-THP    | March 30, 2022   | CL-027-65                 | -30 – 70°C     |
| 5  | Relative humidity                     | Zoglab       | DSR-THP    | March 30, 2022   | RH-03032022               | 0 – 100 %RH    |
| 6  | Atmospheric pressure                  | Zoglab       | DSR-THP    | March 30, 2022   | BP-01032022               | 500 – 1100 hPa |
| 7  | Wind tunnel                           | ESSOM        | MP330D     | -                | -                         | 0 – 50 Hz      |

\*\*\*End of certificate of calibration\*\*\*



Certificate Number

CL-008-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Wind Direction Sensor  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: 110-WS-25DL-D  
**SERIAL NUMBER** : Sensor: WSD-013  
Data logger: A5792  
**ID NUMBER** : SGK\_FS0089  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 10 Jan 2023  
**MEASUREMENT DATE** : 13 Jan 2023  
**ISSUE DATE** : 13 Jan 2023

### 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 |

**PLACE OF CALIBRATION** : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

|                              |   |       |                 |
|------------------------------|---|-------|-----------------|
| <b>CALIBRATION CONDITION</b> | : Wind tunnel cross-section area <sup>1</sup> | 900   | cm <sup>2</sup> |
|                              | Win direction frontal area <sup>2</sup>       | 129   | cm <sup>2</sup> |
|                              | Diameter of mounting pipe <sup>3</sup>        | -     | mm              |
|                              | Blockage ratio of test object <sup>4</sup>    | 0.143 | [-]             |

**Preconditioning** : 24 hours at ambient conditions.

**Measurement Condition** : The average values during measurement are (23.8)°C, (51.1) %RH and (1010.8) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jittraporn Lertsomphol



Approved signatory: *[Signature]*

Mr. Parinya Booncharoen  
Calibration Department Manager

### Remark:

<sup>1</sup> Nozzle cross-section area of the wind tunnel

<sup>2</sup> Projected cross-section area of the tested object include mounting pipe

<sup>3</sup> Diameter of mounting pipe

<sup>4</sup> Ratio <sup>2</sup> to <sup>1</sup>

MEASUREMENT RESULTS<sup>5</sup>

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

| Air speed<br>m/s | $D^{\dagger}_{std}$<br>Degree (°) | $D^{\ddagger}_{uuc}$<br>Degree (°) | Error<br>Degree (°) | $U (k=2)$<br>Degree (°) |
|------------------|-----------------------------------|------------------------------------|---------------------|-------------------------|
| 4.99             | 0.000                             | 0                                  | 0                   | 0.58                    |
|                  | 45.000                            | 42                                 | -3                  | 0.68                    |
|                  | 90.000                            | 88                                 | -3                  | 0.76                    |
|                  | 135.000                           | 134                                | -2                  | 0.76                    |
|                  | 180.000                           | 181                                | 1                   | 0.68                    |
|                  | 225.000                           | 227                                | 2                   | 0.74                    |
|                  | 270.000                           | 273                                | 3                   | 0.68                    |
|                  | 315.000                           | 318                                | 3                   | 0.68                    |

## Remark:

<sup>5</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

<sup>6</sup> Direction of standard

<sup>7</sup> Direction of Unit Under Calibration



\*\*\*End of Certificate of Calibration\*\*\*

Jiranatee Associates Co.,Ltd  
63/14-15, 67/35-36  
Petchkasem 7,7/1, Rd.Watthapra, Bangkokyai,  
Bangkok 10600 (Thailand)  
Tel: +6608680812  
Mobile: +66863999453  
E-mail: jnac-calibration@jiranatee.com  
Web site: www.jiranatee.com

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

Air speed measurement laboratory  
Calibration services department.

Certificate Number

CL-008-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

|                              |  |
|------------------------------|--|
| <b>MEASUREMENT ITEM</b>      | : Cup anemometer   |
| <b>MANUFACTURER</b>          | : Novalynx   |
| <b>MODEL/TYPE</b>            | : Sensor: WS-02F<br>Data logger: 110-WS-25DL-D   |
| <b>SERIAL NUMBER</b>         | : Sensor: WSD-013<br>Data logger: A5792  |
| <b>ID NUMBER</b>             | : SGK_FS0089   |
| <b>CONDITION AS-RECEIVED</b> | : Used item  |
| <b>CUSTOMER</b>              | : ALS laboratory group (Thailand) co., ltd.<br>104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,<br>Khet Suan Luang, Bangkok 10250 Thailand. |

### Calibration procedure:

The cup anemometer was calibrated against Standard air velocity transducer model: 8455-12 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel-type wind tunnel with 900 cm<sup>2</sup> cross test section area. The WI-CL-007 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 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-0052-21 and MW-0066-22

### 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'

|                         |               |
|-------------------------|---------------|
| <b>RECEIVED DATE</b>    | : 10 Jan 2023 |
| <b>MEASUREMENT DATE</b> | : 13 Jan 2023 |
| <b>ISSUE DATE</b>       | : 13 Jan 2023 |

### 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 |

|                             |   |
|-----------------------------|---|
| <b>PLACE OF CALIBRATION</b> | : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd. |
|-----------------------------|---|

|                               |   |       |                 |
|-------------------------------|---|-------|-----------------|
| <b>CALIBRATION CONDITIONS</b> | : Wind tunnel cross-section area <sup>1</sup> | 900   | cm <sup>2</sup> |
|                               | Win direction frontal area <sup>2</sup>       | 100   | cm <sup>2</sup> |
|                               | Diameter of mounting pipe <sup>3</sup>        | -     | mm              |
|                               | Blockage ratio of test object <sup>4</sup>    | 0.111 | [-]             |

|                              |   |
|------------------------------|---|
| <b>Preconditioning</b>       | : 24 hours at ambient conditions.   |
| <b>Measurement Condition</b> | : The average values during measurement are (23.5) °C, (43.8) %RH and (1015.3) hPa. |

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn Lertsomphol



Approved signatory: \_\_\_\_\_

Mr. Parinya Booncharoen  
Calibration Department Manager

### Remark:

- <sup>1</sup> Nozzle cross-section area of the wind tunnel  
<sup>2</sup> Projected cross-section area of the tested object include mounting pipe  
<sup>3</sup> Diameter of mounting pipe  
<sup>4</sup> Ratio <sup>2</sup> to <sup>1</sup>

MEASUREMENT RESULTS <sup>5</sup>

The cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle, UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

| $v_{std}$ <sup>6</sup><br>(m/s) | Temp. wind tunnel<br>(°C) | Temp. room<br>(°C) | $v_{uuc}$ <sup>7</sup><br>(m/s) | Error<br>(m/s) | $U$ ( $k=2$ )<br>(m/s) |
|---------------------------------|---------------------------|--------------------|---------------------------------|----------------|------------------------|
| 0.981                           | 23.56                     | 23.50              | 0.8                             | -0.2           | 0.15                   |
| 2.027                           | 23.44                     | 23.50              | 1.8                             | -0.2           | 0.16                   |
| 3.049                           | 23.50                     | 23.50              | 2.9                             | -0.2           | 0.21                   |
| 4.125                           | 23.54                     | 23.50              | 3.9                             | -0.2           | 0.20                   |
| 5.00                            | 23.50                     | 23.50              | 4.9                             | -0.1           | 0.20                   |
| 5.98                            | 23.62                     | 23.50              | 5.9                             | -0.1           | 0.17                   |
| 7.05                            | 23.32                     | 23.50              | 6.9                             | -0.1           | 0.18                   |
| 8.16                            | 23.60                     | 23.50              | 8.0                             | -0.1           | 0.21                   |
| 9.09                            | 23.40                     | 23.50              | 9.1                             | 0.0            | 0.22                   |
| 10.10                           | 23.50                     | 23.50              | 10.0                            | -0.1           | 0.24                   |
| 11.15                           | 23.36                     | 23.50              | 11.1                            | -0.1           | 0.23                   |
| 12.14                           | 23.46                     | 23.50              | 12.1                            | 0.0            | 0.23                   |
| 13.19                           | 23.40                     | 23.50              | 13.2                            | 0.0            | 0.26                   |
| 14.25                           | 23.40                     | 23.50              | 14.2                            | 0.0            | 0.24                   |
| 15.24                           | 23.34                     | 23.50              | 15.1                            | -0.1           | 0.25                   |
| 16.29                           | 23.30                     | 23.50              | 16.2                            | -0.1           | 0.33                   |

## Remark:

<sup>5</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

<sup>6</sup> Velocity of standard

<sup>7</sup> Velocity of Unit Under Calibration

## PHOTO OF CALIBRATION SET-UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set-up is not true to scale due to imaging geometry.

\*\*\*End of Certificate of Calibration\*\*\*



# SITHIPHORN ASSOCIATES CO.,LTD.

## CALIBRATION LABORATORY



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

Cert. No. : ACC22038

Pages : 1 of 3

### Calibration Certificate

**Equipment :** SOUND CALIBRATOR  
**Manufacturer :** RION  
**Model :** NC-75  
**Serial No.:** 35024429  
**ID No.:** - SQK\_FS 0114

|                |                    |
|----------------|--------------------|
| REVIEW BY      | <i>Mongkorn P.</i> |
| APPROVED BY    | <i>[Signature]</i> |
| NEXT CAL. DATE | 14/11/23           |

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,  
KHWANG PHATTHANAKAN, KHET SUAN LUANG,  
BANGKOK, 10250 THAILAND.

**Location :** -  
**Ambient Temperature :** ( 23.0  $\pm$  3 ) °C  
**Pressure :** ( 101.3  $\pm$  3 ) kPa  
**Relative Humidity :** ( 50.0  $\pm$  20 ) %

**Received Date :** 03 NOVEMBER 2022  
**Calibration Date :** 14 NOVEMBER 2022  
**Date of Issue :** 15 NOVEMBER 2022

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*[Signature]*  
( Thanakul Petchurai )

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

## Continuation of Calibration Certificate

Cert. No. : ACC22038

Job No. : VC66AC0006

Pages : 2 of 3

Calibration Procedure : CP-AC-03

**Calibration Method :**

This equipment was calibrated by based on IEC-60942-2003 Standard.

The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference microphone.

**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      | 33511B       | MY52302742        | EF-0008-22       | 04-Feb-23       |
| Digital Multimeter      | 33461A       | MY53220104        | EEL.BP. 04/0265  | 09-Feb-23       |
| Digital Multimeter      | 33461A       | MY53220076        | EEL.BP. 03/0265  | 09-Feb-23       |
| Digital Multimeter      | 33461A       | MY60024273        | EEL.BP. 05/0265  | 09-Feb-23       |
| Programmable Attenuator | MAT-1070     | 62100114          | EF-0009-22       | 07-Feb-23       |
| Condenser Microphone    | 4180         | 2977900           | AA-1013-22       | 24-Feb-23       |
| Measuring Amplifier     | NA-42KAI     | 34560495          | AA-3005-22       | 22-Feb-23       |
| Audio Analyzer          | AVR-3360A    | V744B6069         | EF-0010-22       | 07-Feb-23       |

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).

## Continuation of Calibration Certificate

Cert. No. : ACC22038

Job No. : VC66AC0006

Pages : 3 of 3

**Result of calibration :****1. Sound pressure level**

| Specified sound<br>pressure level<br>(dB) | Measured<br>value<br>(dB) | Deviated<br>value<br>(dB) | Uncertainty<br>(dB) | Tolerance<br>limit<br>(dB) |
|---|---------------------------|---------------------------|---------------------|----------------------------|
| 94  | 93.94                     | -0.06                     | 0.14                | 0.40                       |

**2. Frequency**

| Specified<br>Frequency<br>(Hz) | Measured<br>value<br>(Hz) | Deviated<br>value<br>(%) | Uncertainty<br>(%) | Tolerance<br>limit<br>(%) |
|--------------------------------|---------------------------|--------------------------|--------------------|---------------------------|
| 1000                           | 1000.0                    | 0.0                      | 0.1                | 1.0                       |

**3. Total distortion**

| Measured value (%) | Uncertainty (%) | Tolerance limit (%) |
|--------------------|-----------------|---------------------|
| 0.33               | 0.10            | 3.0                 |

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

# SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL22165

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00472131 / 171451 / 73493  
**ID No.:** SGK\_FS0015

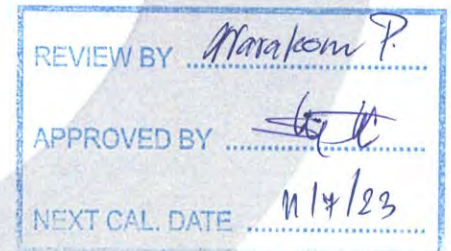
**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,  
KHWANG PHATTHANAKAN, KHET SUAN LUANG,  
BANGKOK, 10250 THAILAND.

**Location :** -

**Ambient Temperature :** ( 23.0  $\pm$  3 ) °C  
**Pressure :** ( 101.3  $\pm$  3 ) kPa  
**Relative Humidity :** ( 50.0  $\pm$  20 ) %

**Received Date :** 06 JULY 2022  
**Calibration Date :** 11-18 JULY 2022  
**Date of Issue :** 19 JULY 2022



**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

(  )  
( Thanakul Petchurai )

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

## Continuation of Calibration Certificate

Cert. No. : ACL22165

Job No. : VC65AC0069

Pages : 2 of 8

Calibration Procedure : CP-AC-01

**Calibration Method :**

This equipment was calibrated by based 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-0007-22       | 04-Feb-23       |
| Waveform Generator      | 33511B       | MY52302742        | EF-0008-22       | 04-Feb-23       |
| Digital Multimeter      | 33461A       | MY53220104        | EEL.BP. 04/0265  | 09-Feb-23       |
| Digital Multimeter      | 33461A       | MY53220076        | EEL.BP. 03/0265  | 09-Feb-23       |
| Digital Multimeter      | 34461A       | MY60024273        | EEL.BP. 05/0265  | 09-Feb-23       |
| Programmable Attenuator | MAT-1070     | 62100114          | EF-0009-22       | 07-Feb-23       |
| Condenser Microphone    | 4180         | 2977900           | AA-1013-22       | 24-Feb-23       |
| Measuring Amplifier     | NA-42KAI     | 34560495          | AA-3005-22       | 22-Feb-23       |

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).

Continuation of Calibration Certificate

**Cert. No. : ACL22165**  
**Job No. : VC65AC0069**  
**Pages : 3 of 8**

**Summary of Measurement Result :**

| Parameter  | Pass | Fail | Uncertainty<br>(dB) | Maximum-permitted<br>uncertainty of<br>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  | ✓    | -    | 0.4                 | 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                               | -    | -    | -                   | 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   |

## Continuation of Calibration Certificate

Cert. No. : ACL22165

Job No. : VC65AC0069

Pages : 4 of 8

**Result of calibration :****1. Absolute sensitivity**

| Reference<br>Acoustic Signal<br>( dB ) | Measured<br>Value<br>( dB ) | Deviation<br>( dB ) | Acceptance<br>Limit<br>( dB ) |
|--|-----------------------------|---------------------|-------------------------------|
| 93.9 (93.95)                           | 93.9                        | 0.0                 | ±0.3                          |

**2. Self-generated noise**

## 2.1 Normal test

| Measured Value<br>( dB ) |
|--------------------------|
| 14.4                     |

2.2 The microphone of the sound level meter was replaced by electrical signal input device.

| Frequency<br>Weighting | Measured value<br>( dB ) |
|------------------------|--------------------------|
| A - weight             | 8.7                      |
| C - weight             | 16.1                     |
| Flat                   | 21.9                     |

**3. Acoustical signal tests of frequency weightings**

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

| Frequency<br>( Hz ) | Deviation from various frequency weighting response curve (dB) |          |          | Acceptance<br>Limits |
|---------------------|--|----------|----------|----------------------|
|                     | Flat   | C-weight | A-weight |                      |
| 125                 | 0.3  | 0.3      | 0.3      | ± 1.5                |
| 1000                | 0.0  | 0.0      | 0.0      | ± 1.0                |
| 8000                | -1.3   | -1.2     | -1.2     | ±5.0                 |

Continuation of Calibration Certificate

Cert. No. : ACL22165

Job No. : VC65AC0069

Pages : 5 of 8

**4. Electrical signal tests of frequency weightings**

Weighting network response with relative to 1 kHz.

| Frequency<br>( Hz ) | Deviation from various frequency weighting response curve (dB) |          |          |                      |
|---------------------|--|----------|----------|----------------------|
|                     | Flat   | C-weight | A-weight | Acceptance<br>Limits |
| 63                  | -0.1   | -0.1     | 0.0      | ±2.0                 |
| 125                 | 0.0  | 0.0      | 0.0      | ±1.5                 |
| 250                 | 0.0  | 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  | 0.1      | 0.0      | ±3.0                 |
| 8000                | 0.1  | 0.1      | 0.1      | ±5.0                 |

**5. Frequency and time weightings at 1 kHz**

5.1 Frequency weightings at 1 kHz

| Frequency<br>Weighting | Measured<br>Value<br>( dB ) | Deviated<br>Value<br>( dB ) | Acceptance<br>Limits<br>( dB ) |
|------------------------|-----------------------------|-----------------------------|--------------------------------|
| A - weight             | 94.0                        | 0.0                         | -                              |
| C - weight             | 94.0                        | 0.0                         | ± 0.2                          |
| Flat                   | 94.0                        | 0.0                         | ± 0.2                          |

5.2 Time weighting at 1 kHz

| Frequency<br>Weighting | Measured<br>Value<br>( dB ) | Deviated<br>Value<br>( dB ) | Acceptance<br>Limits<br>( dB ) |
|------------------------|-----------------------------|-----------------------------|--------------------------------|
| Fast                   | 94.0                        | 0.0                         | -                              |
| Slow                   | 94.0                        | 0.0                         | ± 0.1                          |
| Leq                    | 94.0                        | 0.0                         | ± 0.1                          |

**6. Long - term stability**

| Frequency<br>Weighting | SLM Display<br>at initial<br>( dB ) | SLM Display<br>at final<br>( dB ) | Deviated<br>Value<br>( dB ) | Acceptance<br>Limits<br>( dB ) |
|------------------------|-------------------------------------|-----------------------------------|-----------------------------|--------------------------------|
| A - weight             | 94.0                                | 94.1                              | 0.1                         | ± 0.3                          |

Continuation of Calibration Certificate

**Cert. No. : ACL22165**  
**Job No. : VC65AC0069**  
**Pages : 6 of 8**

**7. Level linearity on the reference level range**

| Anticipated<br>Value<br>( dB ) | Measured<br>Value<br>( dB ) | Deviated<br>Value<br>( dB ) | Acceptance<br>Limits<br>( 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                          | 104.1                       | 0.1                         | ± 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                           | 28.0                        | 0.0                         | ± 1.1                          |
| 27.0                           | 26.9                        | -0.1                        | ± 1.1                          |
| 26.0                           | 26.0                        | 0.0                         | ± 1.1                          |
| 25.0                           | 25.0                        | 0.0                         | ± 1.1                          |

Continuation of Calibration Certificate

**Cert. No. : ACL22165**  
**Job No. : VC65AC0069**  
**Pages : 7 of 8**

**8. Level linearity including the level range control**

| Range | Anticipated<br>Value<br>( dB ) | Measured<br>Value<br>( dB ) | Deviated<br>Value<br>( dB ) | Acceptance<br>Limits<br>( dB ) |
|-------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| Auto  | 94.0                           | 94.0                        | 0.0                         | ±1.1                           |

**9. Tone burst response**

| Time<br>Weighting | Tone burst<br>duration, Tb<br>( ms ) | Cycle | Anticipated<br>Value<br>( dB ) | Measured<br>Value<br>( dB ) | Deviated<br>Value<br>( dB ) | Acceptance<br>Limits<br>( dB ) |
|-------------------|--------------------------------------|-------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| Fast              | 0.25                                 | 1     | 108.0                          | 107.9                       | -0.1                        | 1.5 ; -5.0                     |
|                   | 2                                    | 8     | 117.0                          | 116.9                       | -0.1                        | 1.0 ; -2.5                     |
|                   | 200                                  | 800   | 134.0                          | 134.0                       | 0.0                         | ±1.0                           |
| Slow              | 2                                    | 8     | 108.0                          | 107.9                       | -0.1                        | 1.5 ; -5.0                     |
|                   | 200                                  | 800   | 127.6                          | 127.5                       | -0.1                        | ±1.0                           |
| SEL               | 0.25                                 | 1     | 99.0                           | 98.8                        | -0.2                        | 1.5 ; -5.0                     |
|                   | 2                                    | 8     | 108.0                          | 107.9                       | -0.1                        | 1.0 ; -2.5                     |
|                   | 200                                  | 800   | 128.0                          | 128.0                       | 0.0                         | ±1.0                           |

**10. Peak C sound level**

| Number of cycle<br>in<br>test signal | Anticipated<br>Value<br>( dB ) | Measured<br>Value, L <sub>peak</sub><br>( dB ) | Deviated<br>Value<br>( dB ) | Acceptance<br>Limits<br>( dB ) |
|--------------------------------------|--------------------------------|--|-----------------------------|--------------------------------|
| Continuous                           | 133.0                          | 133.0  | 0.0                         | -                              |
| One                                  | 136.4                          | 136.3  | -0.1                        | ±3.0                           |

| Number of cycle<br>in<br>test signal | Anticipated<br>Value<br>( dB ) | Measured<br>Value<br>( dB ) | Deviated<br>Value<br>( dB ) | Acceptance<br>Limits<br>( dB ) |
|--------------------------------------|--------------------------------|-----------------------------|-----------------------------|--------------------------------|
| Continuous                           | 133.0                          | 133.0                       | 0.0                         | -                              |
| Positive half cycle                  | 135.4                          | 135.1                       | -0.3                        | ±2.0                           |
| Negative half cycle                  | 135.4                          | 135.1                       | -0.3                        | ±2.0                           |

Continuation of Calibration Certificate

**Cert. No. : ACL22165**  
**Job No. : VC65AC0069**  
**Pages : 8 of 8**

**11. Overload indication**

| Measured value ( dB )      |                            | Deviated<br>Value<br>( dB ) | Acceptance<br>Limits<br>( dB ) |
|----------------------------|----------------------------|-----------------------------|--------------------------------|
| Positive<br>one-half cycle | Negative<br>one-half cycle |                             |                                |
| 89.5                       | 89.6                       | 0.1                         | ±1.5                           |

**12. High level stability**

| Frequency<br>Weighting | SLM Display<br>at initial<br>( dB ) | SLM Display<br>at final<br>( dB ) | Deviated<br>Value<br>( dB ) | Acceptance<br>Limits<br>( 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** —————



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22TM75

Page.: 1 of 3

## Certificate of Calibration

Equipment : Incubator  
Manufacturer : Memmert  
Model : ICP 750  
Serial No. : F816.0063  
ID No. : SGK\_CL0028  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.  
Songkhla Branch.  
114/1 Moo 8, Kanjanavanij Rd., Banphru,  
Hatyai, Songkhla 90250, Thailand  
Location : BOD Room  
Received Order : 24 January 2022  
Calibration Date : 25 January 2022  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Kunchit Promprat

REVIEW BY Ananta B.  
APPROVED BY Kanitta H.  
NEXT CAL. DATE 26/7/23

Approved by :

Malee  
Approved Signatory

- ( ) Pornthippa Tameyakul  
(✓) Malee Butkruea  
( ) Suwit Imjai

Issue Date :

7 February 2022

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.

A 0037405



Equipment : Incubator  
 Condition As-Received : Used Item  
 Reference : 2201-0617OC-3  
 Procedure Used :-

Cert. No.: 22TM75

Page.: 2 of 3

Calibration were conducted using calibration procedure CP-OT02 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:-

| Instrument           | Model  | Serial No. | Cert. No. | Due Date    |
|----------------------|--------|------------|-----------|-------------|
| 1 ) Data Acquisition | 34972A | MY57013823 | 21LM3/1   | 26 Feb 2022 |

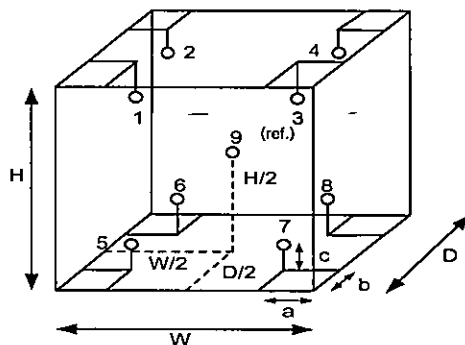
2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This certification is traceable to the International System of Unit.

**Result of Calibration :-** ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close



| Environment during calibration |           |          |
|--------------------------------|-----------|----------|
|                                | Beginning | Finished |
| Temp. ( °C )                   | 28        | 28       |
| REL.Humid. ( % )               | 57        | 52       |
| AC Supply ( Volt )             | 231       | 231      |

#### Probe Installation Details :

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

#### Dimension of Chamber :

D = 0.60 m  
 W = 1.0 m  
 H = 1.2 m  
 Capacity = 0.75 m<sup>3</sup>

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

*Mulu.*



Equipment : Incubator  
Condition As-Received : Used Item  
Reference : 2201-0617OC-3  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 22TM75

Page.: 3 of 3

| Calibration Point<br>( °C ) | UUC* Setting<br>( °C ) | UUC* Reading<br>( °C ) | Temperature stability<br>( ± °C ) | Temperature uniformity<br>( °C ) | Overall Variation<br>( °C ) | Uncertainty<br>( ± °C ) | Coverage Factor<br><i>k</i> |
|-----------------------------|------------------------|------------------------|-----------------------------------|----------------------------------|-----------------------------|-------------------------|-----------------------------|
| 20.0                        | 20.0                   | 20.1                   | 0.094                             | 0.50                             | 0.83                        | 0.30                    | 2                           |

| Calibration Point<br>( °C ) | Measured Temperature ( °C ) |        |        |        |        |        |        |        |          |
|-----------------------------|-----------------------------|--------|--------|--------|--------|--------|--------|--------|----------|
|                             | Position                    |        |        |        |        |        |        |        |          |
|                             | 1                           | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9 (ref.) |
| 20.0                        | 20.280                      | 20.370 | 20.363 | 20.378 | 19.915 | 19.925 | 19.673 | 19.727 | 20.098   |

**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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TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22LM162

Page.: 1 of 2

## Certificate of Calibration

Equipment : DO Meter with Sensor

Manufacturer : YSI

Model : 5000

Serial No. : 17B101473

ID No. : SGK\_CL0073

Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.  
Songkhla Branch.  
114/1 Moo 8, Kanjanavanij Rd., Banphru,

Location : TPA Chemistry Calibration Lab.2

Received Order : 18 November 2022

Calibrated Date : 21 November 2022

Ambient Temperature : (  $26 \pm 10$  ) °C

Relative Humidity : (  $50 \pm 30$  ) %

AC Line Voltage : (  $220 \pm 22$  ) V

Calibrated by : Warakorn Lerngagtrakul

|                |            |
|----------------|------------|
| REVIEW BY      | Ananta B.  |
| APPROVED BY    | Kanitta H. |
| NEXT CAL. DATE | 21 Nov 24. |

Approved by :

*Malu.*

Approved Signatory

- ( ) Pornthippa Tameyakul  
(✓) Malee Butkruea  
( ) Suwit Imjai

Issue Date :

22 November 2022

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.

A 0047729



Equipment : DO Meter with Sensor  
Condition As-Received : Used Item  
Reference : 2111-0663DSC-2

Cert. No.: 22LM162

Page.: 2 of 2

**Procedure Used :-**

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>Model</u> | <u>Serial No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|------------------------|--------------|-------------------|------------------|-----------------|
| 1) Digital Thermometer | 1523         | 3240076           | 221249           | 02 Mar 2023     |

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.

**Result of Calibration :-** ( \* ) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 17B100103

| <u>Calibration Point</u><br>( °C ) | <u>Immersion Depth</u><br>( mm ) | <u>Standard Temperature</u><br>( °C ) | <u>UUC* Reading</u><br>( °C ) | <u>Error</u><br>( °C ) | <u>Uncertainty</u><br>( ± °C ) | <u>Coverage Factor</u><br><i>k</i> |
|------------------------------------|----------------------------------|---------------------------------------|-------------------------------|------------------------|--------------------------------|------------------------------------|
| 20.00                              | 60                               | 20.001                                | 19.88                         | -0.121                 | 0.15                           | 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)**  
**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

**Cert.No.: 22TW259**

**Page.: 1 of 2**

## **Certificate of Testing**

|  |   |
|--|---|
| <b>Equipment :</b>                                     | DO Meter  |
| <b>Manufacturer :</b>                                  | YSI   |
| <b>Model :</b>   | 5000  |
| <b>Serial No. :</b>                                    | 17B101473   |
| <b>ID No. :</b>  | SGK_CL0073  |
| <b>Received Date :</b>                                 | 18 November 2022  |
| <b>Test Date :</b>                                     | 21 November 2022  |
| <b>Reference :</b>                                     | 2211-0663DSC-1  |
| <b>Submitted by :</b>                                  | ALS Laboratory Group (Thailand) Co.,Ltd.<br>Songkhla Branch.<br>114/1 Moo 8, Kanjanavanij Rd., Banphru,<br>Hatyai, Songkhla 90250, Thailand |
| <b>Laboratory Condition :</b>                          | Temperature ( $25 \pm 5$ ) °C<br>Humidity ( $50 \pm 20$ ) %   |
| <b>Test Procedure :</b>                                | In - house method : CP-CH9<br>by Comparison Technique with Azide Modification Method  |
| <b>Tested by :</b>                                     | Walalak Sirithean   |
| <b>Approved by :</b>                                   | <br>Approved Signatory                                   |
| ( <input checked="" type="checkbox"/> ) Malee Butkruea |   |
| ( <input type="checkbox"/> ) Saithip Meangmai          |   |
| ( <input type="checkbox"/> ) Warakorn Lerngagtrakul    |   |
| <b>Issue Date :</b>                                    | 22 November 2022  |



Cert.No.: 22TW259

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       | 21CG1389               | 25 Mar 2023     |
| 2) Balance         | 1126143764        | 140RC004      | 22MM50                 | 20 Sep 2023     |

2. Standard Material :-

| <u>Material</u>                 | <u>Manufacturer</u> | <u>Lot.No.</u> | <u>Assay</u> |
|---------------------------------|---------------------|----------------|--------------|
| Sodium Thiosulfate pentahydrate | Merck               | AM1763316      | 100.2%       |

**Result :** Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 17B100103

| Titration Method<br>(Azide Modification Method)<br>(mg/L) | DO Meter<br>Reading<br>(mg/L) | Standard Deviation<br>(mg/L) |
|---|-------------------------------|------------------------------|
| 8.12  | 8.12                          | 0.0045                       |

This report was certified only for the instrument we tested. It is allowable to use for study the system efficiency, The environmental impact control and present to organization it may concerned. 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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*Malu.*

a 1136621



# Southern Calibration Service Co., Ltd.

669/35 Karnjanavanit Rd., Banpru, Hatyai, Songkla 90250 Thailand  
Tel : 08 1599 0417 Fax : 0 7480 5133 Email : s.calibration@gmail.com www.scal-lab.com



## CALIBRATION CERTIFICATE

Issued Date : 1-May-2023

Certificate No. : 23CH0203

CSR No. : A088/04367

Page. : 1 of 2

Customer : ALS Laboratory Group (Thailand) Co., Ltd  
114/1 Moo 8, Karnchanawanich Rd. Tambon, Ban Phru,  
Amphoe Hat Yai, Songkhla, 90250

Calibration Place : Chemical Laboratory

Instrument Name : pH meter

Manufacturer : Mettler Toledo

Model : S220

Serial No. : B625631849

ID No. : SGK\_CL0030

Electrode No. : 1204613

Received Date : 28-Apr-2023

Calibrated Date : 28-Apr-2023

Ambient Temperature : (25 ± 3) °C

Relative Humidity : (55 ± 15) %

|                |                |
|----------------|----------------|
| REVIEW BY      | Ananta B.      |
| APPROVED BY    | Kamrta H.      |
| NEXT CAL. DATE | 28 / 10 / 2024 |

### Calibration Method Used :

This instrument was calibrated using the Calibration In - house method : SCAL.WI.008 based on direct measurement by using certified reference Material (CRM)

The Southern Calibration Service Co.,Ltd.calibration control system complies with requirement of ISO/IEC 17025:2017

### Traceability of measurement :

This Certificate is traceable to the International and /or national standards which realize the units of measurement according to the International System of Unit (SI) through :

- HACH : HACH LANGE GmbH

- SCAL : Sounthern Calibration Service Co., Ltd.,

- WK : WK Electric Co., Ltd.

Calibrated by : Alisara Ma

Approved by :

Imron Rattanaylum / Technical Manager

The uncertainties are for a confidence probability of approximately 95%

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**Details of Calibration****1. Reference Standard Equipment Used:**

| Equipment                         | Model  | Serial No. | Cert. no.      | Due Date    |
|-----------------------------------|--------|------------|----------------|-------------|
| Standard Solution                 | 4.005  | C02994     | 1777           | 5-Sep-2024  |
| Standard Solution                 | 7.000  | C03007     | 1787           | 17-Oct-2024 |
| Standard Solution                 | 10.012 | C02953     | 1735           | 29-Apr-2024 |
| Temperature/Electrical Calibrator | MC2-TE | 14987      | WK2106-299-223 | 5-Jun-2024  |
| Digital Thermometer With Sensor   | DP-77  | I.360896   | 22SDTH005      | 8-Aug-2023  |

2. The results reported in this certificate refer to the condition of the instrument on the date of calibration

and carry no implication regarding the longterm stability of instrument.

3. This certificate is not certified any commercial transaction

4. Condition of Item : normal condition , no indication for any damage or malfunction

**Result of Calibration :****1. Electrical Measurement**

| Applied Voltage<br>( mV ) | pH meter Reading |        | Correction<br>( mV ) | Uncertainty<br>( ± mV ) |
|---------------------------|------------------|--------|----------------------|-------------------------|
|                           | ( mV )           | ( pH ) |                      |                         |
| 177.48                    | 177.5            | 3.70   | -0.02                | 0.17                    |
| 0.00                      | 0.0              | 6.70   | 0.00                 | 0.13                    |
| -177.48                   | -177.4           | 9.80   | -0.08                | 0.17                    |

**2. Before Sample Test Measurement**

| Standard Buffer Solutions<br>( pH ) | pH meter Reading |        | Correction<br>( pH ) | Uncertainty<br>( ± pH ) |
|-------------------------------------|------------------|--------|----------------------|-------------------------|
|                                     | ( pH )           | ( mV ) |                      |                         |
| 4.005                               | 3.97             | 159.2  | 0.035                | 0.0090                  |
| 6.999                               | 6.98             | -15.4  | 0.019                | 0.013                   |
| 10.012                              | 9.95             | -188.0 | 0.062                | 0.036                   |

**3. After Sample Test Measurement**

| Standard Buffer Solutions<br>( pH ) | pH meter Reading |        | Correction<br>( pH ) | Uncertainty<br>( ± pH ) |
|-------------------------------------|------------------|--------|----------------------|-------------------------|
|                                     | ( pH )           | ( mV ) |                      |                         |
| 4.005                               | 3.97             | 158.9  | 0.035                | 0.0090                  |
| 6.999                               | 7.01             | -17.5  | -0.011               | 0.013                   |
| 10.012                              | 9.98             | -187.6 | 0.032                | 0.036                   |

**4. Temperature Measurement**

| Cal Point<br>( °C ) | Standard Temperature<br>( °C ) | UUC Reading<br>( °C ) | Correction<br>( °C ) | Uncertainty<br>( ± °C ) |
|---------------------|--------------------------------|-----------------------|----------------------|-------------------------|
| 25                  | 25.032                         | 25.1                  | -0.068               | 0.11                    |

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 ...

**Sartorius (Thailand) Co., Ltd.**

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310

Tel: +66 2643 8361-6 , e-mail: service.thailand@sartorius.com

**SARTORIUS**

# Certificate

## of Calibration

REVIEW BY Ananta B.  
APPROVED BY Kanitta H.  
NEXT CAL. DATE 25/1/23/24

Model Number : MSE224S-100-DUCertificate No. : 23BCI0044Description : Analytical BalanceIssued Date : Friday, January 27, 2023Serial Number : 0034705158Reference No. : 202361ID No. : SGK\_CL0045Manufacturer : SartoriusPage No. : 1 of 2Customer Name : ALS Laboratory Group (Thailand) Co., Ltd.Songkhla Branch: 114/1 Moo 8 Karnchanawanich Rd., T. Ban Phru, A. Hat Yai, Songkhla. 90250.Calibrated Place : Balance Room.Calibrated By : Mr. Chonchai InthanaCalibration Date : Wednesday, January 25, 2023

Calibration

Procedure No. : This calibration was conducted byUsing in-house calibration procedure number (WI-003)Based on UKAS LAB 14 : 2019**Metrological data :**Capacity : 220 g Readability : 0.0001 g**Ambients Conditions:**Temperature : 22.4 °C ± 3.0 °CHumidity : 65.0 % RH ± 5.0 % RHPressure :                      ±                     **Reasons for calibration**☐ New Installation ☐ Service / Repaired ☒ Re-calibration/ MaintenanceEquipment Condition: ☒ Good Operate ☐ Fair**Measurement Method UKAS Publication Ref :Lab 14**

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). The calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came from list of Sartorius Metrological Specifications.

**Traceability:**

| Model Number  | Description                                    | Traceability | Certificate No. | Due Date    |
|---------------|--|--------------|-----------------|-------------|
| YCS011-522-00 | Sartorius weight set 1mg - 1kg E2 s/n 37929119 | SPC-RT       | C02212565       | 14-Sep-2023 |
| MHB-382SD     | Humidity/Barometer/Temp Lutron MHB-382SD       | DKSH         | C19220444       | 5-Sep-2023  |

This certificate relate and apply this equipment only.

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Sartorius (Thailand) Co., Ltd.

Mr.Chonchai Inthana(Technical Manager)

S  
T  
A  
M  
P

# Certificate of Calibration

Model Number : MSE224S-100-DU

Certificate No. : 23BCI0044

Description : Analytical Balance

Issued Date : Friday, January 27, 2023

Serial Number : 0034705158

Reference No. : 202361

ID No. SGK\_CL0045

Manufacturer : Sartorius

Page No. : 2 of 2

## Calibration Results : Without Adjustment

### Repeatability

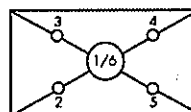
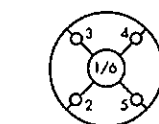
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

|                             |         |          |
|-----------------------------|---------|----------|
| Nominal Value : (Low Load)  | 20.0000 | 200.0000 |
| 20 g                        | 20.0001 | 200.0000 |
| Tolerance                   | 20.0000 | 200.0000 |
| 0.0001 g                    | 20.0000 | 200.0000 |
|                             | 20.0000 | 200.0001 |
| Nominal Value : (High Load) | 20.0000 | 200.0000 |
| 200 g                       | 20.0000 | 200.0001 |
| Tolerance                   | 20.0000 | 200.0000 |
| 0.0001 g                    | 20.0000 | 200.0001 |
|                             | 20.0000 | 200.0001 |
| <b>Standard Deviation</b>   | 0.00003 | 0.00005  |

### Eccentricity (Off-center loading error)

The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R76).

Nominal value : 50 g  
Tolerance 0.0004 g



|   | Difference |
|---|------------|
| 1 | —          |
| 2 | 0.0001     |
| 3 | 0.0000     |
| 4 | 0.0000     |
| 5 | 0.0000     |
| 6 | —          |

### Linearity

The linearity, also called linearity error. Describes the deviation of the characteristic curve of a weighing instrument from the linear slope.

Tolerance 0.0002 g

| Nominal Value<br>(g) | Conventional Mass Value<br>(g) | Displayed Value<br>(g) | Deviation<br>(g) | Uncertainty<br>(g) |
|----------------------|--------------------------------|------------------------|------------------|--------------------|
| 0.01                 | 0.0100                         | 0.0100                 | 0.0000           | 0.00013            |
| 0.1                  | 0.1000                         | 0.1000                 | 0.0000           | 0.00013            |
| 1                    | 1.0000                         | 1.0000                 | 0.0000           | 0.00014            |
| 2                    | 2.0000                         | 2.0000                 | 0.0000           | 0.00014            |
| 5                    | 5.0000                         | 5.0000                 | 0.0000           | 0.00014            |
| 10                   | 10.0000                        | 10.0000                | 0.0000           | 0.00014            |
| 20                   | 20.0000                        | 20.0000                | 0.0000           | 0.00014            |
| 50                   | 50.0000                        | 50.0000                | 0.0000           | 0.00015            |
| 100                  | 100.0000                       | 100.0000               | 0.0000           | 0.00019            |
| 200                  | 200.0000                       | 200.0001               | 0.0001           | 0.00030            |

End of Report.



**Southern Calibration Service Co., Ltd.**

669/35 Karnjanavanit Rd., Banpru, Hatyai, Songkla 90250 Thailand  
Tel : 08 1599 0417 Fax : 0 7480 5133 Email : s.calibration@gmail.com www.scal-lab.com



## CALIBRATION CERTIFICATE

Issued Date : 1-May-2023

Certificate No. : 23TH1728

CSR No. : A088/04367

Page. : 1 of 3

Customer : ALS Laboratory Group (Thailand) Co., Ltd  
114/1 Moo 8, Karnchanawanich Rd. Tambon, Ban Phru,  
Amphoe Hat Yai, Songkhla, 90250

Calibration Place : Chemical Laboratory

Instrument Name : Hot Air Oven

Manufacturer : Memmert

Model : UF110

Serial No. : B416.3387

ID No. : SGK\_CL0024

Resolution : 0.1 °C

Received Date : 28-Apr-2023

Calibrated Date : 28-Apr-2023

Ambient Temperature : (30 ± 10) °C

Relative Humidity : (50 ± 30) %

|                |                             |
|----------------|-----------------------------|
| REVIEW BY      | ..... Ananta B. ....        |
| APPROVED BY    | ..... Kanitta H. ....<br>10 |
| NEXT CAL. DATE | ..... 28/11/2024 ....<br>10 |

### Calibration Method Used :

This instrument was calibrated using the Calibration In - house method : SCAL.WI.012 based on GLA - 20

The Southern Calibration Service Co.,Ltd.calibration control system complies with requirement of ISO/IEC 17025:2017

### Traceability of measurement :

This Certificate is traceable to the International and /or national standards which realize the units of measurement according to the International System of Unit (SI) through :

- SCaL : Sounthern Calibration Service Co., Ltd.,

Calibrated by : Ibrorhim Saleemin

Approved by :

Imron Rattanaylum / Technical Manager

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

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### Details of Calibration

#### 1. Reference Standard Equipment Used:

| Equipment                    | Model  | Serial No. | Cert. no. | Due Date    |
|------------------------------|--------|------------|-----------|-------------|
| Data Acquisition/Switch Unit | 34970A | MY58009813 | 22SDAT004 | 24-May-2023 |

2. The results reported in this certificate refer to the condition of the instrument on the date of calibration

and carry no implication regarding the longterm stability of instrument.

3. This certificate is not certified any commercial transaction

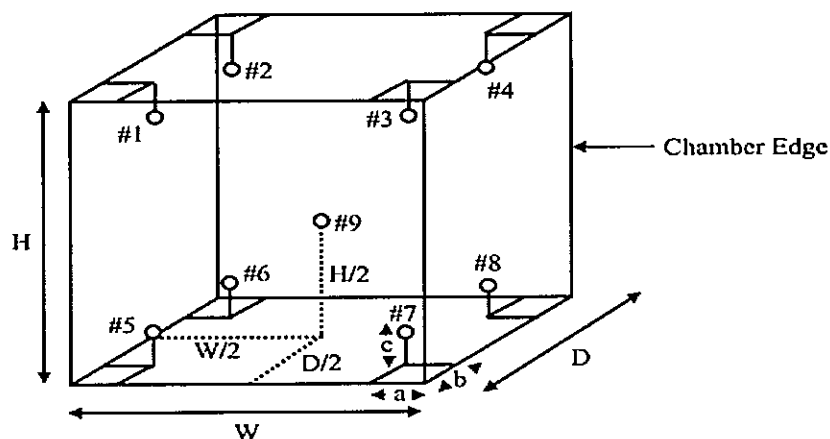
4. Condition of Item : normal condition , no indication for any damage or malfunction

#### Result of Calibration :

( ☒ ) Without Adjustment

( ☐ ) After Adjustment

#### 1. Sensor Installation Diagram



#### Sensor Installation Details

a = 5.0 cm  
b = 5.0 cm  
c = 5.0 cm

#### Dimension of the chamber

W = 40.0 cm  
H = 40.0 cm  
D = 33.0 cm

## Result of Calibration :

### 2. Temperature Measurement Accuracy Test

The measurement results of the Hot Air Oven and associates are reported in the manner as shown below

| Cal point<br>( °C ) | Measured Standard Temperature At Spread Locations ( °C ) |        |        |        |        |        |        |        |        | Uncertainty<br>( ± °C ) |
|---------------------|--|--------|--------|--------|--------|--------|--------|--------|--------|-------------------------|
|                     | #1   | #2     | #3     | #4     | #5     | #6     | #7     | #8     | Ref. 9 |                         |
| 40                  | 40.48  | 40.28  | 40.28  | 39.91  | 40.17  | 40.09  | 39.93  | 40.27  | 39.89  | 0.36                    |
| 70                  | 70.36  | 70.23  | 70.58  | 69.74  | 69.99  | 69.92  | 69.86  | 70.13  | 70.04  | 0.36                    |
| 103                 | 103.19   | 103.12 | 103.46 | 103.37 | 103.10 | 103.54 | 103.43 | 103.06 | 103.40 | 0.36                    |
| 104                 | 104.31   | 104.23 | 104.62 | 103.77 | 104.12 | 104.06 | 103.90 | 104.20 | 104.56 | 0.36                    |
| 105                 | 105.07   | 105.03 | 105.48 | 105.27 | 105.12 | 105.01 | 105.01 | 105.00 | 104.96 | 0.36                    |
| 180                 | 180.31   | 180.00 | 180.00 | 180.07 | 180.18 | 180.05 | 180.01 | 180.10 | 180.24 | 0.41                    |

### 3. Performance Result

The performance of the Hot Air Oven are reported as shown below

| Cal point<br>( °C ) | UUC Setting<br>( °C ) | UUC Reading<br>( °C ) | Temperature Stability<br>( ± °C ) | Temperature Uniformity<br>( °C ) | Overall Variation<br>( °C ) |
|---------------------|-----------------------|-----------------------|-----------------------------------|----------------------------------|-----------------------------|
| 40                  | 40.0                  | 40.0                  | 0.20                              | 0.70                             | 0.72                        |
| 70                  | 70.0                  | 70.0                  | 0.20                              | 0.60                             | 0.94                        |
| 103                 | 103.0                 | 103.0                 | 0.20                              | 0.43                             | 0.54                        |
| 104                 | 104.0                 | 104.0                 | 0.10                              | 0.79                             | 0.88                        |
| 105                 | 105.0                 | 105.0                 | 0.10                              | 0.59                             | 0.69                        |
| 180                 | 180.0                 | 180.0                 | 0.10                              | 0.38                             | 0.38                        |

- UUC = Unit Under Calibration

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 ...



# Southern Calibration Service Co., Ltd.

669/35 Karnjanavanit Rd., Banpru, Hatyai, Songkhla 90250 Thailand

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## CALIBRATION CERTIFICATE

Issued Date : 8-Feb-2022

Certificate No. : 22WB004

CSR No. : A0223/01123

Page. : 1 of 3

Customer : ALS Laboratory Group (Thailand) Co., Ltd  
114/1 Moo 8 Karnchanawanich Rd. T.Ban Phru,  
A. Hat Yai, Songkhla 90250 TH

Calibration Place : Chemical Laboratory  
Instrument Name : Water Bath  
Manufacturer : Memmert  
Model : WNE29  
Serial No. : L616.0538  
ID No. : SGK\_CL0035  
Resolution : 0.1 °C  
Received Date : 5-Feb-2022  
Calibrated Date : 5-Feb-2022  
Ambient Temperature : (30 ± 10) °C  
Relative Humidity : (50 ± 30) %

|                |            |
|----------------|------------|
| REVIEW BY      | Ananta B.  |
| APPROVED BY    | Kanitta H. |
| NEXT CAL. DATE | 6/07/2023  |

### Calibration Method Used :

This instrument was calibrated using the Calibration In - house method : SCAL.W1.014 based on ASTM E 715 : 1980 (reapproved 2001)

The Southern Calibration Service Co.,Ltd.calibration control system complies with requirement of ISO/IEC 17025:2017

### Traceability of measurement :

This Certificate is traceable to the International and /or national standards which realize the units of measurement according to the International System of Unit (SI) through :

- Q Reborn : Quality Reborn Co.,Ltd.

Calibrated by : Imron Rattanaylum

Approved by :

Sakeereen Heemhad / Technical Manager

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### Details of Calibration

#### 1. Reference Standard Equipment Used:

| Equipment               | Model  | Serial No. | Cert. no. | Due Date   |
|-------------------------|--------|------------|-----------|------------|
| Data logger With Sensor | 34970A | MY44064411 | QR21-0314 | 9-Feb-2022 |

2. The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the longterm stability of instrument.

3. This certificate is not certified any commercial transaction

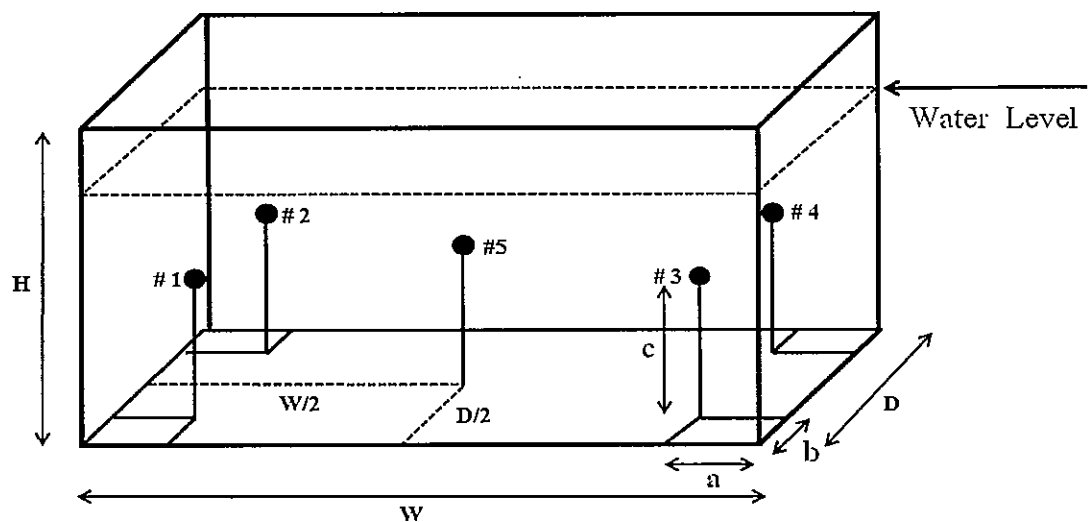
4. Condition of Item : normal condition , no indication for any damage or malfunction

### Result of Calibration :

(✓) Without Adjustment

( ) After Adjustment

#### 1. Sensor Installation Diagram



#### Sensor Installation Details

a = 5 cm  
b = 5 cm  
c = 5 cm

#### Dimension of the chamber

W = 45 cm  
H = 30 cm  
D = 35 cm

### Result of Calibration .:

#### 2. Temperature Measurement Accuracy Test

The measurement results of the Water Bath and associates are reported in the manner as shown below

| Cal point<br>(°C) | Measured Standard Temperature At Spread Locations (°C) |       |       |       |       | Uncertainty<br>(±°C) |
|-------------------|--|-------|-------|-------|-------|----------------------|
|                   | #1   | #2    | #3    | #4    | Ref.5 |                      |
| 80                | 79.95  | 80.07 | 79.95 | 79.99 | 80.03 | 0.14                 |

#### 3. Performance Result

The performance of the Water Bath are reported as shown below

| Cal point<br>(°C) | UUC Setting<br>(°C) | UUC Reading<br>(°C) | Temperature Stability<br>(±°C) | Temperature Uniformity<br>(°C) | Overall Variation<br>(°C) |
|-------------------|---------------------|---------------------|--------------------------------|--------------------------------|---------------------------|
| 80                | 81.0                | 81.0                | 0.10                           | 0.19                           | 0.19                      |

- UUC = Unit Under Calibration

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 ...



Southern Calibration Service Co., Ltd.

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## CALIBRATION CERTIFICATE

Issued Date : 8-Jan-2023

Certificate No. : 23TH0050

CSR No. : A047/02339

Page. : 1 of 3

Customer : ALS Laboratory Group (Thailand) Co., Ltd  
114/1 Moo 8, Karnchanawanich Rd. Tambon, Ban Phru,  
Amphoe Hat Yai, Songkhla, 90250

Calibration Place : Microbiological Laboratory

Instrument Name : Autoclave

Manufacturer : TOMY

Model : SX-700

Serial No. : 52134079

ID No. : SGK\_ML0001

Resolution : 1 °C

Received Date : 5-Jan-2023

Calibrated Date : 5-Jan-2023

Ambient Temperature : (30 ± 10) °C

Relative Humidity : (50 ± 30) %

|                |                 |
|----------------|-----------------|
| REVIEW BY      | Nattawut P.     |
| APPROVED BY    | Kanitta H.      |
| NEXT CAL. DATE | Jul 05-May-2024 |

### Calibration Method Used :

This instrument was calibrated using the Calibration In - house method : SCAL.WI.16.013 based on BS 2646 : 1993 (part 5)

The Southern Calibration Service Co.,Ltd.calibration control system complies with requirement of ISO/IEC 17025:2017

### Traceability of measurement :

This Certificate is traceable to the International and /or national standards which realize the units of measurement according to the International System of Unit (SI) through :

- SCaL : Sounthern Calibration Service Co., Ltd.,

Calibrated by : Ibrorhim Saleemin

Approved by :

  
Kanyarat Chaipet / Technical Manager

The uncertainties are for a confidence probability of approximately 95%

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### Details of Calibration

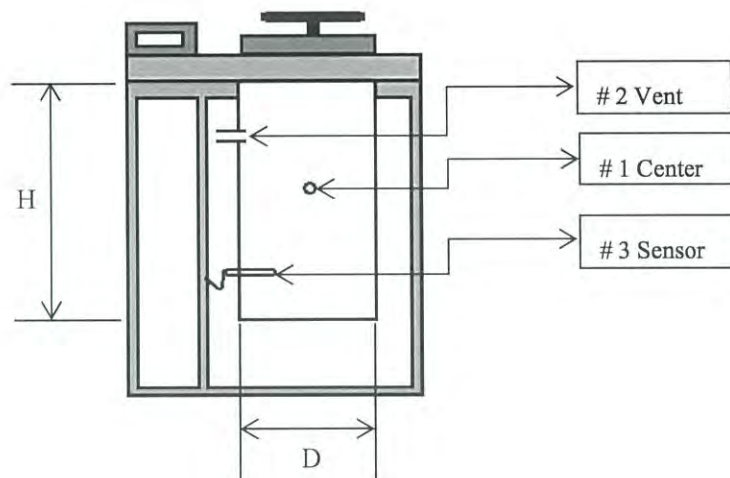
#### 1. Reference Standard Equipment Used:

| Equipment               | Model | Serial No. | Cert. no. | Due Date   |
|-------------------------|-------|------------|-----------|------------|
| Data logger With Sensor | GL220 | C90432223  | 22SDAT005 | 4-May-2023 |

- The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the longterm stability of instrument.
- This certificate is not certified any commercial transaction
- Condition of Item : normal condition , no indication for any damage or malfunction

**Result of Calibration :** ( ✓ ) Without Adjustment ( ) After Adjustment

#### 1. Sensor Installation Diagram



Chamber Diameter (D) : 30 cm

Chamber Height (H) : 70 cm

## Result of Calibration :

### 2. Temperature Measurement Accuracy Test

The measurement results of the Autoclave and associates are reported in the manner as shown below

| Cal point<br>( °C ) | Measured Standard Temperature At Spread Locations<br>( °C ) |         |           | Pressure Reading | Uncertainty<br>( ± °C ) |
|---------------------|---|---------|-----------|------------------|-------------------------|
|                     | Center #1   | Vent #2 | Sensor #3 |                  |                         |
| 115                 | 115.5   | 115.4   | 115.5     | 0.07 MPa         | 0.76                    |
| 118                 | 118.7   | 118.9   | 119.1     | 0.09 MPa         | 0.76                    |
| 121                 | 122.0   | 122.1   | 122.1     | 0.11 MPa         | 0.76                    |

### 3. Performance Result

The performance of the Autoclave are reported as shown below

| Cal point<br>( °C ) | UUC Setting<br>( °C ) | UUC Reading<br>( °C ) | Temperature Stability<br>( ± °C ) | Temperature Uniformity<br>( °C ) | Overall Variation<br>( °C ) |
|---------------------|-----------------------|-----------------------|-----------------------------------|----------------------------------|-----------------------------|
| 115                 | 115                   | 115                   | 0.20                              | 0.30                             | 0.30                        |
| 118                 | 118                   | 118                   | 0.70                              | 0.70                             | 0.90                        |
| 121                 | 121                   | 121                   | 0.50                              | 0.40                             | 0.60                        |

- Operating Time = 1800.65 sec

- UUC = Unit Under Calibration

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 ...



**Southern Calibration Service Co., Ltd.**

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## CALIBRATION CERTIFICATE

Issued Date : 9-Aug-2022

Certificate No. : 22OV529

CSR No. : A037/01847

Page : 1 of 3

Customer : ALS Laboratory Group (Thailand) Co., Ltd  
114/1 Moo 8, Kamchanawanich Rd. Tambon, Ban Phru,  
Amphoe Hat Yai, Songkhla, 90250

Calibration Place : Microbiological Laboratory

Instrument Name : Incubator

Manufacturer : Memmert

Model : ICP750

Serial No. : F816.0061

ID No. : SGK\_ML0013

Resolution : 0.1 °C

Received Date : 6-Aug-2022

Calibrated Date : 6-Aug-2022

Ambient Temperature : (30 ± 10) °C

Relative Humidity : (50 ± 30) %

|                |             |
|----------------|-------------|
| REVIEW BY      | APPROVED BY |
| APPROVED BY    | APPROVED BY |
| NEXT CAL. DATE |             |

### Calibration Method Used :

This instrument was calibrated using the Calibration In - house method : SCAL.WI.012 based on G-20

The Southern Calibration Service Co.,Ltd.calibration control system complies with requirement of ISO/IEC 17025:2017

### Traceability of measurement :

This Certificate is traceable to the International and /or national standards which realize the units of measurement according to the International System of Unit (SI) through :

- SCaL : Sounthern Calibration Service Co., Ltd.,

Calibrated by : Ibrorhim Saleemin

Approved by :

Kanyarat Chaipet / Technical Manager

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

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### Details of Calibration

#### 1. Reference Standard Equipment Used:

| Equipment                    | Model  | Serial No. | Cert. no. | Due Date    |
|------------------------------|--------|------------|-----------|-------------|
| Data Acquisition/Switch Unit | 34970A | MY58009813 | 22SDAT004 | 24-May-2023 |

2. The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the longterm stability of instrument.

3. This certificate is not certified any commercial transaction

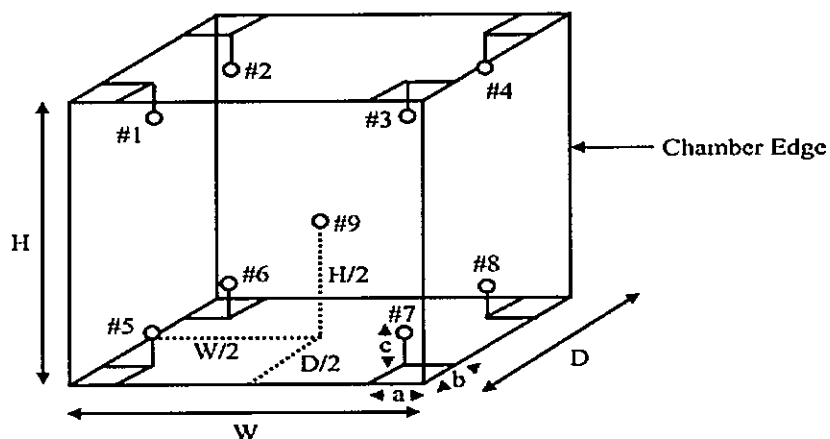
4. Condition of Item : normal condition , no indication for any damage or malfunction

#### Result of Calibration :

( ☒ ) Without Adjustment

( ☐ ) After Adjustment

#### 1. Sensor Installation Diagram



#### Sensor Installation Details

a = 5.0 cm

b = 5.0 cm

c = 5.0 cm

#### Dimension of the chamber

W = 104.0 cm

H = 120.0 cm

D = 60.0 cm



Certificate No. : 22OV529

CSR No. : A037/01847

Page. : 3 of 3

**Result of Calibration .:**

**2. Temperature Measurement Accuracy Test**

The measurement results of the Incubator and associates are reported in the manner as shown below

| Cal point<br>( °C ) | Measured Standard Temperature At Spread Locations ( °C ) |       |       |       |       |       |       |       |        | Uncertainty<br>( ± °C ) |
|---------------------|--|-------|-------|-------|-------|-------|-------|-------|--------|-------------------------|
|                     | #1   | #2    | #3    | #4    | #5    | #6    | #7    | #8    | Ref. 9 |                         |
| 35                  | 34.99  | 34.92 | 34.95 | 34.88 | 34.96 | 35.00 | 34.94 | 34.94 | 34.94  | 0.38                    |

**3. Performance Result**

The performance of the Incubator are reported as shown below

| Cal point<br>( °C ) | UUC Setting<br>( °C ) | UUC Reading<br>( °C ) | Temperature Stability<br>( ± °C ) | Temperature Uniformity<br>( °C ) | Overall Variation<br>( °C ) |
|---------------------|-----------------------|-----------------------|-----------------------------------|----------------------------------|-----------------------------|
| 35                  | 35.0                  | 35.0                  | 0.10                              | 0.12                             | 0.19                        |

- UUC = Unit Under Calibration

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 ...

## CALIBRATION CERTIFICATE

Issued Date : 8-Jan-2023

Certificate No. : 23CH0016

CSR No. : A047/02339

Page. : 1 of 2

Customer : ALS Laboratory Group (Thailand) Co., Ltd  
114/1 Moo 8, Karnchanawanich Rd. Tambon, Ban Phru,  
Amphoe Hat Yai, Songkhla, 90250

Calibration Place : Microbiological Laboratory

Instrument Name : pH meter

Manufacturer : Sartorius

Model : Basic pH Meter PB-10

Serial No. : C70160695

ID No. : SGK\_ML0016

Electrode No. : N/A

Received Date : 5-Jan-2023

Calibrated Date : 5-Jan-2023

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

Relative Humidity :  $(55 \pm 15) \%$

|                |                          |
|----------------|--------------------------|
| REVIEW BY      | Nattawut P.              |
| APPROVED BY    | Kanitta H.               |
| NEXT CAL. DATE | 05-Jul-24<br>Nattawut P. |

### Calibration Method Used :

This instrument was calibrated using the Calibration In - house method : SCAL.WI.008 based on direct measurement by using certified reference Material (CRM)

The Southern Calibration Service Co.,Ltd.calibration control system complies with requirement of ISO/IEC 17025:2017

### Traceability of measurement :

This Certificate is traceable to the International and /or national standards which realize the units of measurement according to the International System of Unit (SI) through :

- HACH : HACH LANGE GmbH
- WK : WK Electric Co., Ltd.

Calibrated by : Jessadagon Lemhud

Approved by :



Kanyarat Chaipet / Technical Manager

The uncertainties are for a confidence probability of approximately 95%

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### Details of Calibration

#### 1. Reference Standard Equipment Used:

| Equipment                         | Model  | Serial No. | Cert. no.      | Due Date    |
|-----------------------------------|--------|------------|----------------|-------------|
| Standard Solution                 | 4.005  | C02950     | 1733           | 22-Apr-2024 |
| Standard Solution                 | 7.000  | C03001     | 1783           | 23-Sep-2024 |
| Standard Solution                 | 10.013 | C02953     | 1735           | 29-Apr-2024 |
| Temperature/Electrical Calibrator | MC2-TE | 14987      | WK2106-299-223 | 5-Jun-2024  |

2. The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the longterm stability of instrument.

3. This certificate is not certified any commercial transaction

4. Condition of Item : normal condition , no indication for any damage or malfunction

Result of Calibration : (✓) Without Adjustment ( ) After Adjustment

#### 1. Electrical Measurement

| Applied Voltage<br>( mV ) | pH meter Reading<br>( mV ) | Correction<br>( mV ) | Uncertainty<br>( ± mV ) |
|---------------------------|----------------------------|----------------------|-------------------------|
| 177.48                    | 177.4                      | 0.08                 | 0.17                    |
| 0.00                      | 0.0                        | 0.00                 | 0.13                    |
| -177.48                   | -177.4                     | -0.08                | 0.17                    |

#### 2. Sample Test Measurement

| Standard Buffer Solutions<br>( pH ) | pH meter Reading<br>( pH ) | Correction<br>( pH ) | Uncertainty<br>( ± pH ) |
|-------------------------------------|----------------------------|----------------------|-------------------------|
| 4.004                               | 4.02                       | -0.016               | 0.011                   |
| 7.000                               | 7.01                       | -0.010               | 0.013                   |
| 10.013                              | 10.02                      | -0.007               | 0.036                   |

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 ...



# Southern Calibration Service Co., Ltd.

669/35 Karnjanavanit Rd., Banpru, Hatyai, Songkla 90250 Thailand  
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## CALIBRATION CERTIFICATE

Issued Date : 2-Feb-2023

Certificate No. : 23TH0521

CSR No. : A075/03704

Page. : 1 of 3

Customer : ALS Laboratory Group (Thailand) Co., Ltd  
114/1 Moo 8, Karnchanawanich Rd. Tambon, Ban Phru,  
Amphoe Hat Yai, Songkhla, 90250

Calibration Place : Microbiological Laboratory

Instrument Name : Water Bath

Manufacturer : Memmert

Model : WPE45

Serial No. : L716.0558

ID No. : SGK\_ML0021

Resolution : 0.1 °C

Received Date : 30-Jan-2023

Calibrated Date : 30-Jan-2023

Ambient Temperature : (30 ± 10) °C

Relative Humidity : (50 ± 30) %

|                |             |
|----------------|-------------|
| REVIEW BY      | Nattawut P. |
| APPROVED BY    | Kanitta H.  |
| NEXT CAL. DATE | 30-Jul-24   |

### Calibration Method Used :

This instrument was calibrated using the Calibration In - house method : SCAL.WI.014 based on ASTM E 715 : 1980  
(reapproved 2001)

The Southern Calibration Service Co.,Ltd.calibration control system complies with requirement of ISO/IEC 17025:2017

### Traceability of measurement :

This Certificate is traceable to the International and /or national standards which realize the units of measurement  
according to the International System of Unit (SI) through :

- SCAL : Sounthern Calibration Service Co., Ltd.,

Calibrated by : Ibrorhim Saleemin

Approved by :

Imron Rattanaylum / Technical Manager

The uncertainties are for a confidence probability of approximately 95%

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### Details of Calibration

#### 1. Reference Standard Equipment Used:

| Equipment                    | Model  | Serial No. | Cert. no. | Due Date    |
|------------------------------|--------|------------|-----------|-------------|
| Data Acquisition/Switch Unit | 34970A | MY58009813 | 22SDAT004 | 24-May-2023 |

2. The results reported in this certificate refer to the condition of the instrument on the date of calibration

and carry no implication regarding the longterm stability of instrument.

3. This certificate is not certified any commercial transaction

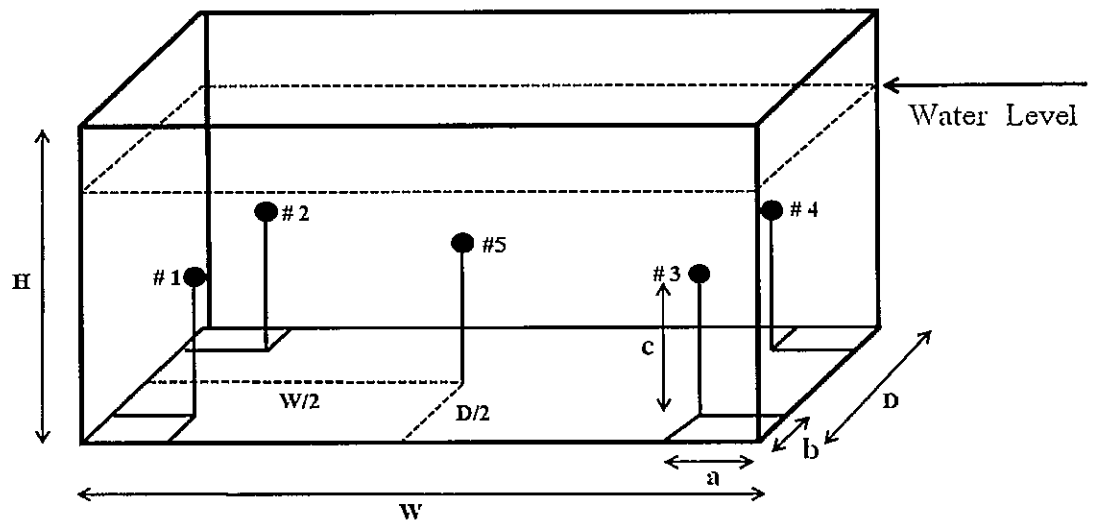
4. Condition of Item : normal condition , no indication for any damage or malfunction

#### Result of Calibration ∴

( ✓ ) Without Adjustment

( ) After Adjustment

#### 1. Sensor Installation Diagram



#### Sensor Installation Details

a = 5 cm  
b = 5 cm  
c = 5 cm

#### Dimension of the chamber

W = 45 cm  
H = 30 cm  
D = 35 cm



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**Result of Calibration :**

**2. Temperature Measurement Accuracy Test**

The measurement results of the Water Bath and associates are reported in the manner as shown below

| Cal point<br>( °C ) | Measured Standard Temperature At Spread Locations ( °C ) |       |       |       |       | Uncertainty<br>( ± °C ) |
|---------------------|--|-------|-------|-------|-------|-------------------------|
|                     | #1   | #2    | #3    | #4    | Ref.5 |                         |
| 44.5                | 44.47  | 44.48 | 44.45 | 44.51 | 44.50 | 0.14                    |

**3. Performance Result**

The performance of the Water Bath are reported as shown below

| Cal point<br>( °C ) | UUC Setting<br>( °C ) | UUC Reading<br>( °C ) | Temperature Stability<br>( ± °C ) | Temperature Uniformity<br>( °C ) | Overall Variation<br>( °C ) |
|---------------------|-----------------------|-----------------------|-----------------------------------|----------------------------------|-----------------------------|
| 44.5                | 44.5                  | 44.5                  | 0.10                              | 0.24                             | 0.25                        |

- UUC = Unit Under Calibration

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 ...