

ภาคผนวก ง

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ใบรับรองการสอบเทียบเครื่องมือ



right solutions.  
right partner.

รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

| Sample Name | Parameter                    | Equipment Name              | ID No.     | Calibrated Date | Next Cal  | Freq. Calibrate (Months) |
|-------------|------------------------------|-----------------------------|------------|-----------------|-----------|--------------------------|
| Ambient     | Total Suspended Particulate  | High Volume                 | RYG_FS0182 | -               | -         | On site Calibration      |
| Ambient     | Total Suspended Particulate  | High Volume                 | RYG_FS0180 | -               | -         | On site Calibration      |
| Ambient     | Total Suspended Particulate  | High Volume                 | RYG_FS0174 | -               | -         | On site Calibration      |
| Ambient     | Total Suspended Particulate  | Digital Balance             | RYG_EN0001 | 22-Feb-24       | 22-Feb-25 | 12                       |
| Ambient     | Particulate Matter (PM-10)   | High Volume                 | RYG_FS0399 | -               | -         | On site Calibration      |
| Ambient     | Particulate Matter (PM-10)   | High Volume                 | RYG_FS0187 | -               | -         | On site Calibration      |
| Ambient     | Particulate Matter (PM-10)   | High Volume                 | RYG_FS0185 | -               | -         | On site Calibration      |
| Ambient     | Particulate Matter (PM-10)   | Digital Balance             | RYG_EN0001 | 22-Feb-24       | 22-Feb-25 | 12                       |
| Ambient     | Wind Speed / Wind Direction  | Wind Speed / Wind Direction | RYG_FS0544 | 21-Jul-23       | 21-Jan-25 | 18                       |
| Ambient     | Wind Speed / Wind Direction  | Wind Speed / Wind Direction | RYG_FS0531 | 19-Jan-23       | 19-Jul-24 | 18                       |
| Ambient     | Wind Speed / Wind Direction  | Wind Speed / Wind Direction | RYG_FS0530 | 19-Jan-23       | 19-Jul-24 | 18                       |
| Stack       | Butyl Acrylate               | Console Control Unit        | RYG_FS0315 | 9-Jan-24        | 9-Jul-24  | 6                        |
| Stack       | Butyl Acrylate               | Pitot Tube                  | RYG_FS0321 | 9-Jan-24        | 9-Jul-24  | 6                        |
| Stack       | Butyl Acrylate               | Flue gas Analyzer           | RYG_FS0464 | 8-Mar-24        | 7-Mar-25  | 12                       |
| Stack       | Butyl Acrylate               | Field Rotameter             | BKK_FS1004 | 4-Jan-24        | 4-Apr-24  | 3                        |
| Stack       | Butyl Acrylate               | GC-MSD                      | BKK_EN0119 | 18-Apr-23       | 18-Oct-24 | 18                       |
| Stack       | Methyl Methacrylate          | Console Control Unit        | RYG_FS0315 | 9-Jan-24        | 9-Jul-24  | 6                        |
| Stack       | Methyl Methacrylate          | Pitot Tube                  | RYG_FS0321 | 9-Jan-24        | 9-Jul-24  | 6                        |
| Stack       | Methyl Methacrylate          | Flue gas Analyzer           | RYG_FS0464 | 8-Mar-24        | 7-Mar-25  | 12                       |
| Stack       | Methyl Methacrylate          | Field Rotameter             | BKK_FS1004 | 4-Jan-24        | 4-Apr-24  | 3                        |
| Stack       | Methyl Methacrylate          | GC-MSD                      | BKK_EN0119 | 18-Apr-23       | 18-Oct-24 | 18                       |
| Stack       | Total Suspended Particulate  | Console Control Unit        | BKK_FS0556 | 8-Jan-24        | 8-Jul-24  | 6                        |
| Stack       | Total Suspended Particulate  | Pitot Tube                  | BKK_FS0560 | 8-Jan-24        | 8-Jul-24  | 6                        |
| Stack       | Total Suspended Particulate  | Flue gas Analyzer           | RYG_FS0565 | 13-Nov-23       | 12-Nov-24 | 12                       |
| Stack       | Total Suspended Particulate  | Digital Balance             | RYG_EN0003 | 22-Feb-24       | 22-Feb-25 | 12                       |
| Stack       | Total VOCs                   | Console Control Unit        | RYG_FS0315 | 9-Jan-24        | 9-Jul-24  | 6                        |
| Stack       | Total VOCs                   | Pitot Tube                  | RYG_FS0321 | 9-Jan-24        | 9-Jul-24  | 6                        |
| Stack       | Total VOCs                   | Flue gas Analyzer           | RYG_FS0464 | 8-Mar-24        | 7-Mar-25  | 12                       |
| Stack       | Total VOCs                   | Field Rotameter             | BKK_FS1040 | 4-Jan-24        | 4-Apr-24  | 3                        |
| Stack       | Total VOCs                   | FID Analyzer                | BKK_FS0758 | 3-Jan-24        | 3-Jul-24  | 6                        |
| Workplace   | Total Dust                   | Field Rotameter             | BKK_FS1040 | 4-Jan-24        | 4-Apr-24  | 3                        |
| Workplace   | Total Dust                   | Field Rotameter             | RYG_FS0659 | 1-Apr-24        | 1-Jul-24  | 3                        |
| Workplace   | Total Dust                   | Digital Balance             | RYG_EN0004 | 22-Feb-24       | 22-Feb-25 | 12                       |
| Workplace   | Total VOC                    | TVOC Analyzer               | BKK_FS0819 | 19-Jan-24       | 19-Jul-25 | 18                       |
| Noise       | Leq 24 hrs                   | Sound Calibrator            | RYG_FS0215 | 20-Sep-23       | 20-Sep-24 | 12                       |
| Noise       | Leq 24 hrs                   | Sound Level Meter           | RYG_FS0386 | 19-Oct-23       | 19-Oct-24 | 12                       |
| Noise       | Leq 24 hrs                   | Sound Level Meter           | RYG_FS0437 | 19-Oct-23       | 19-Oct-24 | 12                       |
| Noise       | Leq 8 hrs                    | Sound Calibrator            | RYG_FS0213 | 28-Feb-24       | 27-Feb-25 | 12                       |
| Noise       | Leq 8 hrs                    | Sound Level Meter           | RYG_FS0433 | 22-Feb-24       | 21-Feb-25 | 12                       |
| Noise       | Leq 8 hrs                    | Sound Level Meter           | RYG_FS0434 | 22-Feb-24       | 21-Feb-25 | 12                       |
| Rayong Lab  | pH at 25 °C                  | pH meter                    | RYG_EN0183 | 19-Jan-24       | 19-Jan-25 | 12                       |
| Rayong Lab  | BOD                          | DO meter with Sensor        | RYG_EN0032 | 24-Jul-23       | 24-Jan-25 | 18                       |
| Rayong Lab  | BOD                          | Incubator                   | RYG_EN0154 | 29-May-23       | 29-Nov-24 | 18                       |
| Rayong Lab  | COD                          | Spectrophotometer           | RYG_EN0037 | 18-Sep-23       | 18-Mar-25 | 18                       |
| Rayong Lab  | Total Suspended Solids       | Electronic Balance          | RYG_EN0002 | 22-Feb-24       | 22-Feb-25 | 12                       |
| Rayong Lab  | Total Suspended Solids       | Hot Air Oven                | RYG_EN0010 | 21-Mar-24       | 21-Sep-25 | 18                       |
| Rayong Lab  | Total Dissolved Solids 180°C | Electronic Balance          | RYG_EN0002 | 22-Feb-24       | 22-Feb-25 | 12                       |
| Rayong Lab  | Total Dissolved Solids 180°C | Hot Air Oven                | RYG_EN0010 | 21-Mar-24       | 21-Sep-25 | 18                       |
| Rayong Lab  | Oil & Grease                 | Electronic Balance          | RYG_EN0002 | 22-Feb-24       | 22-Feb-25 | 12                       |
| Rayong Lab  | Oil & Grease                 | Hot Air Oven                | RYG_EN0213 | 21-Mar-24       | 21-Mar-25 | 12                       |
| Rayong Lab  | Oil & Grease                 | Water Bath                  | RYG_EN0061 | 21-Mar-24       | 21-Sep-25 | 18                       |
| Rayong Lab  | Temperature                  | pH meter                    | RYG_FS0596 | 3-Jul-23        | 3-Jul-24  | 12                       |

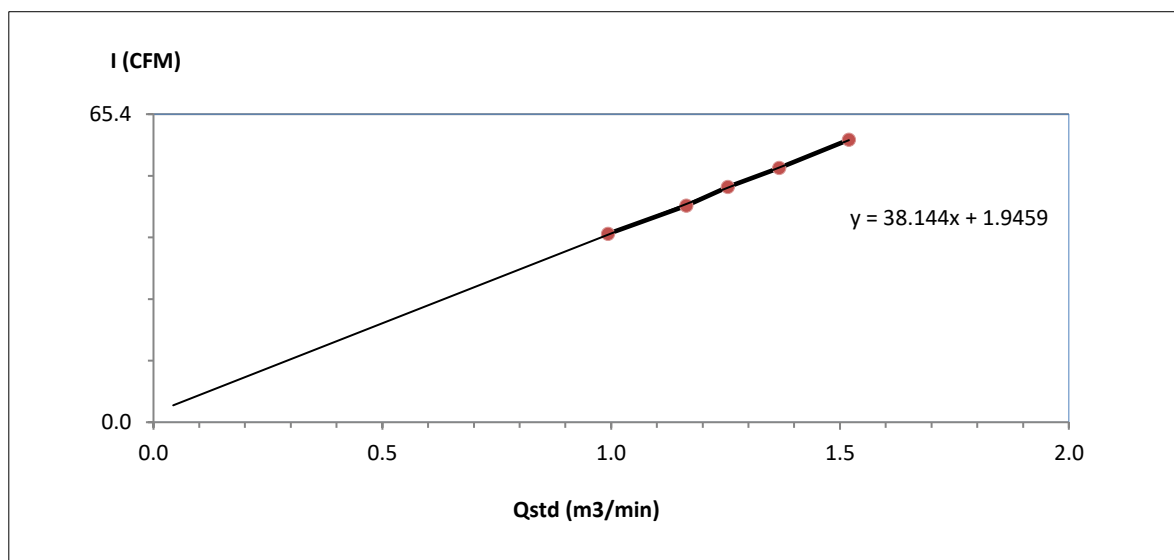




## High Volume Air Sampler Calibration Worksheet

|                       |                     |                               |            |
|-----------------------|---------------------|-------------------------------|------------|
| Project Site :        | THAI MMA Co., Ltd.  | Barometric Pressure (mm Hg) : | 759        |
| Calibrate Location :  | บ้านบน              | Temperature ( °C ) :          | 31         |
| Calibrate Date :      | 15-Mar-24           | High Volume ID :              | RYG_FS0182 |
| CalibrationSheet No.: | C-150324-RYG_FS0182 | High Volume Model :           | TE-5170D   |
| Calibrator ID:        | BKK_FS0624          | High Volume S/N :             | 5335       |
| Calibrator Model :    | TE-5028A            | Calibrator Slope :            | 1.64931    |
| Calibrator S/N :      | 2584                | Calibrator Intercept :        | -0.02579   |

| Test No. | Delta H <sub>2</sub> O<br>(inch) | Q <sub>std</sub><br>(m <sup>3</sup> /min) | I : Chart<br>(CFM) | Linear Regression   |
|----------|----------------------------------|---|--------------------|---|
| 1        | 2.6                              | 0.9931                                    | 40                 | Slope : 38.1437<br>Intercept : 1.9459<br>Correlation Coefficient : 0.9996 |
| 2        | 3.6                              | 1.1640                                    | 46                 |   |
| 3        | 4.2                              | 1.2552                                    | 50                 |   |
| 4        | 5.0                              | 1.3672                                    | 54                 |   |
| 5        | 6.2                              | 1.5195                                    | 60                 |   |



Calibrated by N. Uppathamp

( Mr.Nontachai Uppathamp )  
Field Scientist(1)

Approved by : Mr. Noppong Juntarupan

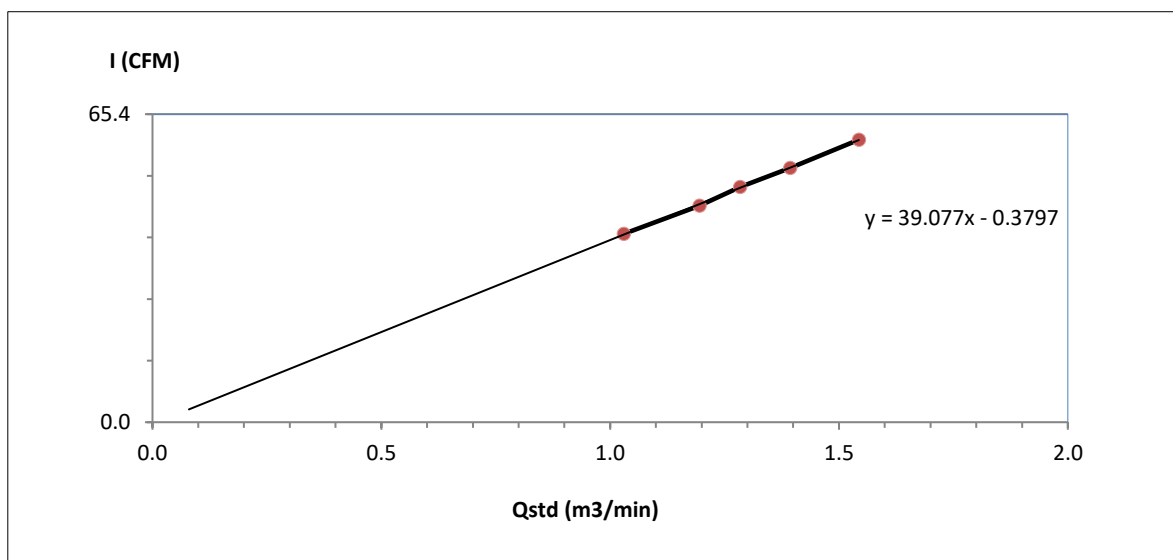
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)



## High Volume Air Sampler Calibration Worksheet

|                       |                     |                               |            |
|-----------------------|---------------------|-------------------------------|------------|
| Project Site :        | THAI MMA Co., Ltd.  | Barometric Pressure (mm Hg) : | 759        |
| Calibrate Location :  | บ้านมณรมาย          | Temperature ( °C ) :          | 31         |
| Calibrate Date :      | 15-Mar-24           | High Volume ID :              | RYG_FS0180 |
| CalibrationSheet No.: | C-150324-RYG_FS0180 | High Volume Model :           | TE-5170D   |
| Calibrator ID:        | BKK_FS0624          | High Volume S/N :             | 1328       |
| Calibrator Model :    | TE-5028A            | Calibrator Slope :            | 1.64931    |
| Calibrator S/N :      | 2584                | Calibrator Intercept :        | -0.02579   |

| Test No. | Delta H <sub>2</sub> O<br>(inch) | Q <sub>std</sub><br>(m <sup>3</sup> /min) | I : Chart<br>(CFM) | Linear Regression  |
|----------|----------------------------------|---|--------------------|--|
| 1        | 2.8                              | 1.0296                                    | 40                 | Slope : 39.0771<br>Intercept : -0.3797<br>Correlation Coefficient : 0.9996 |
| 2        | 3.8                              | 1.1952                                    | 46                 |  |
| 3        | 4.4                              | 1.2842                                    | 50                 |  |
| 4        | 5.2                              | 1.3938                                    | 54                 |  |
| 5        | 6.4                              | 1.5434                                    | 60                 |  |



Calibrated by N. Uppathamp

( Mr.Nontachai Uppathamp )  
Field Scientist(1)

Approved by : N. Juntarupan

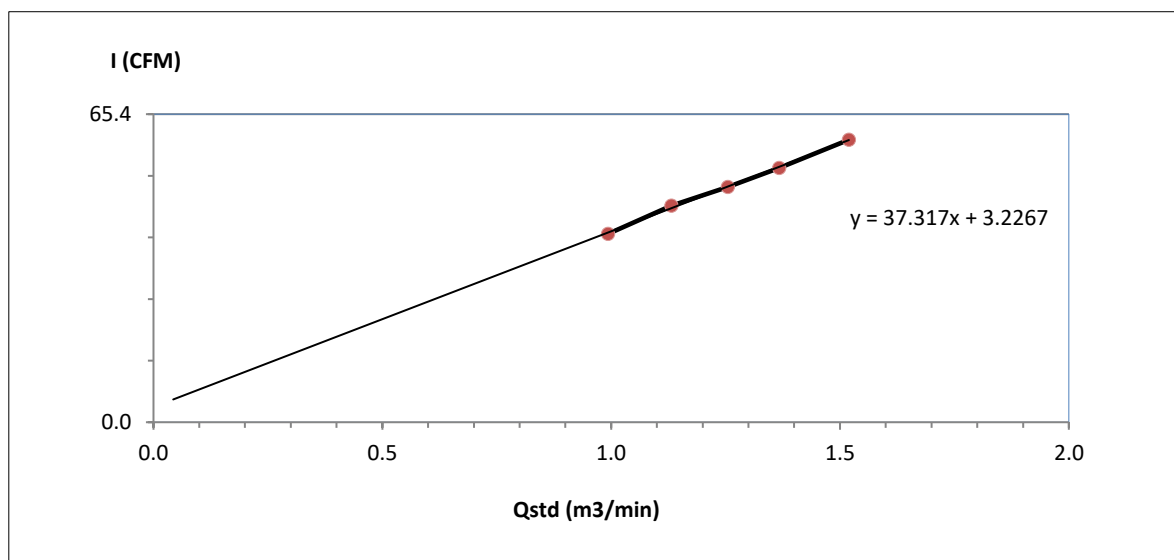
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)



## High Volume Air Sampler Calibration Worksheet

|                       |                     |                               |            |
|-----------------------|---------------------|-------------------------------|------------|
| Project Site :        | THAI MMA Co., Ltd.  | Barometric Pressure (mm Hg) : | 759        |
| Calibrate Location :  | บ้านเนินพยอม        | Temperature ( °C ) :          | 31         |
| Calibrate Date :      | 15-Mar-24           | High Volume ID :              | RYG_FS0174 |
| CalibrationSheet No.: | C-150324-RYG_FS0174 | High Volume Model :           | TE-5170D   |
| Calibrator ID:        | BKK_FS0624          | High Volume S/N :             | 4800       |
| Calibrator Model :    | TE-5028A            | Calibrator Slope :            | 1.64931    |
| Calibrator S/N :      | 2584                | Calibrator Intercept :        | -0.02579   |

| Test No. | Delta H <sub>2</sub> O<br>(inch) | Q <sub>std</sub><br>(m <sup>3</sup> /min) | I : Chart<br>(CFM) | Linear Regression   |
|----------|----------------------------------|---|--------------------|---|
| 1        | 2.6                              | 0.9931                                    | 40                 | Slope : 37.3170<br>Intercept : 3.2267<br>Correlation Coefficient : 0.9991 |
| 2        | 3.4                              | 1.1320                                    | 46                 |   |
| 3        | 4.2                              | 1.2552                                    | 50                 |   |
| 4        | 5.0                              | 1.3672                                    | 54                 |   |
| 5        | 6.2                              | 1.5195                                    | 60                 |   |



Calibrated by N. Uppathamp  
( Mr.Nontachai Uppathamp )  
Field Scientist(1)

Approved by : N. Juntarupan  
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)



**SARTORIUS**

NSC-TISI-TIS 17025  
CALIBRATION 0426

# Certificate

## of Calibration

Model Number : LA130S-F  
Description : Analytical Balance  
Serial Number : 25409664  
ID No. : RYG\_EN0001  
Manufacturer : Sartorius

Certificate No. : 24BCI0068  
Issued Date : Friday, February 23, 2024  
Reference No. : 229196

Page No. : 1 of 2

Customer Name : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd.(Balance Room)  
616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated By : Mr.Chonchai Inthana  
Calibration Date : Thursday, February 22, 2024

Calibration  
Procedure No. : This calibration was conducted by  
Using in-house calibration procedure number (WI-003)  
Based on UKAS LAB 14 : 2019

### Metrological data :

Capacity : 150 g Readability : 0.0001 g

### Ambients Conditions:

Temperature : 23.6 °C ± 5.0 °C  
Humidity : 54.0 % RH ± 10.0 % RH  
Pressure :                      ±                     

### Reasons for calibration

☐ New Installation ☐ Service / Repaired ☒ Re-calibration/ Maintenance

Equipment Condition: ☒ Good Operate ☐ Fair

## Measurement Method UKAS Publication Ref :Lab 14

The measurement uncertainty stated is the expended 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 form list of Sartorius Metrological Specifications.

## Traceability:

| Model Number  | Description                                       | Traceability | Certificate No. | Due Date    |
|---------------|---|--------------|-----------------|-------------|
| YCS011-522-00 | Sartorius weight set 1mg - 5000g E2,YCS011-522-00 | TCS          | M2308197S       | 23-Aug-2025 |
| MHB-382SD     | Humidity/Barometer/Temp Lutron MHB-382SD          | DKSH         | C19231845       | 23-Aug-2024 |

This certificate relate and apply this equipment only.

This certificate may not be reproduced other than in full except with the prior written approval of the Verification Operation Division  
Sartorius (Thailand) Co., Ltd.

Mr.chonchai Inthana(Technical Manager)

S  
T  
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M  
P



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

129 Rama 9 Road, Huaykwang, Bangkok 10310

Tel: +66 2643 8361-6 Fax: +66 2643-8367, e-mail: service.thailand@sartorius.com

**SARTORIUS**

# Certificate of Calibration

Model Number : LA130S-F

Description : Analytical Balance

Serial Number : 25409664

ID No. : RYG\_EN0001

Manufacturer : Sartorius

Certificate No. : 24BCI0068

Issued Date : Friday, February 23, 2024

Reference No. : 229196

Page No. : 2 of 2

## Calibration Results : Without Adjustment

### Repeatability

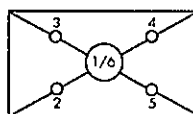
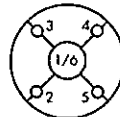
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

|                             |         |          |
|-----------------------------|---------|----------|
| Nominal Value : (Low Load)  | 10.0000 | 99.9999  |
| 10 g                        | 10.0000 | 100.0000 |
| Tolerance                   | 10.0000 | 100.0001 |
| 0.0001 g                    | 10.0000 | 100.0001 |
|                             | 9.9999  | 100.0000 |
| Nominal Value : (High Load) | 10.0000 | 100.0001 |
| 100 g                       | 10.0000 | 100.0000 |
| Tolerance                   | 10.0000 | 100.0001 |
| 0.0001 g                    | 9.9999  | 100.0002 |
|                             | 9.9999  | 100.0001 |
| Standard Deviation          | 0.00005 | 0.00008  |

### 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 | 0.0001  |
| 4 | 0.0002  |
| 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           | 0.00020            |
| 0.05                 | 0.0500                         | 0.0500                 | 0.0000           | 0.00021            |
| 0.1                  | 0.1000                         | 0.1000                 | 0.0000           | 0.00021            |
| 0.5                  | 0.5000                         | 0.5000                 | 0.0000           | 0.00021            |
| 1                    | 1.0000                         | 1.0000                 | 0.0000           | 0.00021            |
| 2                    | 2.0000                         | 2.0000                 | 0.0000           | 0.00021            |
| 5                    | 5.0000                         | 5.0000                 | 0.0000           | 0.00021            |
| 10                   | 10.0000                        | 10.0001                | 0.0001           | 0.00024            |
| 20                   | 20.0000                        | 20.0001                | 0.0001           | 0.00021            |
| 100                  | 100.0000                       | 99.9999                | -0.0001          | 0.00024            |

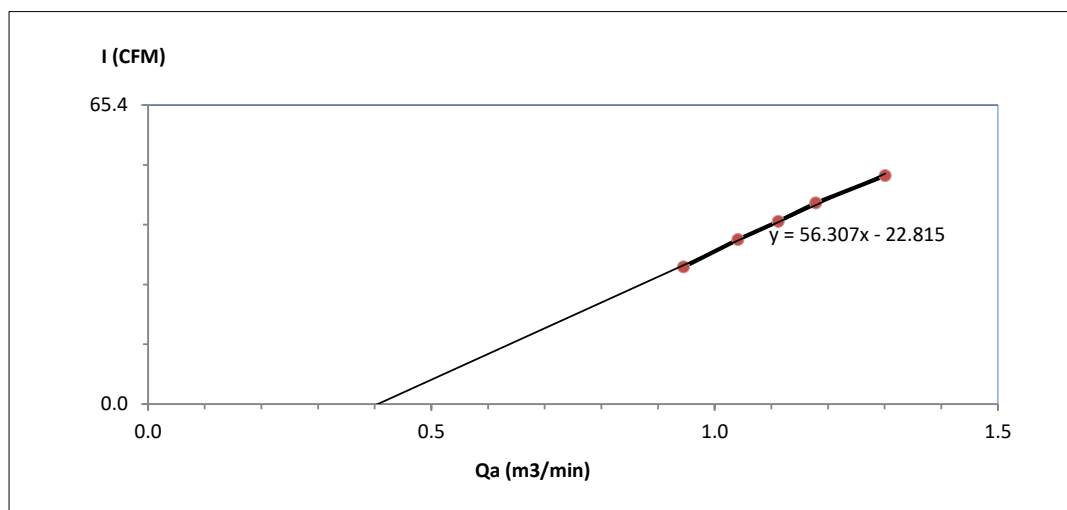
End of Report.



## High Volume Air Sampler Calibration Worksheet

|                       |                     |                               |            |
|-----------------------|---------------------|-------------------------------|------------|
| Project Site :        | THAI MMA Co., Ltd.  | Barometric Pressure (mm Hg) : | 759        |
| Calibrate Location :  | บ้่าน               | Temperature ( °C) :           | 31         |
| Calibrate Date :      | 15-Mar-24           | High Volume ID :              | RYG_FS0399 |
| CalibrationSheet No.: | C-150324-RYG_FS0399 | High Volume Model :           | TE-5009X   |
| Calibrator ID:        | BKK_FS0624          | High Volume S/N :             | 5683       |
| Calibrator Model :    | TE-5028A            | Calibrator Slope :            | 1.03303    |
| Calibrator S/N :      | 2584                | Calibrator Intercept :        | -0.01606   |

| Test No. | Delta H <sub>2</sub> O<br>(inch) | Qa<br>(m <sup>3</sup> /min) | I : Chart<br>(CFM) | Linear Regression   |
|----------|----------------------------------|-----------------------------|--------------------|---|
| 1        | 2.3                              | 0.945                       | 30                 | Slope : 56.3065<br>Intercept : -22.8149<br>Correlation Coefficient : 0.9986 |
| 2        | 2.8                              | 1.041                       | 36                 |   |
| 3        | 3.2                              | 1.112                       | 40                 |   |
| 4        | 3.6                              | 1.178                       | 44                 |   |
| 5        | 4.4                              | 1.301                       | 50                 |   |



Calibrated by N. Uppathamp  
( Mr.Nontachai Uppathamp )  
Field Scientist(1)

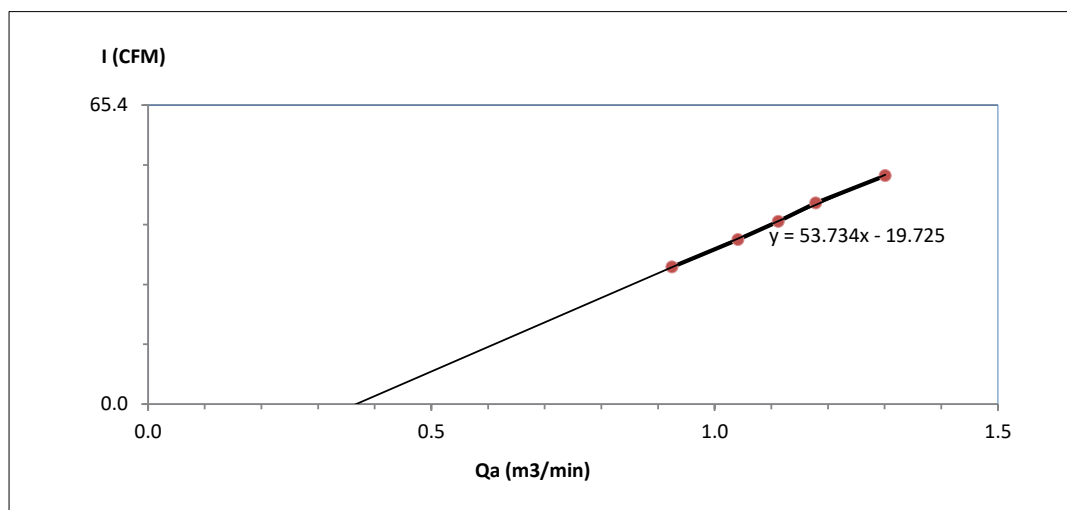
Approved by : N. Juntarupan  
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)



## High Volume Air Sampler Calibration Worksheet

|                       |                     |                               |            |
|-----------------------|---------------------|-------------------------------|------------|
| Project Site :        | THAI MMA Co., Ltd.  | Barometric Pressure (mm Hg) : | 759        |
| Calibrate Location :  | บ้านบางนา           | Temperature ( °C ) :          | 31         |
| Calibrate Date :      | 15-Mar-24           | High Volume ID :              | RYG_FS0187 |
| CalibrationSheet No.: | C-150324-RYG_FS0187 | High Volume Model :           | TE-5009X   |
| Calibrator ID:        | BKK_FS0624          | High Volume S/N :             | 4795       |
| Calibrator Model :    | TE-5028A            | Calibrator Slope :            | 1.03303    |
| Calibrator S/N :      | 2584                | Calibrator Intercept :        | -0.01606   |

| Test No. | Delta H <sub>2</sub> O<br>(inch) | Qa<br>(m <sup>3</sup> /min) | I : Chart<br>(CFM) | Linear Regression   |
|----------|----------------------------------|-----------------------------|--------------------|---|
| 1        | 2.2                              | 0.925                       | 30                 | Slope : 53.7338<br>Intercept : -19.7253<br>Correlation Coefficient : 0.9995 |
| 2        | 2.8                              | 1.041                       | 36                 |   |
| 3        | 3.2                              | 1.112                       | 40                 |   |
| 4        | 3.6                              | 1.178                       | 44                 |   |
| 5        | 4.4                              | 1.301                       | 50                 |   |



Calibrated by N. Uppathamp  
( Mr.Nontachai Uppathamp )  
Field Scientist(1)

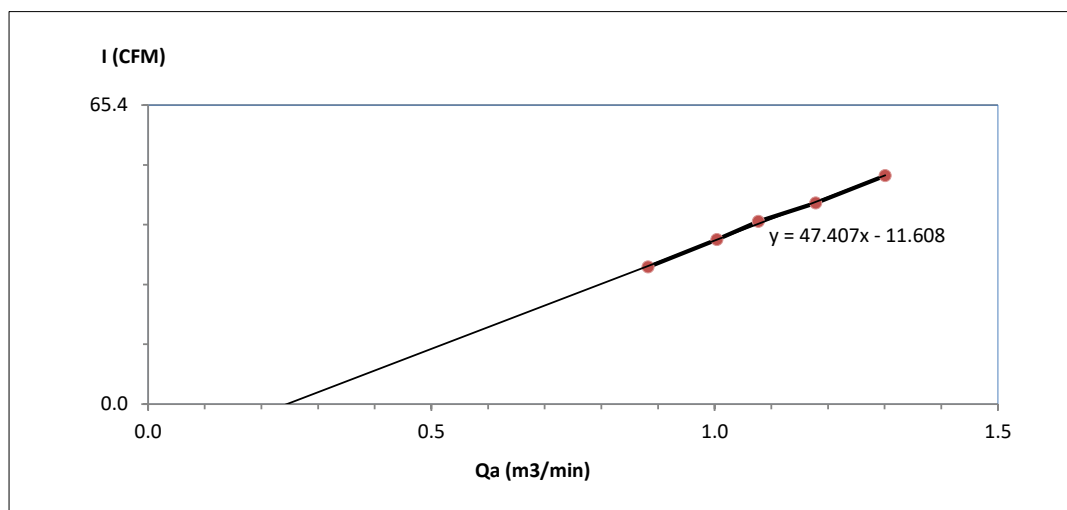
Approved by : N. Juntarupan  
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)



## High Volume Air Sampler Calibration Worksheet

|                       |                     |                               |            |
|-----------------------|---------------------|-------------------------------|------------|
| Project Site :        | THAI MMA Co., Ltd.  | Barometric Pressure (mm Hg) : | 759        |
| Calibrate Location :  | บ้านเนินพยอม        | Temperature ( °C ) :          | 31         |
| Calibrate Date :      | 15-Mar-24           | High Volume ID :              | RYG_FS0185 |
| CalibrationSheet No.: | C-150324-RYG_FS0185 | High Volume Model :           | TE-5009X   |
| Calibrator ID:        | BKK_FS0624          | High Volume S/N :             | 4793       |
| Calibrator Model :    | TE-5028A            | Calibrator Slope :            | 1.03303    |
| Calibrator S/N :      | 2584                | Calibrator Intercept :        | -0.01606   |

| Test No. | Delta H <sub>2</sub> O<br>(inch) | Qa<br>(m <sup>3</sup> /min) | I : Chart<br>(CFM) | Linear Regression   |
|----------|----------------------------------|-----------------------------|--------------------|---|
| 1        | 2.0                              | 0.882                       | 30                 | Slope : 47.4068<br>Intercept : -11.6084<br>Correlation Coefficient : 0.9991 |
| 2        | 2.6                              | 1.004                       | 36                 |   |
| 3        | 3.0                              | 1.077                       | 40                 |   |
| 4        | 3.6                              | 1.178                       | 44                 |   |
| 5        | 4.4                              | 1.301                       | 50                 |   |



Calibrated by N. Uppathamp  
( Mr.Nontachai Uppathamp )  
Field Scientist(1)

Approved by : N. Juntarupan  
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)





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

Air speed measurement laboratory  
Calibration services department.

|                |             |
|----------------|-------------|
| REVIEW BY      | Manakorn P. |
| APPROVED BY    | [Signature] |
| NEXT CAL. DATE | 21/11/25    |

|                    |
|--------------------|
| Certificate Number |
| CWS-001-66         |

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Cup anemometer  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: 110-WS-25DL-D  
**SERIAL NUMBER** : Sensor: WSD-A5662  
Data logger: A5662  
**ID NUMBER** : RYG\_FS0544  
**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** : 11 Jul 2023  
**MEASUREMENT DATE** : 21 Jul 2023  
**ISSUE DATE** : 21 Jul 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 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 | [-]             |

**Preconditioning** : 24 hours at ambient conditions.  
**Measurement Condition** : The average values during measurement are (24.0) °C, (41.7) %RH and (1009.1) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn 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 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.

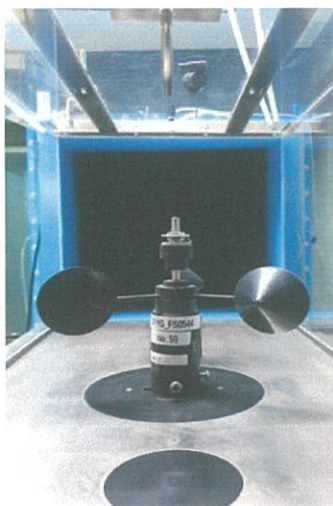
| $V_{std}$ <sup>6</sup><br>(m/s) | Temp. wind tunnel<br>(°C) | Temp. room<br>(°C) | $V_{uuc}$ <sup>7</sup><br>(m/s) | Error<br>(m/s) | $U (k=2)$<br>(m/s) |
|---------------------------------|---------------------------|--------------------|---------------------------------|----------------|--------------------|
| 1.024                           | 23.84                     | 23.95              | 0.8                             | -0.2           | 0.31               |
| 2.079                           | 24.08                     | 23.95              | 1.8                             | -0.3           | 0.31               |
| 3.019                           | 24.04                     | 23.95              | 2.8                             | -0.2           | 0.31               |
| 4.150                           | 24.12                     | 23.95              | 3.9                             | -0.3           | 0.31               |
| 5.00                            | 23.72                     | 23.95              | 4.8                             | -0.2           | 0.31               |
| 5.99                            | 23.88                     | 23.95              | 5.8                             | -0.2           | 0.31               |
| 7.04                            | 23.68                     | 23.95              | 6.9                             | -0.2           | 0.31               |
| 8.15                            | 23.64                     | 23.95              | 7.9                             | -0.2           | 0.31               |
| 9.09                            | 23.30                     | 23.95              | 9.0                             | -0.1           | 0.31               |
| 10.05                           | 23.40                     | 23.95              | 9.9                             | -0.1           | 0.31               |
| 11.13                           | 23.48                     | 23.95              | 11.0                            | -0.2           | 0.31               |
| 12.11                           | 23.40                     | 23.95              | 12.0                            | -0.1           | 0.31               |
| 13.16                           | 23.50                     | 23.95              | 13.0                            | -0.1           | 0.31               |
| 14.22                           | 23.40                     | 23.95              | 14.0                            | -0.2           | 0.31               |
| 15.22                           | 23.50                     | 23.95              | 15.0                            | -0.2           | 0.31               |
| 16.27                           | 23.44                     | 23.95              | 16.1                            | -0.2           | 0.31               |

**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.







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NSC-TISI-TIS 17025  
CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department.

Certificate Number

CWD-001-66

## 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-A5662  
Data logger: A5662  
**ID NUMBER** : RYG\_FS0544  
**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** : 11 Jul 2023  
**MEASUREMENT DATE** : 21 Jul 2023  
**ISSUE DATE** : 21 Jul 2023

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature :  $23.0 \pm 3.0$  °C  
Relative Humidity :  $55.0 \pm 15.0$  %RH  
Atmospheric Pressure :  $1010 \pm 10$  hPa

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

**CALIBRATION CONDITION** : 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, (43.0) %RH and (1011.6) 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 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 | $D^{\text{std}}$<br>Degree (°) | $D^{\text{uuc}}$<br>Degree (°) | Error<br>Degree (°) | $U (k=2)$<br>Degree (°) |
|------------------|--------------------------------|--------------------------------|---------------------|-------------------------|
| 5.00             | 45.000                         | 41                             | -4                  | 1.0                     |
|                  | 90.000                         | 87                             | -3                  | 1.0                     |
|                  | 135.000                        | 132                            | -3                  | 1.0                     |
|                  | 180.000                        | 180                            | 0                   | 1.0                     |
|                  | 225.000                        | 228                            | 3                   | 1.0                     |
|                  | 270.000                        | 273                            | 3                   | 1.0                     |
|                  | 315.000                        | 318                            | 3                   | 1.0                     |
|                  | 360.000                        | 359                            | -1                  | 1.0                     |

**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\*\*\*





## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-037-66  
Page 1 of 2

**Equipment Name:** Data Logger with Temperature sensor  
**Manufacturer:** Novalynx  
**Model:** 110-WS-25DL-D  
**Serial No.:** A5662  
**ID No.:** RYG\_FS0544

### Customer

**Name:** ALS laboratory group (Thailand) Co., Ltd.  
**Address:** 104 Phatthanakan 40, Phatthanakan Rd.,  
Khwaeng Suan Luang, Khet Suan Luang, Bangkok  
10250 Thailand.

**Received date:** 11 Jul 2023  
**Calibration date:** 21 Jul 2023  
**Issue date:** 21 Jul 2023

### Reference Used During Calibration

1. Standard Temperature Probe Model: STS-100 A500,  
Serial No.: 667682-09, Due date: 28 Mar 2024
2. Digital Temperature Indicator Model: DTI-1000-A MK  
II, Serial No.: 671407-00591 Due date: 22 July 2023

### Calibration Condition

Temperature:  $(23 \pm 3)^{\circ}\text{C}$   
Relative Humidity:  $(55 \pm 15)\%$

### Calibration Procedure

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

### Traceability

The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0038-23, Certificate number: ER-0092-22

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

### Calibrated by

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



### Approved Signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

**Result of Calibration:-** ☒ Without Adjustment ☐ With Adjustment

**Calibration Range:** 20-40 °C

**Function:**

This equipment was connected with temperature sensor Model: HMP60 S/N: T2320591.

Dimension : Diameter 12 mm. Length 80 mm.

| <u>Immersion<br/>Depth<br/>(mm)</u> | <u>Standard<br/>Reading<br/>(°C)</u> | <u>UUC<br/>Reading<br/>(°C)</u> | <u>Error<br/>(°C)</u> | <u>Uncertainty<br/>(°C)</u> |
|-------------------------------------|--------------------------------------|---------------------------------|-----------------------|-----------------------------|
| 70                                  | 20.060                               | 19.6                            | -0.5                  | 0.099                       |
| 70                                  | 25.054                               | 24.6                            | -0.5                  | 0.099                       |
| 70                                  | 30.050                               | 29.7                            | -0.3                  | 0.14                        |
| 70                                  | 35.043                               | 34.5                            | -0.5                  | 0.099                       |
| 70                                  | 40.036                               | 39.5                            | -0.5                  | 0.14                        |

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 \***



## CERTIFICATE OF CALIBRATION

Calibration No. : RH-01072023

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger  
Manufacturer : Novalynx  
Model/Type : 110-WS-25DL-D  
Serial Number : A5662  
ID No. : RYG\_FS0544  
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  $(25\pm3)^{\circ}\text{C}$ , and relative humidity of  $(50\pm15)\%$ .

### Measurement Method:

Unit Under Calibration (UUC) was calibrated by comparison method with standard chilled mirror hygrometer model: 1860-3 in the humidity generator chamber to determine the errors.

### Traceability:

This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the international system of units (SI) via MCS Calibration, Inc. Certificate number: 20926-601. Due date: Sep 26, 2024.

Measurement Date : Jul 21, 2023

Issued Date : Jul 21, 2023

### Measurement Results:

This equipment was connected with Indoor air quality probe and Displayed (UR) on display. Model: HMP60, Serial number: T2320591.

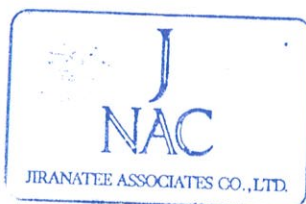
Calibration was performed in the range of 20%RH to 80%RH

The results of calibration are reported in table below.

| Determined<br>(%RH) | Standard (Reading)<br>(%RH) | UUC (Reading)<br>(%RH) | Error<br>(%RH) | Uncertainty<br>$\pm$ (%RH) |
|---------------------|-----------------------------|------------------------|----------------|----------------------------|
| 20                  | 20.07                       | 16.3                   | -3.8           | 0.51                       |
| 50                  | 50.23                       | 45.0                   | -5.2           | 0.51                       |
| 80                  | 80.23                       | 73.5                   | -6.7           | 0.51                       |

### Performed by

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



### Approved Signatory:



Mr. Parinya Booncharoen.  
Calibration Department Manager





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CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department.

|                |                    |
|----------------|--------------------|
| REVIEW BY      | <i>Parinya P.</i>  |
| APPROVED BY    | <i>[Signature]</i> |
| NEXT CAL. DATE | 19/7/24            |

Certificate Number

CL-013-66

## 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-014  
Data logger: A5789  
**ID NUMBER** : RYG\_FS0531  
**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** : 16 Jan 2023  
**MEASUREMENT DATE** : 19 Jan 2023  
**ISSUE DATE** : 20 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 (23.6)°C, (46.6) %RH and (1014.9) 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 | $D^{\text{std}}$<br>Degree (°) | $D^{\text{uuc}}$<br>Degree (°) | Error<br>Degree (°) | $U (k=2)$<br>Degree (°) |
|------------------|--------------------------------|--------------------------------|---------------------|-------------------------|
| 4.99             | 0.000                          | 0                              | 0                   | 0.58                    |
|                  | 45.000                         | 43                             | -2                  | 0.74                    |
|                  | 90.000                         | 88                             | -2                  | 0.74                    |
|                  | 135.000                        | 133                            | -2                  | 0.74                    |
|                  | 180.000                        | 179                            | -1                  | 0.74                    |
|                  | 225.000                        | 227                            | 2                   | 0.74                    |
|                  | 270.000                        | 272                            | 2                   | 0.74                    |
|                  | 315.000                        | 317                            | 2                   | 0.74                    |

## 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\*\*\*





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CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department.

Certificate Number

CL-013-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Cup anemometer  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: 110-WS-25DL-D  
**SERIAL NUMBER** : Sensor: WSD-014  
Data logger: A5789  
**ID NUMBER** : RYG\_FS0531  
**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** : 16 Jan 2023  
**MEASUREMENT DATE** : 18 Jan 2023  
**ISSUE DATE** : 20 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 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 | [-]             |

**Preconditioning** : 24 hours at ambient conditions.  
**Measurement Condition** : The average values during measurement are (23.7) °C, (44.5) %RH and (1018.3) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jittraporn 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 exercise 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.

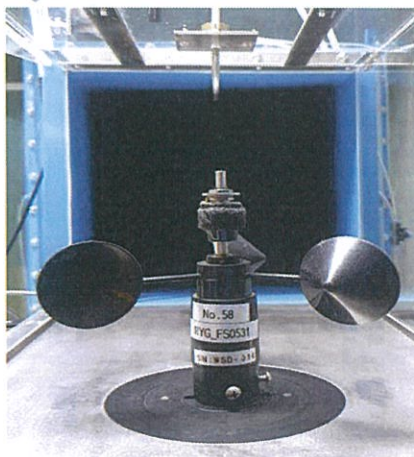
| $v_{std}^6$<br>(m/s) | Temp. wind tunnel<br>(°C) | Temp. room<br>(°C) | $v_{uuc}^7$<br>(m/s) | Error<br>(m/s) | $U (k=2)$<br>(m/s) |
|----------------------|---------------------------|--------------------|----------------------|----------------|--------------------|
| 0.983                | 23.60                     | 23.70              | 0.7                  | -0.3           | 0.18               |
| 2.024                | 23.74                     | 23.70              | 1.7                  | -0.3           | 0.16               |
| 3.044                | 23.50                     | 23.70              | 2.9                  | -0.2           | 0.18               |
| 4.119                | 23.82                     | 23.70              | 3.9                  | -0.2           | 0.19               |
| 5.02                 | 23.50                     | 23.70              | 4.9                  | -0.2           | 0.18               |
| 5.99                 | 23.88                     | 23.70              | 5.8                  | -0.2           | 0.18               |
| 7.08                 | 23.50                     | 23.70              | 6.9                  | -0.1           | 0.20               |
| 8.18                 | 23.58                     | 23.70              | 8.0                  | -0.2           | 0.18               |
| 9.11                 | 23.50                     | 23.70              | 9.0                  | -0.1           | 0.19               |
| 10.08                | 23.66                     | 23.70              | 10.0                 | -0.1           | 0.25               |
| 11.15                | 23.32                     | 23.70              | 11.0                 | -0.2           | 0.21               |
| 12.14                | 23.66                     | 23.70              | 12.0                 | -0.2           | 0.20               |
| 13.20                | 23.32                     | 23.70              | 13.2                 | 0.0            | 0.25               |
| 14.25                | 23.50                     | 23.70              | 14.1                 | -0.1           | 0.27               |
| 15.23                | 23.30                     | 23.70              | 15.1                 | -0.2           | 0.27               |
| 16.29                | 23.40                     | 23.70              | 16.2                 | -0.1           | 0.23               |

**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\*\*\*



## CERTIFICATE OF CALIBRATION

Certificate No.: CL-006-66  
Page 1 of 2

Equipment Name: Data Logger with Temperature  
Sensor

Manufacturer: Novalynx  
Model: 110-WS-25DL-D  
Serial No.: A5789  
ID No.: RYG\_FS0531

### Customer

Name: ALS laboratory group (Thailand) Co., Ltd.  
Address: 104 Phatthanakan 40, Phatthanakan Rd.,  
Khwaeng Suan Luang, Khet Suan Luang, Bangkok  
10250 Thailand.

Received date: 16 Jan 2023  
Calibration date: 18 Jan 2023  
Issue date: 20 Jan 2023

### Reference Used During Calibration

1. Standard Temperature Probe Model: STS-100 A500,  
Serial No.: 667682-09, Due date: 23 Mar 2023  
2. Digital Temperature Indicator Model: DTI-1000-A MK  
II, Serial No.: 671407-00591 Due date: 22 July 2023

### Calibration Condition

Temperature:  $(23 \pm 3)^\circ\text{C}$   
Relative Humidity:  $(55 \pm 15)\%$

### Calibration Procedure

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

### Traceability

The measurement results are traceable to the  
international system of units (SI) through National  
Institute of Metrology Thailand (NIMT) Certificate  
number: TT-0034-22, Certificate number: ER-0092-  
22

### Calibrated by

- ☐ Mr. Sorawit Thachalad  
☒ Miss Jitraporn Lertsomphol



### Approved Signatory:

*25/Ans*

Mr. Parinya Booncharoen  
Calibration Department Manager

**Result of Calibration:-** ☒ Without Adjustment ☐ With Adjustment

**Calibration Range:** 20-40 °C

**Function:**

This equipment was connected with temperature sensor Model: HMP60 S/N: T0210901.

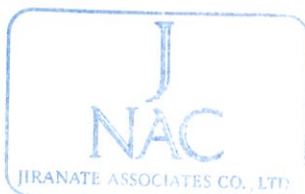
Dimension : Diameter 12 mm. Length 80 mm.

| <u>Immersion<br/>Depth<br/>(mm)</u> | <u>Standard<br/>Reading<br/>(°C)</u> | <u>UUC<br/>Reading<br/>(°C)</u> | <u>Error<br/>(°C)</u> | <u>Uncertainty<br/>(°C)</u> |
|-------------------------------------|--------------------------------------|---------------------------------|-----------------------|-----------------------------|
| 60                                  | 20.067                               | 19.8                            | -0.3                  | 0.099                       |
| 60                                  | 25.058                               | 24.6                            | -0.5                  | 0.099                       |
| 60                                  | 30.052                               | 29.5                            | -0.6                  | 0.099                       |
| 60                                  | 35.047                               | 34.5                            | -0.5                  | 0.099                       |
| 60                                  | 40.038                               | 39.3                            | -0.7                  | 0.099                       |

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 \***



## CERTIFICATE OF CALIBRATION

Calibration No. : RH-06012023

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger  
Manufacturer : Novalynx  
Model/Type : 110-WS-25DL-D  
Serial Number : A5789  
ID No. : RYG\_FS0531  
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  $(25\pm3)^{\circ}\text{C}$ , and relative humidity of  $(50\pm15)\%$ .

### Measurement Method:

Unit Under Calibration (UUC) was calibrated by comparison method with standard thermo hygrometer in the humidity generator chamber to determine the errors.

### Traceability:

This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the international system of units (SI) via MCS Calibration, Inc. Certificate number: 20314-101. Due date: Mar 14, 2023.

Measurement Date : Jan 18, 2023  
Issued Date : Jan 20, 2023

### Measurement Results:

This equipment was connected with Indoor air quality probe and Displayed (UR) on display. Model: HMP60, Serial number: T0210901.

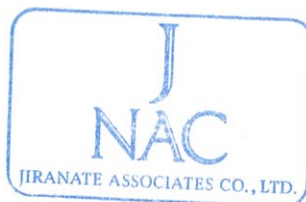
Calibration was performed in the range of 20%RH to 80%RH

The results of calibration are reported in table below.

| Determined<br>(%RH) | Standard (Reading)<br>(%RH) | UUC (Reading)<br>(%RH) | Error<br>(%RH) | Uncertainty<br>$\pm$ (%RH) |
|---------------------|-----------------------------|------------------------|----------------|----------------------------|
| 20                  | 20.03                       | 18.0                   | -2.0           | 0.51                       |
| 50                  | 50.24                       | 47.8                   | -2.4           | 0.51                       |
| 80                  | 80.19                       | 77.3                   | -2.9           | 0.51                       |

### Performed by

- ☐ Mr. Sorawit Thachalad  
☒ Miss Jittrapor Lertsomphol



Approved Signatory: 

Mr. Parinya Booncharoen.  
Calibration Department Manager





JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd.  
63/14-15, 67/35-36  
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Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC-TISI-TIS 17025  
CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department.

|                |             |
|----------------|-------------|
| REVIEW BY      | Monskom P.  |
| APPROVED BY    | [Signature] |
| NEXT CAL. DATE | 19/1/24     |

Certificate Number

CL-012-66

## 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-011  
Data logger: A5660  
**ID NUMBER** : RYG\_FS0530  
**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** : 16 Jan 2023  
**MEASUREMENT DATE** : 19 Jan 2023  
**ISSUE DATE** : 20 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 (23.7)°C, (44.2) %RH and (1015.2) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

☒ Mr. Sorawit Thachalad  
☐ Miss Jittraporn 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 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 | $D^{\circ}_{std}$<br>Degree (°) | $D^{\circ}_{uuc}$<br>Degree (°) | Error<br>Degree (°) | $U (k=2)$<br>Degree (°) |
|------------------|---------------------------------|---------------------------------|---------------------|-------------------------|
| 5.01             | 0.000                           | 0                               | 0                   | 0.58                    |
|                  | 45.000                          | 42                              | -3                  | 0.74                    |
|                  | 90.000                          | 88                              | -2                  | 0.74                    |
|                  | 135.000                         | 133                             | -2                  | 0.68                    |
|                  | 180.000                         | 179                             | -1                  | 0.74                    |
|                  | 225.000                         | 226                             | 1                   | 0.74                    |
|                  | 270.000                         | 270                             | 0                   | 0.74                    |
|                  | 315.000                         | 316                             | 1                   | 0.74                    |

**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.

Jiranatee Associates Co.,Ltd.  
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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-012-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Cup anemometer  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: 110-WS-25DL-D  
**SERIAL NUMBER** : Sensor: WSD-011  
Data logger: A5660  
**ID NUMBER** : RYG\_FS0530  
**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** : 16 Jan 2023  
**MEASUREMENT DATE** : 18 Jan 2023  
**ISSUE DATE** : 20 Jan 2023

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature :  $23.0 \pm 3.0$  °C  
Relative Humidity :  $55.0 \pm 15.0$  %RH  
Atmospheric Pressure :  $1010 \pm 10$  hPa

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

**CALIBRATION CONDITIONS** : 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 [-]

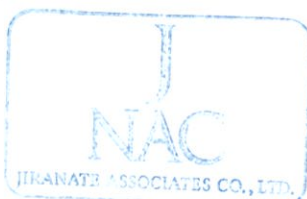
**Preconditioning** : 24 hours at ambient conditions.  
**Measurement Condition** : The average values during measurement are (23.7) °C, (50.2) %RH and (1017.1) hPa.

### 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.

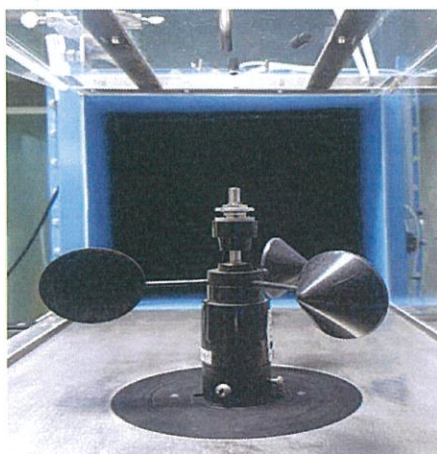
| $v_{std}^6$<br>(m/s) | Temp. wind tunnel<br>(°C) | Temp. room<br>(°C) | $v_{uuc}^7$<br>(m/s) | Error<br>(m/s) | $U (k=2)$<br>(m/s) |
|----------------------|---------------------------|--------------------|----------------------|----------------|--------------------|
| 0.979                | 23.56                     | 23.70              | 0.8                  | -0.2           | 0.16               |
| 2.025                | 23.80                     | 23.70              | 1.8                  | -0.2           | 0.16               |
| 3.046                | 23.50                     | 23.70              | 2.8                  | -0.2           | 0.20               |
| 4.120                | 23.64                     | 23.70              | 3.9                  | -0.3           | 0.20               |
| 5.01                 | 23.44                     | 23.70              | 4.8                  | -0.2           | 0.18               |
| 5.98                 | 23.60                     | 23.70              | 5.8                  | -0.2           | 0.18               |
| 7.05                 | 23.28                     | 23.70              | 6.9                  | -0.1           | 0.19               |
| 8.17                 | 23.60                     | 23.70              | 8.0                  | -0.2           | 0.19               |
| 9.09                 | 23.20                     | 23.70              | 9.0                  | 0.0            | 0.22               |
| 10.09                | 23.52                     | 23.70              | 9.9                  | -0.2           | 0.20               |
| 11.13                | 23.20                     | 23.70              | 10.9                 | -0.2           | 0.21               |
| 12.13                | 23.50                     | 23.70              | 11.9                 | -0.2           | 0.21               |
| 13.19                | 23.20                     | 23.70              | 13.0                 | -0.2           | 0.22               |
| 14.25                | 23.46                     | 23.70              | 14.3                 | 0.0            | 0.24               |
| 15.22                | 23.20                     | 23.70              | 15.1                 | -0.1           | 0.34               |
| 16.31                | 23.30                     | 23.70              | 16.1                 | -0.2           | 0.29               |

**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\*\*\*





## CERTIFICATE OF CALIBRATION

Certificate No.: CL-005-66  
Page 1 of 2

Equipment Name: Data Logger with Temperature  
Sensor

Manufacturer: Novalynx

Model: 110-WS-25DL-D

Serial No.: A5660

ID No.: RYG\_FS0530

### Customer

Name: ALS laboratory group (Thailand) Co., Ltd.  
Address: 104 Phatthanakan 40, Phatthanakan Rd.,  
Khwaeng Suan Luang, Khet Suan Luang, Bangkok  
10250 Thailand.

Received date: 16 Jan 2023  
Calibration date: 18 Jan 2023  
Issue date: 20 Jan 2023

### Reference Used During Calibration

1. Standard Temperature Probe Model: STS-100 A500,  
Serial No.: 667682-09, Due date: 23 Mar 2023  
2. Digital Temperature Indicator Model: DTI-1000-A MK  
II, Serial No.: 671407-00591 Due date: 22 July 2023

### Calibration Condition

Temperature:  $(23 \pm 3)^{\circ}\text{C}$   
Relative Humidity:  $(55 \pm 15)\%$

### Calibration Procedure

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

### Traceability

The measurement results are traceable to the  
international system of units (SI) through National  
Institute of Metrology Thailand (NIMT) Certificate  
number: TT-0034-22, Certificate number: ER-0092-  
22

### Calibrated by

- ☐ Mr. Sorawit Thachalad  
☒ Miss Jitraporn Lertsomphol



### Approved Signatory:

*25/Jan*  
Mr. Parinya Booncharoen  
Calibration Department Manager

**Result of Calibration:-** ☒ Without Adjustment ☐ With Adjustment

**Calibration Range:** 20-40 °C

**Function:**

This equipment was connected with temperature sensor Model: HMP60 S/N: S4620631.

Dimension : Diameter 12 mm. Length 80 mm.

| <u>Immersion<br/>Depth<br/>(mm)</u> | <u>Standard<br/>Reading<br/>(°C)</u> | <u>UUC<br/>Reading<br/>(°C)</u> | <u>Error<br/>(°C)</u> | <u>Uncertainty<br/>(°C)</u> |
|-------------------------------------|--------------------------------------|---------------------------------|-----------------------|-----------------------------|
| 60                                  | 20.066                               | 19.8                            | -0.3                  | 0.099                       |
| 60                                  | 25.058                               | 24.6                            | -0.5                  | 0.14                        |
| 60                                  | 30.052                               | 29.5                            | -0.6                  | 0.099                       |
| 60                                  | 35.047                               | 34.5                            | -0.5                  | 0.099                       |
| 60                                  | 40.038                               | 39.4                            | -0.6                  | 0.099                       |

**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 \***



## CERTIFICATE OF CALIBRATION

Calibration No. : RH-05012023

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger  
Manufacturer : Novalynx  
Model/Type : 110-WS-25DL-D  
Serial Number : A5660  
ID No. : RYG\_FS0530  
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  $(25\pm3)^{\circ}\text{C}$ , and relative humidity of  $(50\pm15)\%$ .

### Measurement Method:

Unit Under Calibration (UUC) was calibrated by comparison method with standard thermo hygrometer in the humidity generator chamber to determine the errors.

### Traceability:

This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the international system of units (SI) via MCS Calibration, Inc. Certificate number: 20314-101. Due date: Mar 14, 2023.

Measurement Date : Jan 18, 2023

Issued Date : Jan 20, 2023

### Measurement Results:

This equipment was connected with Indoor air quality probe and Displayed (UR) on display. Model: HMP60, Serial number: S4620631.

Calibration was performed in the range of 20%RH to 80%RH

The results of calibration are reported in table below.

| Determined<br>(%RH) | Standard (Reading)<br>(%RH) | UUC (Reading)<br>(%RH) | Error<br>(%RH) | Uncertainty<br>$\pm$ (%RH) |
|---------------------|-----------------------------|------------------------|----------------|----------------------------|
| 20                  | 20.03                       | 17.8                   | -2.2           | 0.58                       |
| 50                  | 50.28                       | 48.6                   | -1.7           | 0.57                       |
| 80                  | 80.29                       | 79.8                   | -0.5           | 0.58                       |

### Performed by

- ☐ Mr. Sorawit Thachalad  
☒ Miss Jitraporn Lertsomphol



Approved Signatory: .....

Mr. Parinya Booncharoen.  
Calibration Department Manager





## CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 9-Jan-24  
Next Cal. Date : 9-Jul-24

Barometric Pressure (mmHg) : 754.7  
Relative Humidity (%) : 55.0  
Temperature (°C) : 27.2

### Console Control Meter Data

Calibration No. : C-090124-RYG\_FS0315  
Dry Gas Meter ID : RYG\_FS0315  
Serial No. : 1706091  
Model No. : XC-572-V

### Reference Dry Gas Meter Data

Reference Dry Gas Meter ID : BKK\_FS1122  
Serial No. : A2003240  
Correction Factor (Y) : 0.9824  
Next Calibration Date : 7-Nov-24

| $\Delta H$<br><br>(mm.H <sub>2</sub> O) | $\Theta$<br><br>Minutes | Reference Dry Gas Meter Calibration |         |        |                | Console Control ; Drygas Meter |           |        |                |                |                    | Dry Gas Meter     | Orifice                   |
|---|-------------------------|-------------------------------------|---------|--------|----------------|--------------------------------|-----------|--------|----------------|----------------|--------------------|-------------------|---------------------------|
|   |                         | Vr (Liters)                         |         |        | Tr<br><br>(°C) | Vm (Liters)                    |           |        | Ti<br><br>(°C) | To<br><br>(°C) | Avg.Tm<br><br>(°C) | Correction        | Calibration               |
|   |                         | Final                               | Initial | Total  |                | Final                          | Initial   | Total  |                |                |                    | Factor<br><br>(Y) | Factor<br><br>$\Delta H@$ |
| 15                                      | 12.80                   | 150.00                              | 0.00    | 150.00 | 26.0           | 1906727.4                      | 1906577.0 | 150.40 | 26.0           | 26.0           | 26.0               | 0.9784            | 49.8082                   |
| 25                                      | 9.78                    | 150.00                              | 0.00    | 150.00 | 26.0           | 1906896.2                      | 1906746.0 | 150.20 | 26.0           | 26.0           | 26.0               | 0.9787            | 48.4627                   |
| 50                                      | 6.88                    | 150.00                              | 0.00    | 150.00 | 26.0           | 1907057.8                      | 1906908.0 | 149.80 | 27.0           | 27.0           | 27.0               | 0.9822            | 47.8064                   |
| 80                                      | 5.38                    | 150.00                              | 0.00    | 150.00 | 26.0           | 1907222.8                      | 1907073.0 | 149.80 | 27.0           | 27.0           | 27.0               | 0.9794            | 46.7729                   |
| 120                                     | 4.40                    | 150.00                              | 0.00    | 150.00 | 26.0           | 1907385.8                      | 1907237.0 | 148.80 | 28.0           | 28.0           | 28.0               | 0.9854            | 46.7715                   |
|   |                         |                                     |         |        |                |                                |           |        |                |                | Avg.               | 0.9808            | 47.9243                   |

Y : Ratio of reading of reference to dry gas meter : tolerance for individual values  $\pm$  0.02 from average .

$\Delta H@$  : Orifice pressure differential that equates to 21.24 lm of air @ 25 C and 760 mm of mercury , mmH<sub>2</sub>O ; tolerance for individual values  $\pm$  5.08 from average .

Procedure; 40 CFR 60,APP A,METH ,SEC 5.3 & 7

Calibrated by:

Saksit Phaisanphisut

( Mr. Saksit Phaisanphisut )

RYG Field Service Scientist(4)

Approved by:

Nattapol Jiengwareewong

( Mr.Nattapol Jiengwareewong )

RYG Field Service Specialist(1)



## Stopwatch Calibration Test Report

Calibration Date : 9 Jan 24

Next Cal. Date : 9 Jul 24

Barometric Pressure (mmHg) : 754.7

Temperature (°C) : 27.2

Relative Humidity (%) : 55.0

### Reference Stopwatch Data

Stopwatch ID No. : E18061

Model : F808

Serial No. : -

Calibration Date : 8 Sep 20

Certificate No. : E-2009018

### Console Control Meter Data

Dry Gas Meter No. : RYG\_FS0315

Model : XC-572-V

Serial No. : 1706091

| Run No. | Time Actual (m:ss.ms) | Time Reading (m:ss) | Diff. (ms) | Diff. (min) |
|---------|-----------------------|---------------------|------------|-------------|
| 1       | 5:00:03               | 5:00                | 3          | 0.00005     |
| 2       | 5:00:09               | 5:00                | 8          | 0.00013     |
| 3       | 5:00:09               | 5:00                | 9          | 0.00015     |
| 4       | 5:00:11               | 5:00                | 11         | 0.00018     |
| 5       | 5:00:05               | 5:00                | 5          | 0.00008     |
| 6       | 5:00:06               | 5:00                | 6          | 0.00010     |
| 7       | 5:00:06               | 5:00                | 6          | 0.00010     |
| 8       | 5:00:08               | 5:00                | 8          | 0.00013     |
| 9       | 5:00:09               | 5:00                | 9          | 0.00015     |
| 10      | 5:00:07               | 5:00                | 7          | 0.00012     |
|         |                       |                     | Average    | 0.00012     |
|         |                       |                     | SD         | 0.00004     |

Calibrate by :

Saksit Phaisanphisut

Mr. Saksit Phaisanphisut

RYG Field Service Scientist (4)

Approved by :

Nattapol Jiengwareewong

Mr. Nattapol Jiengwareewong

RYG Field Service Specialist (1)



## DIGITAL TEMPERATURE CALIBRATION DATA SHEET

|                          |                     |                          |                  |
|--------------------------|---------------------|--------------------------|------------------|
| Calibration Date :       | 9 Jan 24            | Ambient Temperature (°C) | 27.2             |
| Calibration sheet No. :  | C-090124-RYG_FS0315 | Relative Humidity (%) :  | 55               |
| Digital Temperature ID : | RYG_FS0315          | Reference Temperature ID | RYG_FS0681       |
| Serial No. :             | 1706091             | Serial No. :             | 201090014918     |
| Model :                  | XC-572-V            | Model :                  | Digicon-CC-VT-MS |
|                          |                     | Next Calibrate :         | 13 Nov 24        |

| Location | Reference Temperature<br>°C | Digital Temperature<br>°C | Error<br>°C | MPE | Pass / Fail |
|----------|-----------------------------|---------------------------|-------------|-----|-------------|
| Stack    | 0                           | -1                        | -1          | ±3  | Pass        |
|          | 25                          | 25                        | 0           | ±3  | Pass        |
|          | 50                          | 50                        | 0           | ±3  | Pass        |
|          | 100                         | 101                       | 1           | ±3  | Pass        |
|          | 150                         | 151                       | 1           | ±3  | Pass        |
|          | 200                         | 200                       | 0           | ±3  | Pass        |
|          | 250                         | 250                       | 0           | ±3  | Pass        |
|          | 300                         | 301                       | 1           | ±3  | Pass        |
|          | 500                         | 502                       | 2           | ±3  | Pass        |
| Probe    | 100                         | 102                       | 2           | ±3  | Pass        |
|          | 120                         | 121                       | 1           | ±3  | Pass        |
|          | 140                         | 141                       | 1           | ±3  | Pass        |
| Oven     | 100                         | 101                       | 1           | ±3  | Pass        |
|          | 120                         | 121                       | 1           | ±3  | Pass        |
|          | 140                         | 141                       | 1           | ±3  | Pass        |
| Filter   | 100                         | 101                       | 1           | ±3  | Pass        |
|          | 120                         | 121                       | 1           | ±3  | Pass        |
|          | 140                         | 141                       | 1           | ±3  | Pass        |
| Exit     | 0                           | 0                         | 0           | ±3  | Pass        |
|          | 10                          | 10                        | 0           | ±3  | Pass        |
|          | 20                          | 20                        | 0           | ±3  | Pass        |
| Meter    | 0                           | -1                        | -1          | ±3  | Pass        |
|          | 25                          | 24                        | -1          | ±3  | Pass        |
|          | 50                          | 48                        | -2          | ±3  | Pass        |
| AUX      | 0                           | 0                         | 0           | ±3  | Pass        |
|          | 25                          | 25                        | 0           | ±3  | Pass        |
|          | 50                          | 50                        | 0           | ±3  | Pass        |

MPE : (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดของการวัดที่ยอมรับได้

Calibrated by :

*Saksit Phaisanphisut*

( Mr. Saksit Phaisanphisut )

RYG Field Service Scientist (4)

Approved by :

*Nattapon Jiengwareewong*

( Mr. Nattapon Jiengwareewong )

RYG Field Service Specialist (1)





PROBE NOZZLE DIAMETER  
CALIBRATION DATA SHEET

|   |                                 |
|---|---------------------------------|
| Calibration Date : 9 Jan 24                 | Nozzle Set ID. : RYG_FS0319     |
| Calibration Sheet No. : C-090124-RYG_FS0319 | Vernier Caliper ID.: BKK_FS1123 |

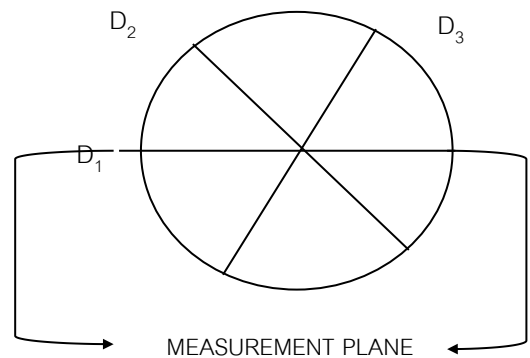
| Nozzle ID # | Nozzle Diameter (cm.) |       |       | Hi - Lo    | $(D_1 + D_2 + D_3) / 3$ |
|-------------|-----------------------|-------|-------|------------|-------------------------|
|             | $D_1$                 | $D_2$ | $D_3$ | $\Delta D$ | $D_{avg}$               |
| 1           | 0.298                 | 0.300 | 0.305 | 0.007      | 0.301                   |
| 2           | 0.465                 | 0.475 | 0.465 | 0.010      | 0.468                   |
| 3           | 0.605                 | 0.605 | 0.605 | 0.000      | 0.605                   |
| 4           | 0.770                 | 0.760 | 0.765 | 0.010      | 0.765                   |
| 5           | 0.930                 | 0.928 | 0.930 | 0.002      | 0.929                   |
| 6           | 1.082                 | 1.080 | 1.085 | 0.005      | 1.082                   |
| 7           | 1.240                 | 1.230 | 1.235 | 0.010      | 1.235                   |
| 8           | 1.594                 | 1.558 | 1.551 | 0.043      | 1.568                   |

Where :

$D_1, D_2, D_3$  = Three different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm.

$\Delta D$  = Maximum distance between any two diameters, must be  $\leq 0.100$  mm.

$D_{avg}$  =  $(D_1 + D_2 + D_3) / 3$



Calibrated by : Saksit Phaisanphisut

( Mr. Saksit Phaisanphisut )  
RYG Field Service Scientist (4)

Approved by : Nattapon Jiengwareewong

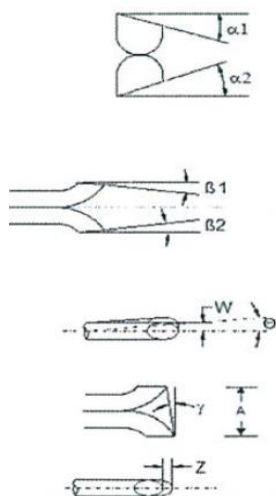
( Mr. Nattapon Jiengwareewong )  
RYG Field Service Specialist (1)



## Type S Pitot Tube Calibration

**Date Calibration** 9-Jan-24  
**Pitot ID** RYG\_FS0321  
**Pitot SN** -

**Due Date** 9-Jul-24  
**Inclinometer ID** BKK\_FS1131  
**Vernier ID** RYG\_FS0539



| Parameter           | Value | Allowable Range                        | Check |
|---------------------|-------|--|-------|
| $\alpha 1$          | -1.4  | $-10^{\circ} < \alpha 1 < +10^{\circ}$ | OK    |
| $\alpha 2$          | -0.2  | $-10^{\circ} < \alpha 2 < +10^{\circ}$ | OK    |
| $\beta 1$           | 0.8   | $-5^{\circ} < \beta 1 < +5^{\circ}$    | OK    |
| $\beta 2$           | -0.4  | $-5^{\circ} < \beta 2 < +5^{\circ}$    | OK    |
| $\gamma$            | 0.8   | -                                      | -     |
| $\theta$            | 0.5   | -                                      | -     |
| $Z = A \tan \gamma$ | 0.013 | $Z \leq 0.125"$                        | OK    |
| $W = A \tan \theta$ | 0.008 | $W \leq 0.031"$                        | OK    |
| Dt                  | 0.310 | 0.188" to 0.375"                       | OK    |
| $A/2Dt$             | 1.484 | $1.05 \leq PA/Dt \leq 1.5$             | OK    |
| A                   | 0.92  | $2.1Dt \leq A \leq 3Dt$                | OK    |

Certify that pitot tube/porbe meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a pitot tube certification fact of 0.84 . See 40 CFR Pt. 60, App. A,EPA Method 2.

Calibrated by : Saksit Phaisanphisut  
 ( Mr. Saksit Phaisanphisut )  
 RYG Field Services Scientist (4)

Approved By : Nattapon Jangwaneevong  
 ( Mr.Samart Roo-ngan )  
 RYG Field Services Specialist (1)

**Certificate No:** G 670176

**Date of issue :** 08-Mar-24

**Instrument description :** Flue Gas Analyzer  
**Instrument model :** Testo 350 New  
**Control unit serial no. :** 03401649/1119  
**Instrument serial no. :** 62087344/1119  
**ID no. or control no. :** RYG\_FS0464  
**Manufacturer :** Testo SE & Co. KGaA  
**Probe description :** -  
**Probe model :** -  
**Probe serial no. :** -  
**Customer name :** ALS LABORATORY GROUP (THAILAND) CO.,LTD.  
**Customer address :** 104 Phatthanakan 40, Phatthanakan Road, Khwaeng Phatthanakan, Khet Suan Luang, Bangkok, 10250 Thailand  
**Total pages of certificate :** 3 Pages  
**Receiving no. :** L-240885  
**Receiving date. :** 04-Mar-24  
**Parameter of calibration :** Gas Calibration(Oxygen 2.50,10.04,21.02 %vol, Carbon Monoxide 80.14,302,1003 ppm, Nitrogen Dioxide 30.34,81.32, 201.9 ppm, Nitric Oxide 30.01, 151.5, 322.5 ppm, Sulphur Dioxide 50.36, 100.8, 600.8 ppm)  
**Condition of UUC. :** Used  
**Ambient condition :** All of the Measurment ware caried out the stabilized labotary  
     Temperature : 23 ±5 °C  
     Humidity : 55 ± 15 %RH  
**Calibration place :** 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210  
**Calibration procedure no. :** This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no. WI-CL-28-C

|                |                    |
|----------------|--------------------|
| REVIEW BY      | <i>Minakorn P.</i> |
| APPROVED BY    | <i>[Signature]</i> |
| NEXT CAL. DATE | 7/3/25             |

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

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

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

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

**Date of calibration :** 08-Mar-24

*Kwanchei K.*

Mr. Kwanchai Khamdoug

**Calibration Technician**

*[Signature]*

Mrs. Nongluck Wongsettee

**Technical Manager**

**Certificate No.:** G 670176

**Standard References (Table 1)**

| Standard                                       | Certificate No. | Vendor | Due date  |
|--|-----------------|--------|-----------|
| Oxygen ( O <sub>2</sub> ) 2.50 % Vol           | 2412/23         | Linde  | 27-Aug-27 |
| Oxygen ( O <sub>2</sub> ) 10.04 % Vol          | CG-0153-21      | Nimt   | 18-Nov-26 |
| Oxygen ( O <sub>2</sub> ) 21.02 % Vol          | CG-0041-22      | Nimt   | 10-Feb-27 |
| Carbon monoxide ( CO ) 80.14 ppm               | CG-0040-22      | Nimt   | 14-Feb-27 |
| Carbon monoxide ( CO ) 302 ppm                 | 1915/23         | Linde  | 16-Jun-25 |
| Carbon monoxide ( CO ) 1003 ppm                | 2584/23         | Linde  | 10-Sep-25 |
| Nitrogen Dioxide ( NO <sub>2</sub> ) 30.34 ppm | 2703/22         | Linde  | 22-Aug-24 |
| Nitrogen Dioxide ( NO <sub>2</sub> ) 81.32 ppm | 3546/23         | Linde  | 14-Jan-26 |
| Nitrogen Dioxide ( NO <sub>2</sub> ) 201.9 ppm | 1975/23         | Linde  | 17-Jul-25 |
| Nitric Oxide ( NO ) 30.01 ppm                  | CG-0014-23      | Nimt   | 19-Feb-25 |
| Nitric Oxide ( NO ) 151.5 ppm                  | 0161/23         | Linde  | 22-Jan-25 |
| Nitric Oxide ( NO ) 322.5 ppm                  | 1974/23         | Linde  | 17-Jul-25 |
| Sulphur Dioxide ( SO <sub>2</sub> ) 50.36 ppm  | 2004/23         | Linde  | 17-Jul-25 |
| Sulphur Dioxide ( SO <sub>2</sub> ) 100.8 ppm  | 3507/22         | Linde  | 09-Nov-24 |
| Sulphur Dioxide ( SO <sub>2</sub> ) 600.8 ppm  | 2003/23         | Linde  | 17-Jul-25 |

**Measured room conditions**

Temperature : 23.6 °C Humidity : 65.2 %RH Pressure : 1011.2 mbar

**Calibration conditions**

Gas Temperature : 23 °C Flow rate : 1,300 ml/min Gas pressure : 1017.1 mbar

**Calibration Results (Before adjustment) (Table 2)**

| Parameter of Standard | Standard Values | Mean of UUC | Error | Uncertainty ( ± ) |
|-----------------------|-----------------|-------------|-------|-------------------|
| O <sub>2</sub> (%Vol) | 2.50            | 2.45        | -0.05 | 0.15              |
| O <sub>2</sub> (%Vol) | 10.04           | 9.93        | -0.11 | 0.20              |
| O <sub>2</sub> (%Vol) | 21.02           | 21.10       | 0.08  | 0.30              |
| CO (ppm)              | 80.14           | 81          | 0.86  | 3.0               |
| CO (ppm)              | 302             | 305         | 3     | 6.0               |
| CO (ppm)              | 1003            | 1009        | 6     | 12                |
| NO <sub>2</sub> (ppm) | 30.34           | 24.2        | -6.14 | 8.0               |
| NO <sub>2</sub> (ppm) | 81.32           | 76.9        | -4.42 | 8.0               |
| NO <sub>2</sub> (ppm) | 201.9           | 188.7       | -13.2 | 12                |
| NO (ppm)              | 30.01           | 27          | -3.01 | 8.0               |
| NO (ppm)              | 151.5           | 144         | -7.5  | 8.0               |
| NO (ppm)              | 322.5           | 304         | -18.5 | 12                |
| SO <sub>2</sub> (ppm) | 50.36           | 50          | -0.36 | 6.0               |
| SO <sub>2</sub> (ppm) | 100.8           | 98          | -2.8  | 6.0               |
| SO <sub>2</sub> (ppm) | 600.8           | 597         | -3.8  | 13                |

**Calibration Results (After adjustment) (Table 3)**

| Parameter of Standard | Standard Values | Mean of UUC | Error | Uncertainty ( ± ) |
|-----------------------|-----------------|-------------|-------|-------------------|
| O2 (%Vol)             | 2.500           | 2.45        | -0.05 | 0.15              |
| O2 (%Vol)             | 10.04           | 9.93        | -0.11 | 0.20              |
| O2 (%Vol)             | 21.02           | 21.10       | 0.08  | 0.30              |
| CO (ppm)              | 80.14           | 81          | 0.86  | 3.0               |
| CO (ppm)              | 302             | 305         | 3     | 6.0               |
| CO (ppm)              | 1003            | 1009        | 6     | 12                |
| NO2 (ppm)             | 30.34           | 29.5        | -0.84 | 8.0               |
| NO2 (ppm)             | 81.32           | 82.4        | 1.08  | 8.0               |
| NO2 (ppm)             | 201.9           | 202.4       | 0.5   | 12                |
| NO (ppm)              | 30.01           | 29          | -1.01 | 8.0               |
| NO (ppm)              | 151.5           | 152         | 0.5   | 8.0               |
| NO (ppm)              | 322.5           | 321         | -1.5  | 12                |
| SO2 (ppm)             | 50.36           | 50          | -0.36 | 6.0               |
| SO2 (ppm)             | 100.8           | 98          | -2.8  | 6.0               |
| SO2 (ppm)             | 600.8           | 597         | -3.8  | 13                |

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

**End of Report**





## ROTA METER CALIBRATION RESULT JANUARY 2024

| Rotameter ID. | Calibration Date | Regression Result      | Coefficient (R <sup>2</sup> ) |
|---------------|------------------|------------------------|-------------------------------|
| BKK_FS0585    | 10 Jan 24        | $Y = 1.0351x + 2.3733$ | 0.9998                        |
| BKK_FS0587    | 10 Jan 24        | $Y = 1.0168x + 15.05$  | 0.9997                        |
| BKK_FS0592    | 10 Jan 24        | $Y = 1.0013x + 12.556$ | 1.0000                        |
| BKK_FS0594    | 10 Jan 24        | $Y = 1.0048x + 4.9762$ | 1.0000                        |
| BKK_FS1004    | 04 Jan 24        | $Y = 0.9873x + 13.47$  | 0.9993                        |
| BKK_FS1005    | 04 Jan 24        | $Y = 1.0187x + 1.25$   | 0.9998                        |
| BKK_FS1006    | 04 Jan 24        | $Y = 1.1589x - 3.6605$ | 0.9981                        |
| BKK_FS1007    | 10 Jan 24        | $Y = 1.1347x + 1.6007$ | 0.9989                        |
| BKK_FS1008    | 10 Jan 24        | $Y = 1.127x + 4.3827$  | 0.9996                        |
| BKK_FS1017    | 04 Jan 24        | $Y = 1.0632x - 0.0701$ | 0.9998                        |
| BKK_FS1018    | 04 Jan 24        | $Y = 1.0115x + 1.2867$ | 0.9996                        |
| BKK_FS1019    | 04 Jan 24        | $Y = 1.0019x + 8.4867$ | 1.0000                        |
| BKK_FS1026    | 19 Jan 24        | $Y = 0.9618x + 1.9626$ | 0.9999                        |
| BKK_FS1027    | 19 Jan 24        | $Y = 1.0065x - 4.3786$ | 1.0000                        |
| BKK_FS1028    | 19 Jan 24        | $Y = 1.0184x - 37.308$ | 0.9997                        |
| BKK_FS1029    | 19 Jan 24        | $Y = 0.9809x + 2.7925$ | 0.9977                        |
| BKK_FS1030    | 19 Jan 24        | $Y = 0.996x - 1.3286$  | 1.0000                        |
| BKK_FS1031    | 19 Jan 24        | $Y = 1.015x - 27.236$  | 0.9997                        |
| BKK_FS1039    | 04 Jan 24        | $Y = 1.0047x + 8.0267$ | 0.9997                        |
| BKK_FS1040    | 04 Jan 24        | $Y = 1.0059x + 3.6952$ | 1.0000                        |
| BKK_FS1041    | 04 Jan 24        | $Y = 1.0677x - 0.0486$ | 0.9995                        |
| BKK_FS1042    | 04 Jan 24        | $Y = 1.0021x + 11.273$ | 0.9995                        |
| BKK_FS1043    | 04 Jan 24        | $Y = 1.0023x + 8.3905$ | 1.0000                        |
| BKK_FS1044    | 04 Jan 24        | $Y = 1.0738x + 1.2527$ | 0.9997                        |
| PHK_FS0027    | 10 Jan 24        | $Y = 1.1096x + 0.3565$ | 1.0000                        |
| PHK_FS0028    | 10 Jan 24        | $Y = 1.034x - 2.52$    | 1.0000                        |
| PHK_FS0029    | 10 Jan 24        | $Y = 1.0017x + 8.0124$ | 1.0000                        |
| RYG_FS0197    | 04 Jan 24        | $Y = 1.0045x + 10.275$ | 1.0000                        |
| RYG_FS0198    | 04 Jan 24        | $Y = 1.0024x + 10.1$   | 1.0000                        |
| RYG_FS0199    | 04 Jan 24        | $Y = 1.0343x - 0.3854$ | 0.9999                        |
| RYG_FS0654    | 04 Jan 24        | $Y = 1.0529x + 0.1565$ | 0.9996                        |
| RYG_FS0655    | 04 Jan 24        | $Y = 0.992x + 8.9667$  | 0.9992                        |
| RYG_FS0656    | 04 Jan 24        | $Y = 1.0068x - 2.8429$ | 1.0000                        |
| RYG_FS0657    | 04 Jan 24        | $Y = 1.0472x + 1.9228$ | 0.9999                        |
| RYG_FS0658    | 04 Jan 24        | $Y = 0.9675x + 20.263$ | 0.9996                        |
| RYG_FS0659    | 04 Jan 24        | $Y = 1.0028x + 10.275$ | 1.0000                        |
| SGK_FS0135    | 17 Jan 24        | $Y = 1.0145x + 2.8273$ | 1.0000                        |
| SGK_FS0136    | 17 Jan 24        | $Y = 1.0113x + 1.75$   | 0.9999                        |
| SGK_FS0138    | 04 Jan 24        | $Y = 1.0632x - 1.0034$ | 0.9999                        |



## ROTA METER CALIBRATION RESULT JANUARY 2024

| Rotameter ID. | Calibration Date | Regression Result      | Coefficient (R <sup>2</sup> ) |
|---------------|------------------|------------------------|-------------------------------|
| SGK_FS0139    | 04 Jan 24        | $Y = 1.0047x + 1.8667$ | 0.9999                        |
| SGK_FS0140    | 04 Jan 24        | $Y = 1.0001x + 14.149$ | 1.0000                        |
| SGK_FS0141    | 04 Jan 24        | $Y = 1.111x - 1.1337$  | 0.9994                        |
| SGK_FS0142    | 04 Jan 24        | $Y = 1.0179x + 0.3633$ | 0.9999                        |
| SGK_FS0143    | 04 Jan 24        | $Y = 1.054x + 2.2352$  | 1.0000                        |

Review By :

(Mr. Wichan Choonharat)

Enviro Field Services Manager

Approved By :

(Mr. Sarayuth Jittranont)

Assistant General Manager

# Certificate of System Qualification

GC-OQ + GCMS-OQ

REVIEW BY Suchada T.APPROVED BY Tamratan M.NEXT CAL. DATE 18 Oct 24

System ID: GM-2  
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.  
Organization Location: 104 Phatthanakan 40, Phattanakan Rd., Kheiswaeng Suan Luang, Khet Suan Luang, Bangkok 10250  
Date: April 18, 2023 3:15:25 PM  
EQP Name: AgilentRecommended , AgilentRecommended  
EQP Revision: GC.02.51, GCMS.02.51  
Overall Qualification 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 MMI

Setpoint Status: Pass

|                      | Setpoint | Actual   |
|----------------------|----------|----------|
| Inlet Pressure:      | 25.0 psi | 25.0 psi |
| Accuracy:            |          | 0.0 psi  |
| Agilent Recommended: | <=       | 1.2      |

## Overall Inlet Pressure Accuracy Test Status

Pass

## GC Oven Temperature Accuracy

Name: 7890

Date: April 18, 2023 3:15:25 PM  
System ID: GM-2



## Setpoint Status:

Pass

Zone:

Oven

Setpoint/Actual

Temperature:

230.0 230.1 °C

Accuracy:

0.1 °C

Agilent Recommended:

|    |      |                 |             |
|----|------|-----------------|-------------|
| >= | -1.0 | % setpoint in K | ( -5.0 °C ) |
| <= | 1.0  | % setpoint in K | ( 5.0 °C )  |

## Setpoint Status:

Pass

Zone:

Oven

Setpoint/Actual

Temperature:

100.0 100.4 °C

Accuracy:

0.4 °C

Agilent Recommended:

|    |      |                 |             |
|----|------|-----------------|-------------|
| >= | -1.0 | % setpoint in K | ( -3.7 °C ) |
| <= | 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:

100.0 100.4 °C

Stability:

0.0 °C

Agilent Recommended:

&lt;= 0.5

## Overall GC Oven Temperature Stability Test Status

Pass

## Log Amp

Tested Combination1

Front

MMI

/ External

SQ

Name:

5975C inert XL with TAD

## Setpoint Status:

Pass

Date: April 18, 2023 3:15:25 PM

System ID: GM-2

## Overall Log Amp Test Status

Pass

## RFPA

Tested Combination1

Front

MMI

/ External

SQ

Name:

5975C inert XL with TAD

Setpoint Status:

Pass

Amu:

1050

m/z

Drift After Five Minutes:

4

mV

RFPA Voltage:

441

mV

Agilent Recommended:

&gt;=

-100

and

&lt;=

100

&lt;=

1100

## Overall RFPA Test Status

Pass

## Tune EI

Tested Combination1

Front

MMI

/ External

SQ

Name:

5975C inert XL with TAD

Setpoint Status:

Pass

Filament:

1

Setpoint Status:

Pass

Filament:

2

## Overall Tune EI Test Status

Pass

## Scouting Run

Tested Combination1

Front

MMI

/ External

SQ

Injection Tower

Name:

7693A

Source:

EI - Inert

Date:

April 18, 2023 3:15:25 PM

System ID:

GM-2

## Setpoint Status:

Completed

Injection Volume on Column:

1.0

uL

## Overall Scouting Run Status

Completed

## Signal to Noise EI

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

Name: 5975C inert XL with TAD

Source: EI - Inert

Filament:

1

## Setpoint Status:

Pass

Signal to Noise:

456

Agilent Recommended:

&gt;=

320

Source: EI - Inert

Filament:

2

## Setpoint Status:

Pass

Signal to Noise:

2034

Agilent Recommended:

&gt;=

320

## Overall Signal to Noise EI Test Status

Pass

## Injection Precision

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

Name: 7693A

Source: EI - Inert

## Setpoint Status:

Pass

Injection Volume on Column:

1.0

uL

Area RSD:

1.66

%

Retention Time RSD:

0.04

%

Agilent Recommended:

&lt;=

5.00

&lt;=

1.00

## Overall Injection Precision Test Status

Pass

Date: April 18, 2023 3:15:25 PM

System ID: GM-2

Mass Ratio Precision

|                     |                 |     |            |    |
|---------------------|-----------------|-----|------------|----|
| Tested Combination1 | Front           | MMI | / External | SQ |
|                     | Injection Tower |     |            |    |
| Name:               | 7693A           |     |            |    |
| Source:             | EI - Inert      |     |            |    |
| Setpoint Status:    | Pass            |     |            |    |

Injection Volume on Column: 1.0 uL

|                      |             |            |
|----------------------|-------------|------------|
|                      | Area Mass 1 | Mass Ratio |
|                      | Abundance*s |            |
| RSD:                 | 1.66 %      | 0.39 %     |
| Agilent Recommended: | <= 5.00     | <= 5.00    |
|                      | Pass        | Pass       |

Overall Mass Ratio Precision Test Status

Pass



Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

|                        |                                   |
|------------------------|-----------------------------------|
| System ID              | GM-2                              |
| Manufacturer           | Agilent Technologies              |
| Name                   | 7890                              |
| Flow Data Input        | Manual Data                       |
| Temperature Data Input | Manual Data or Other Data Logging |

Tested Combination1

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

Sampler 1

|                     |                      |
|---------------------|----------------------|
| Manufacturer        | Agilent Technologies |
| Type                | Injection Tower      |
| Name                | 7693A                |
| Model Number        | G4513A               |
| Serial Number       | CN10120123           |
| Firmware Revision   | A.10.08              |
| Usage               | Sample Injection     |
| Location            | Front                |
| Syringe Volume (µL) | 10                   |

## Sampler 2

|                   |                      |
|-------------------|----------------------|
| Manufacturer      | Agilent Technologies |
| Type              | Tray                 |
| Name              | 7693A                |
| Model Number      | G4514A               |
| Serial Number     | CN10060099           |
| Firmware Revision | A.10.16              |
| Vial Heater       | Not installed        |

## Mainframe 1

|                   |                      |
|-------------------|----------------------|
| Manufacturer      | Agilent Technologies |
| Name              | 7890                 |
| Model Number      | G3440A               |
| Serial Number     | CN10141049           |
| Firmware Revision | A.01.16              |
| Oven Type         | Standard             |

## Inlet 1

|              |                                   |
|--------------|-----------------------------------|
| Manufacturer | Agilent Technologies              |
| Name         | 7890                              |
| Type         | MMI                               |
| 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                  | 5975C inert XL with TAD |
| Serial Number         | US10153217              |
| Firmware Revision     | 5.02.12                 |
| High Vacuum System    | Turbo Pump              |
| Scouting Run Standard | OFN Std                 |

## MS EI Source 1

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

## Electronic Signature

### Purpose

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### Details

|                          |   |
|--------------------------|---|
| Full Name of Signer:     | Supasak Nimsongtham   |
| Logged On User Name:     | supasak.nimsongtham@agilent.com                                   |
| Signature Creation Date: | April 18, 2023  |
| Reason for Signature:    | Executed protocol and published this original version of document |

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User Name: supasak.nimsongtham  
 Hostname: 5CG1115HKC

System Id: GM-2  
 Print Date: April 18, 2023 3:15:30 PM

## ALS GM2 Transaction log :

| Time                      | Transaction State | Activity Performed | Type of Transaction   | Optional Information  |
|---------------------------|-------------------|--------------------|---|---|
| April 18, 2023 2:14:23 PM | Audit             | SessionCreated     | Session   | None  |
| April 18, 2023 2:14:23 PM | Start             | Configuration      | Session   | None  |
| April 18, 2023 2:14:23 PM | Audit             | Entitlement        | Licensing   | User is FieldEngineer and does not require an unlock code   |
| April 18, 2023 2:15:04 PM | Audit             | EqpLoaded          | Session   | EQP details for primary technique [Gc] -<br>File path:<br>[ProtocolPacks/Gc/Configurations/02.51/Gc.02.51.eqp],<br>EQP File Name:<br>[Gc.02.51.eqp], EQP Name:<br>[AgilentRecommended], Protocol Revision :[Gc.02.51]<br>EQP details for hyphenated technique [GcMs] -<br>File path:<br>[ProtocolPacks/GcMs/Configurations/02.51/GcMs.02.51.eqp], EQP File Name:<br>[GcMs.02.51.eqp], EQP Name:<br>[AgilentRecommended] |
| April 18, 2023 2:15:07 PM | End               | Configuration      | Session   | None  |
| April 18, 2023 2:15:11 PM | Start             | Qualification      | Session   | OQ  |
| April 18, 2023 2:15:11 PM | Start             | Execution          | System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated | None  |
| April 18, 2023 2:17:27 PM | End               | Execution          | System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated | Run Count : 1   |

User Name: supasak.nimsongtham  
 Hostname: 5CG1115HKC

System Id: GM-2  
 Print Date: April 18, 2023 3:15:30 PM

## ALS GM2 Transaction log :

| Time                      | Transaction State | Activity Performed | Type of Transaction   | Optional Information |
|---------------------------|-------------------|--------------------|---|----------------------|
| April 18, 2023 2:17:28 PM | Start             | Execution          | Inlet Pressure Accuracy - Front<br>MMI: - Pressure Controlled Inlet<br>- S: 25.0 psi - L: <= 1.2 psi                    | None                 |
| April 18, 2023 2:17:33 PM | End               | Execution          | Inlet Pressure Accuracy - Front<br>MMI: - Pressure Controlled Inlet<br>- S: 25.0 psi - L: <= 1.2 psi                    | Run Count : 1        |
| April 18, 2023 2:17:36 PM | Start             | Execution          | GC Oven Temperature<br>Accuracy - 7890: - Temperature<br>: Oven - S: 230.0°C - L: >= -1.0<br>AND <= 1.0 % setpoint in K | None                 |
| April 18, 2023 2:18:00 PM | Audit             | Data               | GC Oven Temperature<br>Accuracy - 7890: - Temperature<br>: Oven - S: 230.0°C - L: >= -1.0<br>AND <= 1.0 % setpoint in K | Manual Data Entry    |
| April 18, 2023 2:18:01 PM | End               | Execution          | GC Oven Temperature<br>Accuracy - 7890: - Temperature<br>: Oven - S: 230.0°C - L: >= -1.0<br>AND <= 1.0 % setpoint in K | Run Count : 1        |
| April 18, 2023 2:18:03 PM | Start             | Execution          | GC Oven Temperature<br>Accuracy - 7890: - Temperature<br>: Oven - S: 100.0°C - L: >= -1.0<br>AND <= 1.0 % setpoint in K | None                 |
| April 18, 2023 2:18:20 PM | Audit             | Data               | GC Oven Temperature<br>Accuracy - 7890: - Temperature<br>: Oven - S: 100.0°C - L: >= -1.0<br>AND <= 1.0 % setpoint in K | Manual Data Entry    |
| April 18, 2023 2:18:22 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        |
| April 18, 2023 2:18:44 PM | Start             | Execution          | GC Oven Temperature Stability<br>- 7890: - Temperature : Oven -<br>S: 100.0°C - L: <= 0.5°C                             | None                 |

User Name: supasak.nlmsongtham  
 Hostname: 5CG1115HKC

System Id: GM-2  
 Print Date: April 18, 2023 3:15:30 PM

## ALS GM2 Transaction log :

| Time                      | Transaction State | Activity Performed | Type of Transaction  | Optional Information |
|---------------------------|-------------------|--------------------|--|----------------------|
| April 18, 2023 2:19:31 PM | Audit             | Data               | GC Oven Temperature Stability<br>- 7890: - Temperature : Oven -<br>S: 100.0°C - L: <= 0.5°C                              | Manual Data Entry    |
| April 18, 2023 2:19:33 PM | End               | Execution          | GC Oven Temperature Stability<br>- 7890: - Temperature : Oven -<br>S: 100.0°C - L: <= 0.5°C                              | Run Count : 1        |
| April 18, 2023 2:19:36 PM | Start             | Execution          | Log Amp - 5975C inert XL with<br>TAD SQ: - Source: EI - Inert  | None                 |
| April 18, 2023 2:19:46 PM | End               | Execution          | Log Amp - 5975C inert XL with<br>TAD SQ: - Source: EI - Inert  | Run Count : 1        |
| April 18, 2023 2:19:49 PM | Start             | Execution          | RFPA - 5975C inert XL with<br>TAD SQ: - Source: EI - Inert   | None                 |
| April 18, 2023 2:32:54 PM | End               | Execution          | RFPA - 5975C inert XL with<br>TAD SQ: - Source: EI - Inert   | Run Count : 1        |
| April 18, 2023 2:32:57 PM | Start             | Execution          | Tune EI - 5975C inert XL with<br>TAD SQ: - Source: - EI - Inert<br>Filament 1 (Qualitative - No<br>setpoints associated) | None                 |
| April 18, 2023 2:34:05 PM | End               | Execution          | Tune EI - 5975C inert XL with<br>TAD SQ: - Source: - EI - Inert<br>Filament 1 (Qualitative - No<br>setpoints associated) | Run Count : 1        |
| April 18, 2023 2:34:07 PM | Start             | Execution          | Tune EI - 5975C inert XL with<br>TAD SQ: - Source: - EI - Inert<br>Filament 2 (Qualitative - No<br>setpoints associated) | None                 |
| April 18, 2023 2:34:20 PM | End               | Execution          | Tune EI - 5975C inert XL with<br>TAD SQ: - Source: - EI - Inert<br>Filament 2 (Qualitative - No<br>setpoints associated) | Run Count : 1        |

User Name: supasak.nimsongtham  
 Hostname: 5CG1115HKC

System Id: GM-2  
 Print Date: April 18, 2023 3:15:30 PM

## ALS GM2 Transaction log :

| Time                      | Transaction State | Activity Performed | Type of Transaction   | Optional Information                                 |
|---------------------------|-------------------|--------------------|---|--|
| April 18, 2023 2:34:23 PM | Start             | Execution          | Scouting Run - Injection Tower, Front MMI, SQ: - Source: - EI - Inert- Part of GCMS System Preparation                    | None   |
| April 18, 2023 2:34:56 PM | Audit             | Data               | Scouting Run - Injection Tower, Front MMI, SQ: - Source: - EI - Inert- Part of GCMS System Preparation                    | Data files Path : E:\GM-2 OQ2023\SNF1_001.D\DATA. MS |
| April 18, 2023 2:35:12 PM | End               | Execution          | Scouting Run - Injection Tower, Front MMI, SQ: - Source: - EI - Inert- Part of GCMS System Preparation                    | Run Count : 1  |
| April 18, 2023 2:35:13 PM | Start             | Execution          | Signal to Noise EI - Injection Tower, Front MMI, SQ: - Source: EI - Inert using Filament 1 - L: >= 320                    | None   |
| April 18, 2023 2:35:24 PM | Audit             | Data               | Signal to Noise EI - Injection Tower, Front MMI, SQ: - Source: EI - Inert using Filament 1 - L: >= 320                    | Data files Path : E:\GM-2 OQ2023\SNF1_001.D\DATA. MS |
| April 18, 2023 2:35:45 PM | End               | Execution          | Signal to Noise EI - Injection Tower, Front MMI, SQ: - Source: EI - Inert using Filament 1 - L: >= 320                    | Run Count : 1  |
| April 18, 2023 2:35:47 PM | Start             | Execution          | Signal to Noise EI - Injection Tower, Front MMI, SQ: - Source: EI - Inert using Filament 2 - L: >= 320                    | None   |
| April 18, 2023 2:35:52 PM | Start             | Execution          | Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00% | None   |



User Name: supasak.nimsongtham  
 Hostname: 5CG1115HKC

System Id: GM-2  
 Print Date: April 18, 2023 3:15:30 PM

## ALS GM2 Transaction log :

| Time                      | Transaction State | Activity Performed | Type of Transaction   | Optional Information  |
|---------------------------|-------------------|--------------------|---|---|
| April 18, 2023 2:36:20 PM | Audit             | Data               | Injection Precision - Injection<br>Tower, Front MMI, SQ: -<br>Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00% | Data files Path : E:\GM-2<br>OQ2023\IPMRP\IP_MRP002.<br>D\DATA.MS |
| April 18, 2023 2:36:20 PM | Audit             | Data               | Injection Precision - Injection<br>Tower, Front MMI, SQ: -<br>Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00% | Data files Path : E:\GM-2<br>OQ2023\IPMRP\IP_MRP003.<br>D\DATA.MS |
| April 18, 2023 2:36:20 PM | Audit             | Data               | Injection Precision - Injection<br>Tower, Front MMI, SQ: -<br>Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00% | Data files Path : E:\GM-2<br>OQ2023\IPMRP\IP_MRP004.<br>D\DATA.MS |
| April 18, 2023 2:36:20 PM | Audit             | Data               | Injection Precision - Injection<br>Tower, Front MMI, SQ: -<br>Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00% | Data files Path : E:\GM-2<br>OQ2023\IPMRP\IP_MRP005.<br>D\DATA.MS |
| April 18, 2023 2:36:20 PM | Audit             | Data               | Injection Precision - Injection<br>Tower, Front MMI, SQ: -<br>Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00% | Data files Path : E:\GM-2<br>OQ2023\IPMRP\IP_MRP006.<br>D\DATA.MS |
| April 18, 2023 2:36:21 PM | Audit             | Data               | Injection Precision - Injection<br>Tower, Front MMI, SQ: -<br>Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00% | Data files Path : E:\GM-2<br>OQ2023\IPMRP\IP_MRP007.<br>D\DATA.MS |
| April 18, 2023 2:36:42 PM | End               | Execution          | Injection Precision - Injection<br>Tower, Front MMI, SQ: -<br>Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00% | Run Count : 1   |
| April 18, 2023 2:36:45 PM | Start             | Execution          | Mass Ratio Precision - Injection<br>Tower, Front MMI, SQ: -<br>Source: EI - Inert - L (RSD): <= 5.00%                           | None  |

User Name: supasak.nimsongtham  
 Hostname: 5CG1115HKC

System Id: GM-2  
 Print Date: April 18, 2023 3:15:30 PM

## ALS GM2 Transaction log :

| Time                      | Transaction State | Activity Performed | Type of Transaction   | Optional Information  |
|---------------------------|-------------------|--------------------|---|---|
| April 18, 2023 2:37:04 PM | Audit             | Data               | Mass Ratio Precision - Injection<br>Tower, Front MMI, SQ: -<br>Source: EI - Inert - L (RSD): <= 5.00%           | Data files Path : E:\GM-2<br>OQ2023\IPMRP\IP_MRP002.<br>D\DATA.MS |
| April 18, 2023 2:37:04 PM | Audit             | Data               | Mass Ratio Precision - Injection<br>Tower, Front MMI, SQ: -<br>Source: EI - Inert - L (RSD): <= 5.00%           | Data files Path : E:\GM-2<br>OQ2023\IPMRP\IP_MRP003.<br>D\DATA.MS |
| April 18, 2023 2:37:04 PM | Audit             | Data               | Mass Ratio Precision - Injection<br>Tower, Front MMI, SQ: -<br>Source: EI - Inert - L (RSD): <= 5.00%           | Data files Path : E:\GM-2<br>OQ2023\IPMRP\IP_MRP004.<br>D\DATA.MS |
| April 18, 2023 2:37:04 PM | Audit             | Data               | Mass Ratio Precision - Injection<br>Tower, Front MMI, SQ: -<br>Source: EI - Inert - L (RSD): <= 5.00%           | Data files Path : E:\GM-2<br>OQ2023\IPMRP\IP_MRP005.<br>D\DATA.MS |
| April 18, 2023 2:37:06 PM | Audit             | Data               | Mass Ratio Precision - Injection<br>Tower, Front MMI, SQ: -<br>Source: EI - Inert - L (RSD): <= 5.00%           | Data files Path : E:\GM-2<br>OQ2023\IPMRP\IP_MRP006.<br>D\DATA.MS |
| April 18, 2023 2:37:06 PM | Audit             | Data               | Mass Ratio Precision - Injection<br>Tower, Front MMI, SQ: -<br>Source: EI - Inert - L (RSD): <= 5.00%           | Data files Path : E:\GM-2<br>OQ2023\IPMRP\IP_MRP007.<br>D\DATA.MS |
| April 18, 2023 2:37:17 PM | End               | Execution          | Mass Ratio Precision - Injection<br>Tower, Front MMI, SQ: -<br>Source: EI - Inert - L (RSD): <= 5.00%           | Run Count : 1   |
| April 18, 2023 2:37:23 PM | Start             | Execution          | Signal to Noise EI - Injection<br>Tower, Front MMI, SQ: -<br>Source: EI - Inert using<br>Filament 2 - L: >= 320 | None  |

User Name: supasak.nlmsongtham  
 Hostname: SCG1115HKC

System Id: GM-2  
 Print Date: April 18, 2023 3:15:30 PM

## ALS GM2 Transaction log :

| Time                      | Transaction State | Activity Performed | Type of Transaction   | Optional Information  |
|---------------------------|-------------------|--------------------|---|---|
| April 18, 2023 2:56:38 PM | Start             | Execution          | Signal to Noise EI - Injection<br>Tower, Front MMI, SQ: -<br>Source: EI - Inert using<br>Filament 2 - L: >= 320 | None  |
| April 18, 2023 2:57:00 PM | Audit             | Data               | DataManager   | DataManager was in a data<br>verification state but the user<br>chose to start over |
| April 18, 2023 2:57:16 PM | Audit             | Data               | Signal to Noise EI - Injection<br>Tower, Front MMI, SQ: -<br>Source: EI - Inert using<br>Filament 2 - L: >= 320 | Data files Path : E:\GM-2<br>OQ2023\SNF2_003.D\DATA.<br>MS                          |
| April 18, 2023 2:57:58 PM | Start             | Execution          | Signal to Noise EI - Injection<br>Tower, Front MMI, SQ: -<br>Source: EI - Inert using<br>Filament 2 - L: >= 320 | None  |
| April 18, 2023 2:58:05 PM | End               | Execution          | Signal to Noise EI - Injection<br>Tower, Front MMI, SQ: -<br>Source: EI - Inert using<br>Filament 2 - L: >= 320 | Run Count : 1   |
| April 18, 2023 3:01:14 PM | End               | Qualification      | Session   | OQ  |
| April 18, 2023 3:01:14 PM | Start             | Reporting          | Session   | None  |
| April 18, 2023 3:14:47 PM | Audit             | Reporting          | Session   | Report Generated :<br>Certificate   |



## CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 8-Jan-24  
Next Cal. Date : 8-Jul-24

Barometric Pressure (mmHg) : 755.3  
Relative Humidity (%) : 35.0  
Temperature (C°) : 27.3

### Console Control Meter Data

Calibration No. C-080124-BKK\_FS0556  
Dry Gas Meter ID : BKK\_FS0556  
Serial No. : 1606041  
Model No. : XC-572-V

### Reference Dry Gas Meter Data

Reference Dry Gas Meter ID : BKK\_FS1122  
Serial No. : A2003240  
Correction Factor (Y) : 0.9824  
Next Calibration Date : 7-Nov-24

| $\Delta H$<br><br>(mm.H <sub>2</sub> O) | $\Theta$<br><br>Minutes | Reference Dry Gas Meter Calibration |         |        |                | Console Control ; Drygas Meter |          |        |                |                |                    | Dry Gas Meter     | Orifice                   |
|---|-------------------------|-------------------------------------|---------|--------|----------------|--------------------------------|----------|--------|----------------|----------------|--------------------|-------------------|---------------------------|
|   |                         | Vr (Liters)                         |         |        | Tr<br><br>(°C) | Vm (Liters)                    |          |        | Ti<br><br>(°C) | To<br><br>(°C) | Avg.Tm<br><br>(°C) | Correction        | Calibration               |
|   |                         | Final                               | Initial | Total  |                | Final                          | Initial  | Total  |                |                |                    | Factor<br><br>(Y) | Factor<br><br>$\Delta H@$ |
| 15                                      | 11.62                   | 150.00                              | 0.00    | 150.00 | 26.0           | 175364.2                       | 175220.0 | 144.20 | 27.0           | 27.0           | 27.0               | 1.0238            | 40.8788                   |
| 25                                      | 9.15                    | 150.00                              | 0.00    | 150.00 | 26.0           | 175544.6                       | 175400.0 | 144.60 | 27.0           | 27.0           | 27.0               | 1.0200            | 42.2451                   |
| 50                                      | 6.55                    | 150.00                              | 0.00    | 150.00 | 27.0           | 175702.2                       | 175555.0 | 147.20 | 27.0           | 27.0           | 27.0               | 0.9962            | 43.5860                   |
| 80                                      | 5.15                    | 150.00                              | 0.00    | 150.00 | 27.0           | 176015.6                       | 175867.0 | 148.60 | 28.0           | 28.0           | 28.0               | 0.9873            | 42.9689                   |
| 120                                     | 4.25                    | 150.00                              | 0.00    | 150.00 | 28.0           | 176176.2                       | 176027.0 | 149.20 | 28.0           | 28.0           | 28.0               | 0.9763            | 44.1874                   |
|   |                         |                                     |         |        |                |                                |          |        |                |                | Avg.               | 1.0007            | 42.7732                   |

Y : Ratio of reading of reference to dry gas meter : tolerance for individual values  $\pm 0.02$  from average .

$\Delta H@$  : Orifice pressure differential that equates to 21.24 lm of air @ 25 C and 760 mm of mercury , mmH<sub>2</sub>O ; tolerance for individual values  $\pm 5.08$  from average .

Procedure; 40 CFR 60,APP A,METH ,SEC 5.3 & 7

Calibrated by:

Saksit Phaisanphisut

( Mr. Saksit Phaisanphisut )

RYG Field Service Scientist(4)

Approved by:

Nattapol Jiengwareewong

( Mr.Nattapol Jiengwareewong )

RYG Field Service Specialist(





## Stopwatch Calibration Test Report

Calibration Date : 8 Jan 24

Next Cal. Date : 8 Jul 24

Barometric Pressure (mmHg) : 755.3

Temperature (°C) : 27.3

Relative Humidity (%) : 35.0

### Reference Stopwatch Data

Stopwatch ID No. : E18061

Model : F808

Serial No. : -

Calibration Date : 8 Sep 20

Certificate No. : E-2009018

### Console Control Meter Data

Dry Gas Meter No. : BKK\_FS0556

Model : XC-572-V

Serial No. : 1606041

| Run No. | Time Actual (m:ss.ms) | Time Reading (m:ss) | Diff. (ms) | Diff. (min) |
|---------|-----------------------|---------------------|------------|-------------|
| 1       | 5:00:03               | 5:00                | 3          | 0.00005     |
| 2       | 5:00:09               | 5:00                | 8          | 0.00013     |
| 3       | 5:00:09               | 5:00                | 9          | 0.00015     |
| 4       | 5:00:11               | 5:00                | 11         | 0.00018     |
| 5       | 5:00:05               | 5:00                | 5          | 0.00008     |
| 6       | 5:00:06               | 5:00                | 6          | 0.00010     |
| 7       | 5:00:06               | 5:00                | 6          | 0.00010     |
| 8       | 5:00:08               | 5:00                | 8          | 0.00013     |
| 9       | 5:00:09               | 5:00                | 9          | 0.00015     |
| 10      | 5:00:07               | 5:00                | 7          | 0.00012     |
|         |                       |                     | Average    | 0.00012     |
|         |                       |                     | SD         | 0.00004     |

Calibrate by :

Saksit Phaisanphisut

Mr. Saksit Phaisanphisut

RYG Field Service Scientist (4)

Approved by :

Nattapon Jiengwareewong

Mr. Nattapon Jiengwareewong

RYG Field Service Specialist (1)



## DIGITAL TEMPERATURE CALIBRATION DATA SHEET

|                         |                     |                          |      |
|-------------------------|---------------------|--------------------------|------|
| Calibration Date :      | 8 Jan 24            | Ambient Temperature (°C) | 27.3 |
| Calibration sheet No. : | C-080124-BKK_FS0557 | Relative Humidity (%) :  | 35   |

|                          |            |                          |                  |
|--------------------------|------------|--------------------------|------------------|
| Digital Temperature ID : | BKK_FS0557 | Reference Temperature ID | RYG_FS0681       |
| Serial No. :             | 1606041    | Serial No. :             | 201090014918     |
| Model :                  | XC-572-V   | Model :                  | Digicon-CC-VT-MS |
|                          |            | Next Calibrate :         | 13 Nov 24        |

| Location | Reference Temperature<br>°C | Digital Temperature<br>°C | Error<br>°C | MPE | Pass / Fail |
|----------|-----------------------------|---------------------------|-------------|-----|-------------|
| Stack    | 0                           | 0                         | 0           | ±3  | Pass        |
|          | 25                          | 23                        | -2          | ±3  | Pass        |
|          | 50                          | 48                        | -2          | ±3  | Pass        |
|          | 100                         | 99                        | -1          | ±3  | Pass        |
|          | 150                         | 149                       | -1          | ±3  | Pass        |
|          | 200                         | 198                       | -2          | ±3  | Pass        |
|          | 250                         | 248                       | -2          | ±3  | Pass        |
|          | 300                         | 298                       | -2          | ±3  | Pass        |
|          | 500                         | 500                       | 0           | ±3  | Pass        |
| Probe    | 100                         | 99                        | -1          | ±3  | Pass        |
|          | 120                         | 119                       | -1          | ±3  | Pass        |
|          | 140                         | 139                       | -1          | ±3  | Pass        |
| Oven     | 100                         | 100                       | 0           | ±3  | Pass        |
|          | 120                         | 119                       | -1          | ±3  | Pass        |
|          | 140                         | 139                       | -1          | ±3  | Pass        |
| Filter   | 100                         | 100                       | 0           | ±3  | Pass        |
|          | 120                         | 120                       | 0           | ±3  | Pass        |
|          | 140                         | 140                       | 0           | ±3  | Pass        |
| Exit     | 0                           | 0                         | 0           | ±3  | Pass        |
|          | 10                          | 9                         | -1          | ±3  | Pass        |
|          | 20                          | 18                        | -2          | ±3  | Pass        |
| Meter    | 0                           | 0                         | 0           | ±3  | Pass        |
|          | 25                          | 25                        | 0           | ±3  | Pass        |
|          | 50                          | 50                        | 0           | ±3  | Pass        |
| AUX      | 0                           | 0                         | 0           | ±3  | Pass        |
|          | 25                          | 23                        | -2          | ±3  | Pass        |
|          | 50                          | 48                        | -2          | ±3  | Pass        |

MPE : (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดของการวัดที่ยอมรับได้

Calibrated by :

Saksit Phaisanphisut

Mr. Saksit Phaisanphisut

RYG Field Service Scientist (4)

Approved by :

Natthapol Jiengwareewong

Mr. Natthapol Jiengwareewong

RYG Field Service Specialist (1)



PROBE NOZZLE DIAMETER  
CALIBRATION DATA SHEET

|   |                                 |
|---|---------------------------------|
| Calibration Date : 8 Jan 24                 | Nozzle Set ID. : BKK_FS0562     |
| Calibration Sheet No. : C-080124-BKK_FS0562 | Vernier Caliper ID.: BKK_FS1123 |

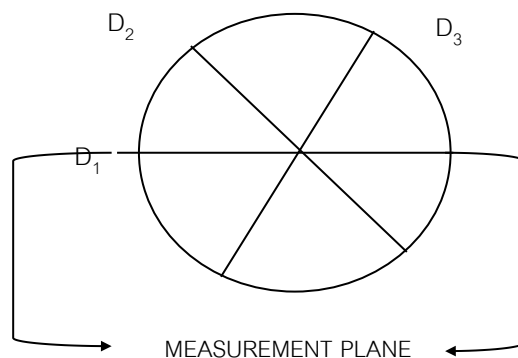
| Nozzle ID # | Nozzle Diameter (cm.) |       |       | Hi - Lo    | $(D_1 + D_2 + D_3) / 3$ |
|-------------|-----------------------|-------|-------|------------|-------------------------|
|             | $D_1$                 | $D_2$ | $D_3$ | $\Delta D$ | $D_{avg}$               |
| 1           | 0.305                 | 0.302 | 0.302 | 0.003      | 0.303                   |
| 2           | 0.485                 | 0.475 | 0.485 | 0.010      | 0.482                   |
| 3           | 0.620                 | 0.635 | 0.635 | 0.015      | 0.630                   |
| 4           | 0.765                 | 0.765 | 0.765 | 0.000      | 0.765                   |
| 5           | 0.970                 | 0.980 | 0.975 | 0.010      | 0.975                   |
| 6           | 1.085                 | 1.085 | 1.081 | 0.004      | 1.084                   |
| 7           | 1.275                 | 1.275 | 1.275 | 0.000      | 1.275                   |
| 8           | 1.610                 | 1.610 | 1.615 | 0.005      | 1.612                   |

Where :

$D_1, D_2, D_3$  = Three different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm.

$\Delta D$  = Maximum distance between any two diameters, must be  $\leq 0.100$  mm.

$D_{avg}$  =  $(D_1 + D_2 + D_3) / 3$



Calibrated by : Saksit Phaisanphisut

( Mr. Saksit Phaisanphisut )

RYG Field Service Scientist (4)

Approved by : Nattapon Jiengwareewong

( Mr. Nattapon Jiengwareewong )

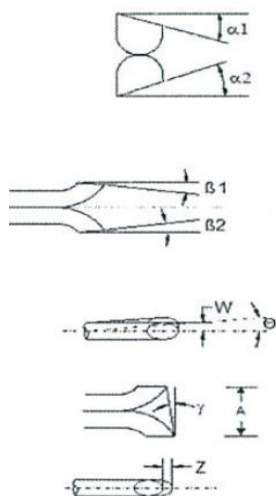
RYG Field Service Specialist (1)



## Type S Pitot Tube Calibration

**Date Calibration** 8-Jan-24  
**Pitot ID** BKK\_FS0560  
**Pitot SN** -

**Due Date** 8-Jul-24  
**Inclinometer ID** BKK\_FS1131  
**Vernier ID** RYG\_FS0539



| Parameter           | Value  | Allowable Range                    | Check |
|---------------------|--------|------------------------------------|-------|
| $\alpha 1$          | 0.6    | $-10^\circ < \alpha 1 < +10^\circ$ | OK    |
| $\alpha 2$          | 1.4    | $-10^\circ < \alpha 2 < +10^\circ$ | OK    |
| $\beta 1$           | -2.3   | $-5^\circ < \beta 1 < +5^\circ$    | OK    |
| $\beta 2$           | -0.5   | $-5^\circ < \beta 2 < +5^\circ$    | OK    |
| $\gamma$            | -1.1   | -                                  | -     |
| $\theta$            | 1.3    | -                                  | -     |
| $Z = A \tan \gamma$ | -0.017 | $Z \leq 0.125''$                   | OK    |
| $W = A \tan \theta$ | 0.020  | $W \leq 0.031''$                   | OK    |
| Dt                  | 0.311  | 0.188" to 0.375"                   | OK    |
| $A/2Dt$             | 1.415  | $1.05 \leq PA/Dt \leq 1.5$         | OK    |
| A                   | 0.88   | $2.1Dt \leq A \leq 3Dt$            | OK    |

Certify that pitot tube/porbe meets or exceeds all specifications, criteria and/or applicable design features and is hereby assigned a pitot tube certification fact of 0.84 . See 40 CFR Pt. 60, App. A,EPA Method 2.

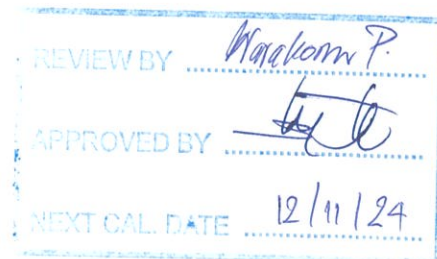
Calibrated by : Saksit Phaisanphisut  
 ( Mr. Saksit Phaisanphisut )  
 RYG Field Services Scientist (4)

Approved By : Natthapol Jiengwareewong  
 ( Mr.Natthapol Jiengwareewong+ )  
 RYG Field Services Specialist (1)

**Certificate No:** G 660705

**Date of issue :** 14-Nov-23

**Instrument description :** Flue Gas Analyzer  
**Instrument model :** Testo 340  
**Control unit serial no. :** -  
**Instrument serial no. :** 63119028  
**ID no. or control no. :** RYG\_FS0565  
**Manufacturer :** Testo SE & Co. KGaA  
**Probe description :** -  
**Probe model :** -  
**Probe serial no. :** -  
**Customer name :** ALS LABORATORY GROUP (THAILAND) CO.,LTD.  
**Customer address :** 104 Phatthanakan 40, Phatthanakan Road, Khwaeng Phatthanakan, Khet Suan Luang, Bangkok, 10250 Thailand  
**Total pages of certificate :** 3 Pages  
**Receiving no. :** L-233748  
**Receiving date. :** 08-Nov-23  
**Parameter of calibration :** Gas Calibration(Oxygen 2.498,10.04,21.02 %vol, Carbon Monoxide 80.14,302,1003 ppm, Nitric Oxide 30.01, 151.5, 322.5 ppm,Sulphur Dioxide 50.36, 100.8, 600.8 ppm)  
**Condition of UUC. :** Used  
**Ambient condition :** All of the Measurment ware caried out the stabilized labotary  
Temperature : 23 ±5 °C  
Humidity : 55 ± 15 %RH  
**Calibration place :** 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210  
**Calibration procedure no. :** This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no. WI-CL-28-C



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

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

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

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

**Date of calibration :** 13-Nov-23

*Kwanchoi K.*

Mr. Kwanchai Khamdoug

**Calibration Technician**

*O. Wuttu*

Mrs. Nongluck Wongsettee

**Technical Manager**



**Certificate No.:** G 660705

**Standard References (Table 1)**

| Standard                                      | Certificate No. | Vendor | Due date  |
|---|-----------------|--------|-----------|
| Oxygen ( O <sub>2</sub> ) 2.498 % Vol         | 4219/21         | Linde  | 30-Sep-25 |
| Oxygen ( O <sub>2</sub> ) 10.04 % Vol         | CG-0153-21      | Nimt   | 18-Nov-26 |
| Oxygen ( O <sub>2</sub> ) 21.02 % Vol         | CG-0041-22      | Nimt   | 10-Feb-27 |
| Carbon monoxide ( CO ) 80.14 ppm              | CG-0040-22      | Nimt   | 14-Feb-27 |
| Carbon monoxide ( CO ) 302 ppm                | 1915/23         | Linde  | 16-Jun-25 |
| Carbon monoxide ( CO ) 1003 ppm               | 2584/23         | Linde  | 10-Sep-25 |
| Nitric Oxide ( NO ) 30.01 ppm                 | CG-0014-23      | Nimt   | 19-Feb-25 |
| Nitric Oxide ( NO ) 151.5 ppm                 | 0161/23         | Linde  | 22-Jan-25 |
| Nitric Oxide ( NO ) 322.5 ppm                 | 1974/23         | Linde  | 17-Jul-25 |
| Sulphur Dioxide ( SO <sub>2</sub> ) 50.36 ppm | 2004/23         | Linde  | 17-Jul-25 |
| Sulphur Dioxide ( SO <sub>2</sub> ) 100.8 ppm | 3507/22         | Linde  | 09-Nov-24 |
| Sulphur Dioxide ( SO <sub>2</sub> ) 600.8 ppm | 2003/23         | Linde  | 17-Jul-25 |

**Measured room conditions**

Temperature : 22.4 °C Humidity : 67.8 %RH Pressure : 1010.2 mbar

**Calibration conditions**

Gas Temperature : 23 °C Flow rate : 600 ml/min Gas pressure : 1017.2 mbar

**Calibration Results (Before adjustment) (Table 2)**

| Parameter of Standard | Standard Values | Mean of UUC | Error  | Uncertainty ( ± ) |
|-----------------------|-----------------|-------------|--------|-------------------|
| O <sub>2</sub> (%Vol) | 2.498           | 2.44        | -0.058 | 0.15              |
| O <sub>2</sub> (%Vol) | 10.04           | 9.96        | -0.08  | 0.20              |
| O <sub>2</sub> (%Vol) | 21.02           | 21.13       | 0.11   | 0.30              |
| CO (ppm)              | 80.14           | 86          | 5.86   | 3.0               |
| CO (ppm)              | 302             | 318         | 16     | 6.0               |
| CO (ppm)              | 1003            | 1049        | 46     | 12                |
| NO (ppm)              | 30.01           | 27          | -3.01  | 8.0               |
| NO (ppm)              | 151.5           | 148         | -3.5   | 8.0               |
| NO (ppm)              | 322.5           | 309         | -13.5  | 12                |
| SO <sub>2</sub> (ppm) | 50.36           | 52          | 1.64   | 6.0               |
| SO <sub>2</sub> (ppm) | 100.8           | 103         | 2.2    | 6.0               |
| SO <sub>2</sub> (ppm) | 600.8           | 604         | 3.2    | 13                |

**Calibration Results (After adjustment) (Table 3)**

| Parameter of Standard | Standard<br>Values | Mean of<br>UUC | Error  | Uncertainty<br>( ± ) |
|-----------------------|--------------------|----------------|--------|----------------------|
| O2 (%Vol)             | 2.498              | 2.44           | -0.058 | 0.15                 |
| O2 (%Vol)             | 10.04              | 9.96           | -0.08  | 0.20                 |
| O2 (%Vol)             | 21.02              | 21.13          | 0.11   | 0.30                 |
| CO (ppm)              | 80.14              | 81             | 0.86   | 3.0                  |
| CO (ppm)              | 302                | 302            | 0      | 6.0                  |
| CO (ppm)              | 1003               | 1001           | -2     | 12                   |
| NO (ppm)              | 30.01              | 32             | 1.99   | 8.0                  |
| NO (ppm)              | 151.5              | 153            | 1.5    | 8.0                  |
| NO (ppm)              | 322.5              | 319            | -3.5   | 12                   |
| SO2 (ppm)             | 50.36              | 52             | 1.64   | 6.0                  |
| SO2 (ppm)             | 100.8              | 103            | 2.2    | 6.0                  |
| SO2 (ppm)             | 600.8              | 604            | 3.2    | 13                   |

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

**End of Report**

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

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310

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



NSC-TISI-TIS 17025

CALIBRATION 0426

**SARTORIUS**

# Certificate

## of Calibration

REVIEW BY Thavitak  
APPROVED BY D. [Signature]  
NEXT CAL. DATE 22/02/2025

Model Number : MSU224S-100-DUCertificate No. : 24BCI0073Description : Analytical BalanceIssued Date : Friday, February 23, 2024Serial Number : 0031709552Reference No. : 229196ID No. : RYG\_EN0003Page No. : 1 of 2Manufacturer : SartoriusCustomer Name : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)616/10 Moo 5 T.Maenam Khu, A.Pluk Daeng, Rayong 21140, Thailand.Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd.(Balance Room)616/10 Moo 5 T.Maenam Khu, A.Pluk Daeng, Rayong 21140, Thailand.Calibrated By : Mr.Chonchai InthanaCalibration Date : Thursday, February 22, 2024

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 : 23.7 °C ± 5.0 °CHumidity : 62.0 % RH ± 10.0 % 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 expended 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 - 5000g E2,YCS011-522-00 | TCS          | M2308197S       | 23-Aug-2025 |
| MHB-382SD     | Humidity/Barometer/Temp Lutron MHB-382SD          | DKSH         | C19231845       | 23-Aug-2024 |

This certificate relate and apply this equipment only.

This certificate may not be reproduced other than in full except with the prior written approval of the Verification Operation Division  
Sartorius (Thailand) Co., Ltd.

Mr.chonchai Inthana(Technical Manager)

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T  
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P

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

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310

Tel: +66 2643 8361-6 Fax: +66 2643-8367, e-mail: service.thailand@sartorius.com

**SARTORIUS**

# Certificate of Calibration

Model Number : MSU224S-100-DUCertificate No. : 24BCI0073Description : Analytical BalanceIssued Date : Friday, February 23, 2024Serial Number : 0031709552Reference No. : 229196ID No. : RYG\_EN0003Manufacturer : SartoriusPage No. : 2 of 2**Calibration Results : Without Adjustment****Repeatability**

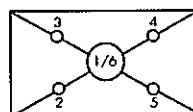
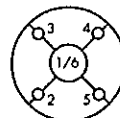
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

|                             |         |          |
|-----------------------------|---------|----------|
| Nominal Value : (Low Load)  | 20.0000 | 200.0001 |
| 20 g                        | 20.0000 | 200.0000 |
| Tolerance                   | 20.0001 | 200.0001 |
| 0.0001 g                    | 20.0000 | 200.0001 |
|                             | 20.0000 | 200.0001 |
| Nominal Value : (High Load) | 20.0000 | 200.0001 |
| 200 g                       | 19.9999 | 200.0001 |
| Tolerance                   | 20.0000 | 200.0000 |
| 0.0001 g                    | 20.0000 | 200.0000 |
|                             | 20.0000 | 200.0001 |
| Standard Deviation          | 0.00005 | 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 : 100 g  
Tolerance 0.0004 g

**Difference**

|   |         |
|---|---------|
| 1 | -       |
| 2 | 0.0000  |
| 3 | -0.0001 |
| 4 | 0.0000  |
| 5 | 0.0001  |
| 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            |
| 0.5                  | 0.5000                         | 0.5000                 | 0.0000           | 0.00013            |
| 1                    | 1.0000                         | 1.0000                 | 0.0000           | 0.00013            |
| 5                    | 5.0000                         | 5.0000                 | 0.0000           | 0.00013            |
| 10                   | 10.0000                        | 10.0000                | 0.0000           | 0.00013            |
| 20                   | 20.0000                        | 20.0000                | 0.0000           | 0.00013            |
| 50                   | 50.0000                        | 50.0000                | 0.0000           | 0.00024            |
| 100                  | 100.0000                       | 99.9999                | -0.0001          | 0.00018            |
| 200                  | 200.0000                       | 199.9999               | -0.0001          | 0.00029            |

End of Report.

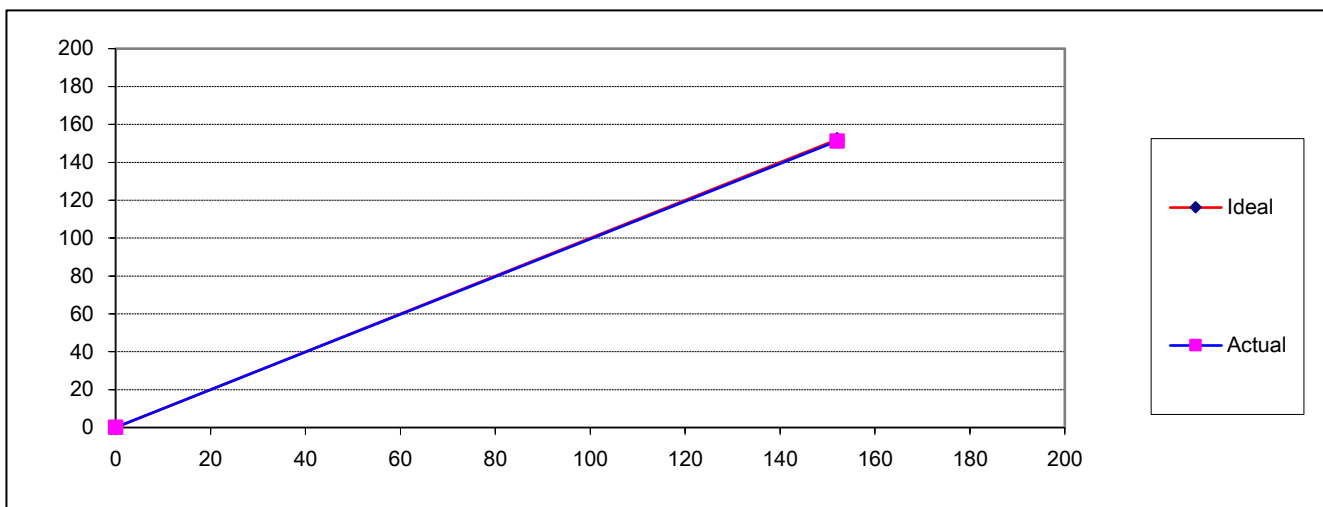


## CALIBRATION REPORT

|                    |              |              |                |
|--------------------|--------------|--------------|----------------|
| Calibration Date   | 3-Jan-24     | Equipment ID | BKK_FS0758     |
| Equipment Name     | FID Analyzer | Manufacturer | Baseline Mocon |
| Model              | 9000H        | Serial No.   | 0315EF0047     |
| Std.Gas Conc.(ppm) | 152          | Cylinder No. | D878173        |
| Certified Date     | 27-Jun-18    | Expired Date | 27-Jun-26      |

### CALIBRATION RESULTS

| Point       | CALIBRATION RESULTS |        |       |        |
|-------------|---------------------|--------|-------|--------|
|             | Ideal               | Actual | Error | %Error |
| ZERO        | 0.00                | 0.10   | 0.10  | 0.10   |
| SPAN        | 152.00              | 151.20 | -0.80 | -0.53  |
| AVERAGE (%) |                     |        |       | -0.21  |



Calibrated By

( Mr.Apisit Sing-ha )  
Field Environmental Scientist (4)

Approved By

( Mr.Sarayuth Jittrantont )  
Assistant General Manager





## ROTA METER CALIBRATION RESULT APRIL 2024

| Rotameter ID. | Calibration Date | Regression Result      | Coefficient (R <sup>2</sup> ) |
|---------------|------------------|------------------------|-------------------------------|
| BKK_FS0585    | 23 Apr 24        | $Y = 1.0322x + 2.25$   | 0.9997                        |
| BKK_FS0587    | 23 Apr 24        | $Y = 1.0111x + 16.357$ | 0.9994                        |
| BKK_FS0592    | 23 Apr 24        | $Y = 1.001x + 14.551$  | 1.0000                        |
| BKK_FS0594    | 23 Apr 24        | $Y = 1.0048x + 4.9762$ | 1.0000                        |
| BKK_FS1004    | 01 Apr 24        | $Y = 0.9826x + 12.32$  | 0.9998                        |
| BKK_FS1005    | 01 Apr 24        | $Y = 1.0183x + 0.0633$ | 0.9998                        |
| BKK_FS1006    | 01 Apr 24        | $Y = 1.1534x - 3.3241$ | 0.9989                        |
| BKK_FS1007    | 23 Apr 24        | $Y = 1.1084x + 2.9017$ | 0.9994                        |
| BKK_FS1008    | 06 May 24        | $Y = 1.1347x + 2.1915$ | 0.9996                        |
| BKK_FS1011    | 07 May 24        | $Y = 1.3995x - 7.1671$ | 0.9994                        |
| BKK_FS1012    | 07 May 24        | $Y = 1.0488x - 26.533$ | 0.9998                        |
| BKK_FS1013    | 07 May 24        | $Y = 1.0255x - 57.741$ | 1.0000                        |
| BKK_FS1017    | 04 Apr 24        | $Y = 1.0213x + 0.1156$ | 1.0000                        |
| BKK_FS1018    | 04 Apr 24        | $Y = 1.0007x + 1.3933$ | 0.9999                        |
| BKK_FS1019    | 04 Apr 24        | $Y = 1.0038x - 1.3381$ | 1.0000                        |
| BKK_FS1020    | 04 Apr 24        | $Y = 1.003x + 5.7656$  | 1.0000                        |
| BKK_FS1021    | 04 Apr 24        | $Y = 1.0096x - 25.605$ | 0.9926                        |
| BKK_FS1022    | 04 Apr 24        | $Y = 1.0937x - 103.66$ | 0.9980                        |
| BKK_FS1023    | 07 May 24        | $Y = 1.1613x - 2.675$  | 1.0000                        |
| BKK_FS1024    | 07 May 24        | $Y = 1.0157x - 4.3362$ | 1.0000                        |
| BKK_FS1025    | 07 May 24        | $Y = 1.0018x - 4.6236$ | 0.9999                        |
| BKK_FS1026    | 19 Jan 24        | $Y = 0.9618x + 1.9626$ | 0.9999                        |
| BKK_FS1027    | 19 Jan 24        | $Y = 1.0065x - 4.3786$ | 1.0000                        |
| BKK_FS1028    | 19 Jan 24        | $Y = 1.0184x - 37.308$ | 0.9997                        |
| BKK_FS1029    | 19 Jan 24        | $Y = 0.9809x + 2.7925$ | 0.9977                        |
| BKK_FS1030    | 19 Jan 24        | $Y = 0.996x - 1.3286$  | 1.0000                        |
| BKK_FS1031    | 19 Jan 24        | $Y = 1.015x - 27.236$  | 0.9997                        |
| BKK_FS1039    | 01 Apr 24        | $Y = 0.9909x + 11.357$ | 0.9991                        |
| BKK_FS1040    | 01 Apr 24        | $Y = 1.0121x - 19.203$ | 0.9996                        |
| BKK_FS1041    | 01 Apr 24        | $Y = 1.0176x + 1.4813$ | 0.9996                        |
| BKK_FS1042    | 01 Apr 24        | $Y = 0.9927x + 10.76$  | 0.9995                        |
| BKK_FS1043    | 01 Apr 24        | $Y = 0.9965x + 13.696$ | 1.0000                        |
| BKK_FS1044    | 01 Apr 24        | $Y = 1.1159x - 0.9354$ | 0.9978                        |
| PHK_FS0027    | 06 May 24        | $Y = 1.1281x + 0.4949$ | 0.9997                        |
| PHK_FS0028    | 06 May 24        | $Y = 1.0332x - 1.8233$ | 0.9999                        |
| PHK_FS0029    | 06 May 24        | $Y = 1.001x + 10.848$  | 1.0000                        |
| RYG_FS0197    | 01 Apr 24        | $Y = 1.0045x + 10.275$ | 1.0000                        |
| RYG_FS0198    | 01 Apr 24        | $Y = 1.0061x + 0.715$  | 0.9999                        |
| RYG_FS0199    | 01 Apr 24        | $Y = 0.976x + 3.1497$  | 0.9998                        |



## ROTA METER CALIBRATION RESULT APRIL 2024

| Rotameter ID. | Calibration Date | Regression Result      | Coefficient (R <sup>2</sup> ) |
|---------------|------------------|------------------------|-------------------------------|
| RYG_FS0654    | 01 Apr 24        | $Y = 1.0354x + 0.3361$ | 0.9998                        |
| RYG_FS0655    | 01 Apr 24        | $Y = 0.978x + 13.603$  | 0.9991                        |
| RYG_FS0656    | 01 Apr 24        | $Y = 1.0035x + 6.879$  | 0.9999                        |
| RYG_FS0657    | 01 Apr 24        | $Y = 1.0233x + 0.8908$ | 0.9982                        |
| RYG_FS0658    | 01 Apr 24        | $Y = 0.9905x + 9.8867$ | 0.9996                        |
| RYG_FS0659    | 01 Apr 24        | $Y = 0.9994x + 13.924$ | 1.0000                        |
| SGK_FS0135    | 23 Apr 24        | $Y = 1.0117x + 4.8833$ | 1.0000                        |
| SGK_FS0136    | 23 Apr 24        | $Y = 1.0134x + 3.6467$ | 1.0000                        |
| SGK_FS0138    | 04 Apr 24        | $Y = 1.0449x - 0.3684$ | 0.9988                        |
| SGK_FS0139    | 04 Apr 24        | $Y = 1.0086x + 3.1267$ | 0.9988                        |
| SGK_FS0140    | 04 Apr 24        | $Y = 1.0029x + 7.5181$ | 1.0000                        |
| SGK_FS0141    | 23 Apr 24        | $Y = 1.1129x - 0.0619$ | 0.9997                        |
| SGK_FS0142    | 23 Apr 24        | $Y = 1.0136x + 2.4267$ | 0.9999                        |
| SGK_FS0143    | 23 Apr 24        | $Y = 1.0036x + 8.3162$ | 1.0000                        |

Review By :

(Mr. Wichan Choonharat)

Enviro Field Services Manager

Approved By :

(Mr. Sarayuth Jittrantont)

Assistant General Manager

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

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



NSC-TISI-TIS 17025

CALIBRATION 0426

**SARTORIUS**

REVIEW BY

Thanihalli

APPROVED BY

D. [Signature]

NEXT CAL. DATE

01/03/24

# Certificate of Calibration

Model Number : MSE125P-100-DU

Certificate No. : 23BCI0114

Description : Semi-micro Balance

Issued Date : Friday, March 03, 2023

Serial Number : 0033108993

Reference No. : 204833

ID No. : RYG\_EN0004

Manufacturer : Sartorius

Page No. : 1 of 3

Customer Name : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)

616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd.(Balance Room)

616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated By : Mr.Chonchai Inthana

Calibration Date : Wednesday, March 01, 2023

Calibration

Procedure No. : This calibration was conducted by

Using in-house calibration procedure number (WI-003)

Based on UKAS LAB 14 : 2019

**Metrological data :**

Capacity : 120 g Readability : 0.00001 g

**Ambients Conditions:**

Temperature : 24.0 °C ± 5.0 °C

Humidity : 63.0 % RH ± 10.0 % RH

Pressure : ±

**Reasons for calibration**
☐ New Installation
 ☐ Service / Repaired
 ☒ Re-calibration/ Maintenance
Equipment Condition: ☒ Good Operate ☐ Fair**Measurement Method UKAS Publication Ref :Lab 14**

The measurement uncertainty stated is the expended 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 form list of Sartorius Metrological Specifications.

**Traceability:**

| Model Number  | Description                                       | Traceability | Certificate No. | Due Date    |
|---------------|---|--------------|-----------------|-------------|
| YCS011-522-00 | Sartorius weight set 1mg - 5000g E2,YCS011-522-00 | 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.

This certificate may not be reproduced other than in full except with the prior written approval of the Verification Operation Division Sartorius (Thailand) Co., Ltd.

[Signature]

Mr.chonchai Inthana(Technical Manager)

STAMP





# Certificate of Calibration

Model Number : MSE125P-100-DU

Certificate No. : 23BCI0114

Description : Semi-micro Balance

Issued Date : Friday, March 03, 2023

Serial Number : 0033108993

Reference No. : 204833

ID No. : RYG\_EN0004

Manufacturer : Sartorius

Page No. : 2 of 3

## Calibration Results : Without Adjustment

### Repeatability

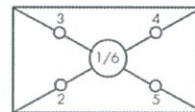
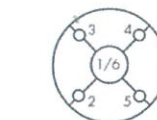
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

|                             |          |          |
|-----------------------------|----------|----------|
| Nominal Value : (Low Load)  | 5.00002  | 50.00002 |
| 5 g                         | 5.00002  | 50.00002 |
| Tolerance                   | 5.00001  | 50.00002 |
| 0.000015 g                  | 5.00002  | 50.00001 |
|                             | 5.00000  | 50.00001 |
| Nominal Value : (High Load) | 5.00002  | 50.00000 |
| 50 g                        | 5.00001  | 50.00000 |
| Tolerance                   | 5.00001  | 50.00000 |
| 0.000015 g                  | 5.00002  | 50.00001 |
|                             | 5.00002  | 50.00002 |
| Standard Deviation          | 0.000007 | 0.000009 |

### 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 0.00015 g



|   | Difference |
|---|------------|
| 1 | -          |
| 2 | -0.00001   |
| 3 | 0.00000    |
| 4 | 0.00002    |
| 5 | 0.00002    |
| 6 | -          |

### Linearity

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

Tolerance 0.00004 g

| Nominal Value<br>(g) | Conventional Mass Value<br>(g) | Displayed Value<br>(g) | Deviation<br>(g) | Uncertainty<br>(g) |
|----------------------|--------------------------------|------------------------|------------------|--------------------|
| 0.01                 | 0.01000                        | 0.01000                | 0.00000          | 0.000026           |
| 0.1                  | 0.10000                        | 0.10000                | 0.00000          | 0.000026           |
| 1                    | 1.00000                        | 1.00000                | 0.00000          | 0.000028           |
| 2                    | 2.00002                        | 2.00002                | 0.00000          | 0.000030           |
| 5                    | 5.00002                        | 5.00001                | -0.00001         | 0.000033           |
| 10                   | 10.00002                       | 10.00002               | 0.00000          | 0.000038           |
| 20                   | 20.00000                       | 20.00000               | 0.00000          | 0.000048           |
| 30                   | 30.00002                       | 30.00002               | 0.00000          | 0.000040           |
| 40                   | 40.00003                       | 40.00002               | -0.00001         | 0.000087           |
| 50                   | 50.00002                       | 50.00001               | -0.00001         | 0.000081           |

# Certificate of Calibration

Model Number : MSE125P-100-DU

Certificate No. : 23BCI0114

Description : Semi-micro Balance

Issued Date : Friday, March 03, 2023

Serial Number : 0033108993

Reference No. : 204833

ID No. : RYG\_EN0004

Manufacturer : Sartorius

Page No. : 3 of 3

## Calibration Results : Without Adjustment

### Repeatability

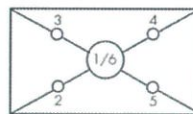
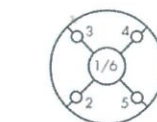
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

|                             |  |          |
|-----------------------------|--|----------|
| Nominal Value : (Low Load)  |  | 100.0000 |
| g                           |  | 100.0000 |
| Tolerance                   |  | 100.0000 |
| 0.000015 g                  |  | 100.0000 |
|                             |  | 100.0000 |
| Nominal Value : (High Load) |  | 100.0000 |
| 100 g                       |  | 100.0001 |
| Tolerance                   |  | 100.0000 |
| 0.000015 g                  |  | 100.0000 |
|                             |  | 100.0000 |
| Standard Deviation          |  | 0.00003  |

### 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 0.00015 g



|   | Difference |
|---|------------|
| 1 | -          |
| 2 | -          |
| 3 | -          |
| 4 | -          |
| 5 | -          |
| 6 | -          |

### Linearity

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

Tolerance 0.0001 g

| Nominal Value<br>(g) | Conventional Mass Value<br>(g) | Displayed Value<br>(g) | Deviation<br>(g) | Uncertainty<br>(g) |
|----------------------|--------------------------------|------------------------|------------------|--------------------|
| 65                   | 65.0000                        | 65.0000                | 0.0000           | 0.00015            |
| 70                   | 70.0000                        | 70.0000                | 0.0000           | 0.00015            |
| 75                   | 75.0000                        | 75.0000                | 0.0000           | 0.00016            |
| 80                   | 80.0000                        | 80.0000                | 0.0000           | 0.00017            |
| 85                   | 85.0001                        | 85.0001                | 0.0000           | 0.00018            |
| 90                   | 90.0001                        | 90.0001                | 0.0000           | 0.00018            |
| 95                   | 95.0001                        | 95.0001                | 0.0000           | 0.00020            |
| 100                  | 100.0000                       | 100.0000               | 0.0000           | 0.00024            |
| 110                  | 110.0000                       | 110.0000               | 0.0000           | 0.00026            |
| 120                  | 120.0000                       | 120.0000               | 0.0000           | 0.00026            |

End of Report.



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NSC-TISI-TIS 17025  
CALIBRATION 0426**SARTORIUS**

# Certificate

## of Calibration

|                |             |
|----------------|-------------|
| REVIEW BY      | Thawit      |
| APPROVED BY    | [Signature] |
| NEXT CAL. DATE | 22/02/2025  |

Model Number : MSE125P-100-DU  
Description : Semi-micro Balance  
Serial Number : 0033108993  
ID No. : RYG\_EN0004  
Manufacturer : Sartorius

Certificate No. : 24BCI0071  
Issued Date : Friday, February 23, 2024  
Reference No. : 229196  
Page No. : 1 of 3

Customer Name : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd.(Balance Room)  
616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated By : Mr.Chonchai Inthana  
Calibration Date : Thursday, February 22, 2024

Calibration  
Procedure No. : This calibration was conducted by  
Using in-house calibration procedure number (WI-003)  
Based on UKAS LAB 14 : 2019

**Metrological data :**

Capacity : 60./120. g Readability : 0.00001./0.0001 g

**Ambients Conditions:**

Temperature : 24.0 °C ± 5.0 °C

Humidity : 60.0 % RH ± 10.0 % RH

Pressure :                      ±                     

**Reasons for calibration**

☐ New Installation ☐ Service / Repaired ☒ Re-calibration/ Maintenance

Equipment Condition: ☒ Good Operate ☐ Fair

**Measurement Method UKAS Publication Ref :Lab 14**

The measurement uncertainty stated is the expended 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 form list of Sartorius Metrological Specifications.

**Traceability:**

| Model Number  | Description                                       | Traceability | Certificate No. | Due Date    |
|---------------|---|--------------|-----------------|-------------|
| YCS011-522-00 | Sartorius weight set 1mg - 5000g E2,YCS011-522-00 | TCS          | M2308197S       | 23-Aug-2025 |
| MHB-382SD     | Humidity/Barometer/Temp Lutron MHB-382SD          | DKSH         | C19231845       | 23-Aug-2024 |

This certificate relate and apply this equipment only.

This certificate may not be reproduced other than in full except with the prior written approval of the Verification Operation Division Sartorius (Thailand) Co., Ltd.

Mr.chonchai Intrhana(Technical Manager)

S  
T  
A  
M  
P



# Certificate of Calibration

Model Number : MSE125P-100-DU

Certificate No. : 24BCI0071

Description : Semi-micro Balance

Issued Date : Friday, February 23, 2024

Serial Number : 0033108993

Reference No. : 229196

ID No. : RYG\_EN0004

Manufacturer : Sartorius

Page No. : 2 of 3

## Calibration Results : Without Adjustment

### Repeatability

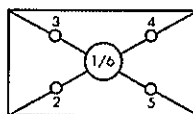
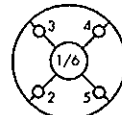
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

|                             |          |          |
|-----------------------------|----------|----------|
| Nominal Value : (Low Load)  | 5.00003  | 50.00003 |
| 5 g                         | 5.00001  | 50.00003 |
| Tolerance                   | 5.00003  | 50.00002 |
| 0.000015 g                  | 5.00002  | 50.00003 |
|                             | 5.00001  | 50.00003 |
| Nominal Value : (High Load) | 5.00002  | 50.00003 |
| 50 g                        | 5.00001  | 50.00003 |
| Tolerance                   | 5.00001  | 50.00002 |
| 0.000015 g                  | 5.00002  | 50.00003 |
|                             | 5.00002  | 50.00002 |
| Standard Deviation          | 0.000008 | 0.000005 |

### 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 0.00015 g



#### Difference

|   |          |
|---|----------|
| 1 | -        |
| 2 | -0.00001 |
| 3 | 0.00000  |
| 4 | 0.00001  |
| 5 | 0.00001  |
| 6 | -        |

### Linearity

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

Tolerance 0.00004 g

| Nominal Value<br>(g) | Conventional Mass Value<br>(g) | Displayed Value<br>(g) | Deviation<br>(g) | Uncertainty<br>(g) |
|----------------------|--------------------------------|------------------------|------------------|--------------------|
| 0.01                 | 0.01000                        | 0.01000                | 0.00000          | 0.000024           |
| 0.1                  | 0.10000                        | 0.10000                | 0.00000          | 0.000025           |
| 1                    | 1.00000                        | 1.00000                | 0.00000          | 0.000027           |
| 2                    | 2.00002                        | 2.00002                | 0.00000          | 0.000028           |
| 5                    | 5.00002                        | 5.00003                | 0.00001          | 0.000031           |
| 10                   | 10.00002                       | 10.00004               | 0.00002          | 0.000036           |
| 20                   | 20.00002                       | 20.00002               | 0.00000          | 0.000049           |
| 30                   | 30.00004                       | 30.00003               | -0.00001         | 0.000089           |
| 40                   | 40.00005                       | 40.00003               | -0.00002         | 0.000089           |
| 50                   | 50.00002                       | 50.00001               | -0.00001         | 0.000089           |

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Tel: +66 2643 8361-6 Fax: +66 2643-8367, e-mail: service.thailand@sartorius.com

**SARTORIUS**

# Certificate

## of Calibration

Model Number : MSE125P-100-DUDescription : Semi-micro BalanceSerial Number : 0033108993ID No. : RYG\_EN0004Manufacturer : SartoriusCertificate No. : 24BC10071 EXT CAL. DATE 22/02/2025Issued Date : Friday, February 23, 2024Reference No. : 229196Page No. : 3 of 3

### Calibration Results : Without Adjustment

#### Repeatability

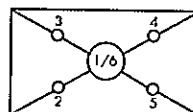
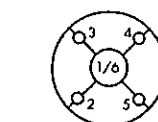
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

|                             |  |          |
|-----------------------------|--|----------|
| Nominal Value : (Low Load)  |  | 100.0000 |
| g                           |  | 100.0000 |
| Tolerance                   |  | 100.0000 |
| 0.000015 g                  |  | 100.0000 |
|                             |  | 100.0000 |
|                             |  | 100.0000 |
| Nominal Value : (High Load) |  | 100.0000 |
| 100 g                       |  | 100.0001 |
| Tolerance                   |  | 100.0000 |
| 0.000015 g                  |  | 100.0000 |
|                             |  | 100.0000 |
|                             |  | 100.0000 |
| Standard Deviation          |  | 0.00003  |

#### 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 0.00015 g



| Difference |   |
|------------|---|
| 1          | - |
| 2          | - |
| 3          | - |
| 4          | - |
| 5          | - |
| 6          | - |

#### Linearity

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

Tolerance 0.0001 g

| Nominal Value<br>(g) | Conventional Mass Value<br>(g) | Displayed Value<br>(g) | Deviation<br>(g) | Uncertainty<br>(g) |
|----------------------|--------------------------------|------------------------|------------------|--------------------|
| 65                   | 65.0000                        | 65.0000                | 0.0000           | 0.00015            |
| 70                   | 70.0000                        | 70.0000                | 0.0000           | 0.00015            |
| 75                   | 75.0001                        | 75.0000                | -0.0001          | 0.00015            |
| 80                   | 80.0001                        | 80.0000                | -0.0001          | 0.00016            |
| 85                   | 85.0001                        | 85.0001                | 0.0000           | 0.00018            |
| 90                   | 90.0001                        | 90.0001                | 0.0000           | 0.00017            |
| 95                   | 95.0001                        | 95.0001                | 0.0000           | 0.00019            |
| 100                  | 100.0000                       | 100.0000               | 0.0000           | 0.00024            |
| 110                  | 110.0000                       | 110.0000               | 0.0000           | 0.00026            |
| 120                  | 120.0000                       | 120.0000               | 0.0000           | 0.00026            |

End of Report.



# บริษัท เอกเสคคิวทิฟ เทรดดิ้ง จำกัด (สำนักงานใหญ่)

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

ที่ RA 015/24

## ใบรายงานผลการปรับเทียบ

ชื่อผู้ขอรับบริการ : บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด.  
ที่อยู่ : 104 ซ.พัฒนาการ 40 ถ.พัฒนาการ แขวงสวนหลวง เขตสวนหลวง กรุงเทพมหานคร 10250.  
ปรับเทียบที่ : บริษัท เอกเสคคิวทิฟ เทรดดิ้ง จำกัด  
ที่อยู่ : 48/194-5 ซอย ประดิษฐ์มนูธรรม 19 ถนนประดิษฐ์มนูธรรม แขวง/เขตลาดพร้าว กรุงเทพฯ 10230

### รายละเอียดเครื่องมือที่ทำการปรับเทียบ :

เครื่องมือ : เครื่องตรวจวัดไอระเหยจากสารเคมี  
ผลิตภัณฑ์ : RAE Systems  
รุ่น : MiniRAE3000  
หมายเลขเครื่อง : 592-906493  
ID : BKK\_FS0819

### สถานะแวดล้อม :

อุณหภูมิ :  $(25 \pm 3) ^\circ\text{C}$   
ความชื้นสัมพัทธ์ :  $(43 \pm 15) \%$   
ความดันบรรยากาศ : 760 มิลลิเมตรปรอท

วันที่ปรับเทียบมาตรฐาน : 19 มกราคม 2567

วิธีการปรับเทียบมาตรฐาน : ปรับเทียบโดยใช้ Standard Reference Gas  
- Isobutylene Standard Gas 100 ppm; Lot number: 302-402431506.

REVIEW BY Monakorn P  
APPROVED BY [Signature]  
EXT CAL. DATE 19/7/25

### ผลการปรับเทียบมาตรฐาน

| Sensor Type | Reference Concentration | Before Cal. | After Cal. | Error Reading | Result |
|-------------|-------------------------|-------------|------------|---------------|--------|
| PID         | 0.0 ppm (Air Zero)      | 0.0 ppm     | 0.0 ppm    | 0.0 ppm       | Pass   |
| PID         | 100 ppm (Isobutylene)   | 93.2 ppm    | 100.0 ppm  | 0.0 ppm       | Pass   |

Flow Rate of Pump : 480 cc/min.

Accuracy :  $\pm 3 \%$  at calibration point

ผู้ปรับเทียบ : [Signature]  
(นายสุรินทร์ สายเนตร)  
Service Engineer

ผู้ตรวจสอบ : [Signature]  
(นายสุทธิวงศ์ คงทองสังข์)  
Service Engineer Manager

ผลการสอบเทียบ/ปรับเทียบ นี้ รับรองเฉพาะตัวอย่างและรายการที่ได้รับระบุไว้เท่านั้น

การนำรายงานผล/ใบรับรองนี้ไปโฆษณาและการคัดลอกหรือการนำผลบางส่วนไปเผยแพร่ต่อสาธารณะต้องได้รับอนุญาตเป็นลายลักษณ์อักษรจากทางบริษัทฯ



# บริษัท เอกเสคคิวทิฟ เทรตติ้ง จำกัด (สำนักงานใหญ่)

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

No. RA 015/24

## Certificate of Calibration

**Customer** : ALS Laboratory Group (Thailand) Co.,Ltd.  
**Address** : 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang Bangkok 10250 TH.  
**Calibration location** : Executive Trading Limited.  
**Address** : 48/194-5 Soi Praditmanutham 19, Pradit Manutham Road, Latphrao, Bangkok 10230

**Tools :**  
Instrument : Gas Detector  
Product : RAE Systems  
Model Name : MiniRAE3000  
Serial Number : 592-906493  
ID : BKK\_FS0819

**Environmental Condition :**  
Temperature :  $(25 \pm 3) ^\circ\text{C}$   
Relative Humidity :  $(43 \pm 15) \%$   
Pressure : 760 mmHg

**Date of Calibration** : January 19, 2024  
**Calibration Method** : This instrument has been calibrated using calibration gases. Test and calibration data is On file with Executive trading limited.  
**Reference Standard** : Isobutylene Standard Gas 100 ppm; Lot number: 302-402431506.

### Test Result

| Sensor Type | Reference Concentration | Before Cal. | After Cal. | Error Reading | Result |
|-------------|-------------------------|-------------|------------|---------------|--------|
| PID         | 0.0 ppm (Air Zero)      | 0.0 ppm     | 0.0 ppm    | 0.0 ppm       | Pass   |
| PID         | 100 ppm (Isobutylene)   | 93.2 ppm    | 100.0 ppm  | 0.0 ppm       | Pass   |

**Flow Rate of Pump** : 480 cc/min.

**Accuracy** :  $\pm 3 \%$  at calibration point

Calibrated By : 

(Mr. Surinthorn Sainate)

Service Engineer

Approved By : 

(Mr. Suttiwong Kongtongsang.)

Service Engineer Manager

The results relate only to the items tested or calibrated.

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





# บริษัท เอกเสคคิวทิฟ เทคดิง จำกัด (สำนักงานใหญ่)

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

ที่ RA 015/24

## ใบรายงานการตรวจเช็คเครื่องตรวจวัดก๊าซ รุ่น MiniRAE3000

หมายเลขเครื่อง : 592-906493

วันที่ตรวจเช็ค : 19 มกราคม 2567

| ลำดับที่ | รายละเอียด<br>การตรวจสอบ | RAW COUNT   |       | สรุป       | หมายเหตุ    |
|----------|--------------------------|-------------|-------|------------|-------------|
|          |                          | REF.        | REAL  |            |             |
| 1.       | PID RAW COUNT            |             |       |            | เปลี่ยนใหม่ |
|          | Ch.H                     | 10000-62500 | 47933 | ■ YES □ NO |             |
|          | Ch.L                     | <62500      | 52971 | ■ YES □ NO |             |
| 2.       | Lamp                     | >40         | 45    | ■ YES □ NO |             |

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

ผู้ตรวจเช็ค : สุรินทร์ สายเนตร  
(นายสุรินทร์ สายเนตร)  
Service Engineer

ผลการสอบเทียบ/ปรับเทียบ นี้ รับรองเฉพาะตัวอย่างและรายการที่ได้ระบุไว้เท่านั้น

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**CALGAZ,**  
**A DIVISION OF AIRGAS USA LLC**  
821 Chesapeake Drive,  
Cambridge, MD 21613  
USA Tel. 1-800-638-1197  
www.calgaz.com

## **CERTIFICATE OF ANALYSIS**

**Date:** 06/06/2022  
**Order Number:** 1110821892  
**Lot Number:** 302-402431506

**Customer:** EXECUTIVE TRADING LIMITED  
**Part Number:** 600-0002-000  
**Use Before:** JUN 6, 2027

| <b>Component</b> | <b>Concentration (± 2%)</b> |
|------------------|-----------------------------|
| ISOBUTYLENE      | 100PPM                      |
| AIR              | Balance                     |

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

**Valve:** CGA600  
**Pressure:** 494 PSIG

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

**Analyst:**

Chris Donnelly

**CERTIFICATE  
of  
Attendance**

It is hereby certified that

**Mr Surinthorn Sainate**  
**(Executive Trading Limited)**

has successfully completed the

**RAE Service Training Course**

Conducted by

**HONEYWELL**

on **2<sup>nd</sup> August 2022**



Conducted by : Desmond Tan  
Service Engineer / Technical Trainer  
Date of Issue : 2<sup>nd</sup> August 2022  
Certificate valid for 2 years from date of issue

# SITHIPORN ASSOCIATES CO.,LTD.

## CALIBRATION LABORATORY

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



Cert. No. : ACC23029

Pages : 1 of 3

### Calibration Certificate

**Equipment :** SOUND CALIBRATOR  
**Manufacturer :** RION  
**Model :** NC-74  
**Serial No.:** 34178123  
**ID No.:** RYG\_FS0215

|                |                     |
|----------------|---------------------|
| REVIEW BY      | <i>Nathakorn P.</i> |
| APPROVED BY    | <i>[Signature]</i>  |
| NEXT CAL. DATE | 20/9/24             |

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,  
KHWAENG 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 :** 07 SEPTEMBER 2023  
**Calibration Date :** 20 SEPTEMBER 2023  
**Date of Issue :** 20 SEPTEMBER 2023

**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. : ACC23029

Job No. : VC66AC0100

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-0010-23       | 07-FEB-24       |
| Digital Multimeter      | 33461A       | MY53220104        | EEL.BP 30/0266   | 13-FEB-24       |
| Digital Multimeter      | 33461A       | MY53220076        | EEL.BP 30/0267   | 13-FEB-24       |
| Digital Multimeter      | 33461A       | MY60024273        | EEL.BP 31/0266   | 14-FEB-24       |
| Programmable Attenuator | MAT-1070     | 62100114          | EF-0011-23       | 08-FEB-24       |
| Condenser Microphone    | 4180         | 2977900           | AA-1001-23       | 14-FEB-24       |
| Measuring Amplifier     | NA-42KAI     | 34560495          | AA-3002-23       | 14-FEB-24       |
| Audio Analyzer          | AVR-3360A    | V744B6069         | EF-0012-23       | 10-FEB-24       |

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. : ACC23029

Job No. : VC66AC0100

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) | Acceptance<br>limit<br>(dB) |
|---|---------------------------|---------------------------|---------------------|-----------------------------|
| 94  | 94.1                      | 0.10                      | 0.14                | 0.40                        |

**2. Frequency**

| Specified<br>Frequency<br>(Hz) | Measured<br>value<br>(Hz) | Deviated<br>value<br>(%) | Uncertainty<br>(%) | Acceptance<br>limit<br>(%) |
|--------------------------------|---------------------------|--------------------------|--------------------|----------------------------|
| 1000                           | 1001.5                    | 0.1                      | 0.1                | 1.0                        |

**3. Total distortion**

| Measured value (%) | Uncertainty (%) | Acceptance limit (%) |
|--------------------|-----------------|----------------------|
| 1.70               | 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.,Bangbumru, Bangplud Bangkok 10700 THAILAND.  
Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiphorn.com http://www.sithiphorn.com



Cert. No. : ACL23325

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 01073423 / 169513 / 73684  
**ID No.:** RYG\_FS0386

**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 :** 11 OCTOBER 2023  
**Calibration Date :** 19-20 OCTOBER 2023  
**Date of Issue :** 24 OCTOBER 2023

|                |                    |
|----------------|--------------------|
| REVIEW BY      | <i>Nathakorn P</i> |
| APPROVED BY    | <i>[Signature]</i> |
| NEXT CAL. DATE | 19/10/24           |

**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. : ACL23325**  
**Job No. : VC67AC0011**  
**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-0009-23       | 07-FEB-24       |
| Waveform Generator      | 33511B       | MY52302742        | EF-0010-23       | 07-FEB-24       |
| Digital Multimeter      | 33461A       | MY53220104        | EEL.BP 30/0266   | 13-FEB-24       |
| Digital Multimeter      | 33461A       | MY53220076        | EEL.BP 29/0266   | 13-FEB-24       |
| Digital Multimeter      | 34461A       | MY60024273        | EEL.BP 31/0266   | 14-FEB-24       |
| Programmable Attenuator | MAT-1070     | 62100114          | EF-0011-23       | 08-FEB-24       |
| Condenser Microphone    | 4180         | 2977900           | AA-1001-23       | 14-FEB-24       |
| Measuring Amplifier     | NA-42KAI     | 34560495          | AA-3002-23       | 14-FEB-24       |

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. : ACL23325

Job No. : VC67AC0011

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  | ✓    | -    | 0.3                 | 0.7   |
| 4. Electrical signal tests of frequency weightings   |      |      |                     |   |
| For 10 Hz to 4 kHz                                   | ✓    | -    | 0.3                 | 0.6   |
| For > 4 kHz to 10 kHz                                | ✓    | -    | 0.3                 | 0.7   |
| For > 10 kHz to 20 kHz                               | -    | -    | -                   | 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   |

Note : Pass/Fail evaluation for each parameter,  
will be considered together from the acceptance limit and the Maximum-permitted uncertainty of measurement.

## Continuation of Calibration Certificate

Cert. No. : ACL23325

Job No. : VC67AC0011

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 (93.98)                           | 93.9                        | 0.0                 | ±0.3                          |

**2. Self-generated noise**

## 2.1 Normal test

| Measured Value<br>( dB ) |
|--------------------------|
| 15.4                     |

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             | 13.1                     |
| C - weight             | 18.8                     |
| Flat                   | 24.6                     |

**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) |          |          |                      |
|---------------------|--|----------|----------|----------------------|
|                     | Flat   | C-weight | A-weight | Acceptance<br>Limits |
| 125                 | 0.2  | 0.2      | 0.2      | ± 1.5                |
| 1000                | 0.0  | 0.0      | 0.0      | ± 1.0                |
| 8000                | 1.6  | 1.7      | 1.6      | ±5.0                 |



Continuation of Calibration Certificate

Cert. No. : ACL23325

Job No. : VC67AC0011

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                  | 0.0  | 0.0      | -0.1     | ±2.0                 |
| 125                 | 0.0  | 0.0      | 0.0      | ±1.5                 |
| 250                 | 0.0  | 0.0      | 0.0      | ±1.5                 |
| 500                 | 0.0  | 0.0      | 0.0      | ±1.5                 |
| 1000                | 0.0  | 0.0      | 0.0      | ±1.0                 |
| 2000                | 0.0  | 0.0      | 0.0      | ±2.0                 |
| 4000                | 0.0  | 0.0      | 0.0      | ±3.0                 |
| 8000                | 0.0  | 0.1      | 0.1      | ±5.0                 |

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

| Frequency<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                                | 94.0                              | 0.0                         | ± 0.3                          |

Continuation of Calibration Certificate

**Cert. No. : ACL23325**

**Job No. : VC67AC0011**

**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                          | 104.0                       | 0.0                         | ± 1.1                          |
| 99.0                           | 99.0                        | 0.0                         | ± 1.1                          |
| 94.0                           | 94.0                        | 0.0                         | ± 1.1                          |
| 89.0                           | 89.0                        | 0.0                         | ± 1.1                          |
| 84.0                           | 84.0                        | 0.0                         | ± 1.1                          |
| 79.0                           | 79.0                        | 0.0                         | ± 1.1                          |
| 74.0                           | 74.0                        | 0.0                         | ± 1.1                          |
| 69.0                           | 69.0                        | 0.0                         | ± 1.1                          |
| 64.0                           | 64.0                        | 0.0                         | ± 1.1                          |
| 59.0                           | 59.0                        | 0.0                         | ± 1.1                          |
| 54.0                           | 53.9                        | -0.1                        | ± 1.1                          |
| 49.0                           | 49.0                        | 0.0                         | ± 1.1                          |
| 44.0                           | 43.9                        | -0.1                        | ± 1.1                          |
| 39.0                           | 38.9                        | -0.1                        | ± 1.1                          |
| 34.0                           | 33.9                        | -0.1                        | ± 1.1                          |
| 30.0                           | 29.9                        | -0.1                        | ± 1.1                          |
| 29.0                           | 28.9                        | -0.1                        | ± 1.1                          |
| 28.0                           | 27.9                        | -0.1                        | ± 1.1                          |
| 27.0                           | 26.9                        | -0.1                        | ± 1.1                          |
| 26.0                           | 25.9                        | -0.1                        | ± 1.1                          |
| 25.0                           | 24.8                        | -0.2                        | ± 1.1                          |



Continuation of Calibration Certificate

Cert. No. : ACL23325  
Job No. : VC67AC0011  
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8. Level linearity including the level range control

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

9. Tone burst response

| Time Weighting | Tone burst duration, Tb ( ms ) | Cycle | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|----------------|--------------------------------|-------|--------------------------|-----------------------|-----------------------|--------------------------|
| Fast           | 0.25                           | 1     | 108.0                    | 107.9                 | -0.1                  | 1.5 ; -5.0               |
|                | 2                              | 8     | 117.0                    | 117.0                 | 0.0                   | 1.0 ; -2.5               |
|                | 200                            | 800   | 134.0                    | 134.0                 | 0.0                   | ±1.0                     |
| Slow           | 2                              | 8     | 108.0                    | 108.0                 | 0.0                   | 1.5 ; -5.0               |
|                | 200                            | 800   | 127.6                    | 127.6                 | 0.0                   | ±1.0                     |
| SEL            | 0.25                           | 1     | 99.0                     | 98.9                  | -0.1                  | 1.5 ; -5.0               |
|                | 2                              | 8     | 108.0                    | 108.0                 | 0.0                   | 1.0 ; -2.5               |
|                | 200                            | 800   | 128.0                    | 128.0                 | 0.0                   | ±1.0                     |

10. Peak C sound level

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value, Lcpeak ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|--------------------------------|--------------------------|-------------------------------|-----------------------|--------------------------|
| Continuous                     | 133.0                    | 133.0                         | 0.0                   | ±3.0                     |
| One                            | 136.4                    | 136.1                         | -0.3                  | ±3.0                     |

| Number of cycle in test signal | Anticipated Value ( dB ) | Measured Value ( dB ) | Deviated Value ( dB ) | Acceptance Limits ( dB ) |
|--------------------------------|--------------------------|-----------------------|-----------------------|--------------------------|
| Continuous                     | 133.0                    | 133.0                 | 0.0                   | ±2.0                     |
| Positive half cycle            | 135.4                    | 135.2                 | -0.2                  | ±2.0                     |
| Negative half cycle            | 135.4                    | 135.2                 | -0.2                  | ±2.0                     |

## Continuation of Calibration Certificate

Cert. No. : ACL23325

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## 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 |                             |                                |
| 89.6                       | 89.6                       | 0.0                         | ±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 —————

# SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



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

Cert. No. : ACL23320

Pages : 1 of 8

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42/ Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 00597167 / 179118 / 87525  
**ID No.:** RYG\_FS0437

**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 ) %

|                |                    |
|----------------|--------------------|
| REVIEW BY      | <i>Nathakorn P</i> |
| APPROVED BY    | <i>[Signature]</i> |
| NEXT CAL. DATE | 19/10/24           |

**Received Date :** 11 OCTOBER 2023  
**Calibration Date :** 19-20 OCTOBER 2023  
**Date of Issue :** 24 OCTOBER 2023

**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. : ACL23320  
Job No. : VC67AC0011  
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-0009-23       | 07-FEB-24       |
| Waveform Generator      | 33511B       | MY52302742        | EF-0010-23       | 07-FEB-24       |
| Digital Multimeter      | 33461A       | MY53220104        | EEL.BP 30/0266   | 13-FEB-24       |
| Digital Multimeter      | 33461A       | MY53220076        | EEL.BP 29/0266   | 13-FEB-24       |
| Digital Multimeter      | 34461A       | MY60024273        | EEL.BP 31/0266   | 14-FEB-24       |
| Programmable Attenuator | MAT-1070     | 62100114          | EF-0011-23       | 08-FEB-24       |
| Condenser Microphone    | 4180         | 2977900           | AA-1001-23       | 14-FEB-24       |
| Measuring Amplifier     | NA-42KAI     | 34560495          | AA-3002-23       | 14-FEB-24       |

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. : ACL23320

Job No. : VC67AC0011

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**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  | ✓    | -    | 0.3                 | 0.7   |
| 4. Electrical signal tests of frequency weightings   |      |      |                     |   |
| For 10 Hz to 4 kHz                                   | ✓    | -    | 0.3                 | 0.6   |
| For > 4 kHz to 10 kHz                                | ✓    | -    | 0.3                 | 0.7   |
| For > 10 kHz to 20 kHz                               | -    | -    | -                   | 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   |

Note : Pass/Fail evaluation for each parameter,  
will be considered together from the acceptance limit and the Maximum-permitted uncertainty of measurement.

## Continuation of Calibration Certificate

Cert. No. : ACL23320

Job No. : VC67AC0011

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**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 (93.98)                           | 93.9                        | 0.0                 | ±0.3                          |

**2. Self-generated noise**

## 2.1 Normal test

| Measured Value<br>( dB ) |
|--------------------------|
| 14.6                     |

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             | 11.2                     |
| C - weight             | 17.5                     |
| Flat                   | 23.1                     |

**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) |          |          |                      |
|---------------------|--|----------|----------|----------------------|
|                     | Flat   | C-weight | A-weight | Acceptance<br>Limits |
| 125                 | 0.2  | 0.2      | 0.2      | ± 1.5                |
| 1000                | 0.0  | 0.0      | 0.0      | ± 1.0                |
| 8000                | 1.3  | 1.4      | 1.4      | ±5.0                 |



## Continuation of Calibration Certificate

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## 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     | -0.1     | ±2.0                 |
| 125                 | 0.0  | 0.0      | -0.1     | ±1.5                 |
| 250                 | 0.0  | 0.0      | -0.1     | ±1.5                 |
| 500                 | 0.0  | 0.0      | 0.0      | ±1.5                 |
| 1000                | 0.0  | 0.0      | 0.0      | ±1.0                 |
| 2000                | 0.0  | 0.0      | 0.0      | ±2.0                 |
| 4000                | 0.0  | 0.0      | 0.0      | ±3.0                 |
| 8000                | 0.0  | 0.1      | 0.1      | ±5.0                 |

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

| Frequency<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                                | 94.0                              | 0.0                         | ± 0.3                          |



## Continuation of Calibration Certificate

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## 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                         | $\pm 1.1$                      |
| 136.0                          | 136.0                       | 0.0                         | $\pm 1.1$                      |
| 135.0                          | 135.0                       | 0.0                         | $\pm 1.1$                      |
| 134.0                          | 134.0                       | 0.0                         | $\pm 1.1$                      |
| 133.0                          | 133.0                       | 0.0                         | $\pm 1.1$                      |
| 132.0                          | 132.0                       | 0.0                         | $\pm 1.1$                      |
| 131.0                          | 131.0                       | 0.0                         | $\pm 1.1$                      |
| 129.0                          | 129.0                       | 0.0                         | $\pm 1.1$                      |
| 124.0                          | 124.0                       | 0.0                         | $\pm 1.1$                      |
| 119.0                          | 119.0                       | 0.0                         | $\pm 1.1$                      |
| 114.0                          | 114.0                       | 0.0                         | $\pm 1.1$                      |
| 109.0                          | 109.0                       | 0.0                         | $\pm 1.1$                      |
| 104.0                          | 104.0                       | 0.0                         | $\pm 1.1$                      |
| 99.0                           | 99.0                        | 0.0                         | $\pm 1.1$                      |
| 94.0                           | 94.0                        | 0.0                         | $\pm 1.1$                      |
| 89.0                           | 89.0                        | 0.0                         | $\pm 1.1$                      |
| 84.0                           | 84.0                        | 0.0                         | $\pm 1.1$                      |
| 79.0                           | 79.0                        | 0.0                         | $\pm 1.1$                      |
| 74.0                           | 74.0                        | 0.0                         | $\pm 1.1$                      |
| 69.0                           | 69.0                        | 0.0                         | $\pm 1.1$                      |
| 64.0                           | 63.9                        | -0.1                        | $\pm 1.1$                      |
| 59.0                           | 59.0                        | 0.0                         | $\pm 1.1$                      |
| 54.0                           | 53.9                        | -0.1                        | $\pm 1.1$                      |
| 49.0                           | 48.9                        | -0.1                        | $\pm 1.1$                      |
| 44.0                           | 43.9                        | -0.1                        | $\pm 1.1$                      |
| 39.0                           | 38.9                        | -0.1                        | $\pm 1.1$                      |
| 34.0                           | 34.0                        | 0.0                         | $\pm 1.1$                      |
| 30.0                           | 29.9                        | -0.1                        | $\pm 1.1$                      |
| 29.0                           | 28.9                        | -0.1                        | $\pm 1.1$                      |
| 28.0                           | 27.9                        | -0.1                        | $\pm 1.1$                      |
| 27.0                           | 26.9                        | -0.1                        | $\pm 1.1$                      |
| 26.0                           | 25.9                        | -0.1                        | $\pm 1.1$                      |
| 25.0                           | 24.9                        | -0.1                        | $\pm 1.1$                      |

## Continuation of Calibration Certificate

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## 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                          | 117.0                       | 0.0                         | 1.0 ; -2.5                     |
|                   | 200                                  | 800   | 134.0                          | 134.0                       | 0.0                         | ±1.0                           |
| Slow              | 2                                    | 8     | 108.0                          | 108.0                       | 0.0                         | 1.5 ; -5.0                     |
|                   | 200                                  | 800   | 127.6                          | 127.6                       | 0.0                         | ±1.0                           |
| SEL               | 0.25                                 | 1     | 99.0                           | 98.9                        | -0.1                        | 1.5 ; -5.0                     |
|                   | 2                                    | 8     | 108.0                          | 108.0                       | 0.0                         | 1.0 ; -2.5                     |
|                   | 200                                  | 800   | 128.0                          | 128.0                       | 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, Lcpeak<br>( dB ) | Deviated<br>Value<br>( dB ) | Acceptance<br>Limits<br>( dB ) |
|--------------------------------------|--------------------------------|-------------------------------------|-----------------------------|--------------------------------|
| Continuous                           | 133.0                          | 133.1                               | 0.1                         | ±3.0                           |
| One                                  | 136.4                          | 136.1                               | -0.3                        | ±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                          | 133.1                       | 0.1                         | ±2.0                           |
| Positive half cycle                  | 135.4                          | 135.2                       | -0.2                        | ±2.0                           |
| Negative half cycle                  | 135.4                          | 135.2                       | -0.2                        | ±2.0                           |

## Continuation of Calibration Certificate

Cert. No. : ACL23320

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## 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 —————





THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0292

MTC No. EEL. BP. 83/0267

## CALIBRATION CERTIFICATE

**Submitted by** : ALS Laboratory Group (Thailand) Co.,Ltd.  
**Address** : 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok, 10250.  
**Calibrated at** : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.  
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

### Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : Rion

Model : NC-74

Serial No. : 34178121 (ID:RYG\_FS0213)

### Ambient Environment

Temperature : (23 + 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) kPa

**Standards used :**

1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
4. Digital Multimeter Agilent 34401A S/N MY44005560.
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
6. Audio Analyzer Keithley 2015-P S/N4106495.
7. Condenser Microphone B&K 4180 S/N 2889871.



**Calibration Procedure:** CP-102-04 based on IEC 60942-2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

This instrument has been calibrated against standards maintained at Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

**Date of Receipt** : 19 Feb. 2024

**Date of Calibration** : 28 Feb. 2024

1 / 2 *[Signature]*

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

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

FM.BL.MTC.002 Rev.5

#### Head Office

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Changwat Samutprakan 10280, Thailand  
Tel. (66) 0 2323 1672-80 ext. 115, 116  
(66) 08 3219 9440  
E-mail : mtc@tistr.or.th Website : www.tistr.or.th

#### Office

196 Phahonyothin Road, Ladyao, Chatuchak,  
Bangkok 10900, Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
(66) 08 1889 6827



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0292

MTC No. EEL. BP. 83/0267

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

Nominal Output of Unit Under Test = 94 dB re 20 $\mu$ Pa at 1000 Hz

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

1. Sound Pressure Level

| Standard Microphone<br>Type | Measured Sound Pressure<br>Level (dB) | Deviated value<br>(dB) | Uncertainty<br>(dB) | Tolerance limit<br>IEC60942:2003 Class 1 |
|-----------------------------|---------------------------------------|------------------------|---------------------|--|
| 1/2 inch Bruel&Kjaer 4180   | 94.01                                 | 0.01                   | $\pm 0.10$          | $\pm 0.40$ dB                            |

2. Frequency

| Standard Microphone<br>Type | Measured Frequency<br>(Hz) | Deviated value<br>(Hz) | Uncertainty<br>(Hz) | Tolerance limit<br>IEC60942:2003 Class 1 |
|-----------------------------|----------------------------|------------------------|---------------------|--|
| 1/2 inch Bruel&Kjaer 4180   | 1003.1                     | 3.1                    | $\pm 1.5$           | $\pm 1.0\%$                              |

3. Total Distortion

| Standard Microphone<br>Type | Measured Total Distortion<br>(%) | Uncertainty<br>(%) | Tolerance limit<br>IEC60942:2003 Class 1 |
|-----------------------------|----------------------------------|--------------------|--|
| 1/2 inch Bruel&Kjaer 4180   | 1.80                             | $\pm 0.50$         | $\pm 3.0\%$                              |

Note : 1. No adjustment.


2. The calibrator pressure correction was not included.

3. The microphone volume correction was included at level of 0.16 dB from manual.

Calibrated by :

  
.....  
(Mr. Weerachai Deechaiyae)

Approved by :

  
.....  
(Mr. Prawate Kluaypa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 28 Feb. 2024

Date of Issue : 29 Feb. 2024

Ref : 2011267021900719001

End of Certificate

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL. BP. 173/0167

## CALIBRATION CERTIFICATE

**Submitted by** : ALS Laboratory Group (Thailand) Co., Ltd.

**Address** : 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phattankan, Khet Suan Luang, Bangkok 10250.

**Calibrated at** : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.  
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

**Instrument Calibrated :**

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00296516 (ID: RYG\_FS0433)

Microphone : Type UC-52 No.180412

Preamplifier : Type NH-24 No.88182

**Standards used :**

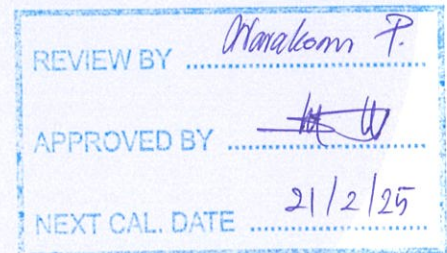
1. Band Pass Filter Wavetek 752A S/N 90010494.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

**Ambient Environment**

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

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

Ambient Pressure :  $(101.325 \pm 1.5) \text{ kPa}$



**Date of Receipt** : 24 Jan. 2024

**Date of Calibration** : 22-28 Feb. 2024

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9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

**Calibration Procedure :**

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

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

**Date of Calibration** : 22-28 Feb. 2024

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**1. Absolute Sensitivity**

| Reference Acoustic<br>Signal (dB) | Measured value (dB) |              | Deviation<br>value (dB) | Acceptance limit<br>Class 2 ( $\pm$ dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|-----------------------------------|---------------------|--------------|-------------------------|---|----------------------------|---|
|                                   | Before adjust       | After adjust |                         |   |                            |   |
| 113.96                            | 114.1               | 113.9        | -0.1                    | 1.0                                     | 0.30                       | N/A   |

**Note:** The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 124.1 dB.

**2. Self-generated noise**

**2.1 Normal test**

| Measured value<br>(dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|------------------------|----------------------------|---|
| 18.9                   | 0.10                       | N/A   |

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

| Frequency<br>Weighting | Measured value<br>(dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|------------------------|------------------------|----------------------------|---|
| A-Weight               | 12.3                   | 0.10                       | N/A   |
| C-Weight               | 17.7                   | 0.10                       | N/A   |
| Flat                   | 23.1                   | 0.10                       | N/A   |

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

| Frequency<br>(Hz) | Deviation from frequency response (dB) |          |      | Acceptance limit<br>class 2 ( $\pm$ dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|-------------------|--|----------|------|---|----------------------------|---|
|                   | A-weight                               | C-weight | Flat |   |                            |   |
| 125               | 0.0                                    | 0.2      | 0.1  | 1.5                                     | 0.45                       | 0.6   |
| 1 000             | 0.0                                    | 0.0      | 0.0  | 1.0                                     | 0.45                       | 0.6   |
| 8 000             | -0.3                                   | -0.3     | -0.3 | 5.0                                     | 0.45                       | 0.7   |

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

| Frequency<br>(Hz) | Deviation from frequency response (dB) |          |      | Acceptance limit<br>class 2 ( $\pm$ dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|-------------------|--|----------|------|---|----------------------------|---|
|                   | A-weight                               | C-weight | Flat |   |                            |   |
| 63                | -0.1                                   | 0.0      | 0.0  | 2.0                                     | 0.20                       | 0.6   |
| 125               | -0.1                                   | 0.0      | 0.0  | 1.5                                     | 0.20                       | 0.6   |
| 250               | 0.0                                    | 0.0      | 0.0  | 1.5                                     | 0.20                       | 0.6   |
| 500               | 0.0                                    | 0.0      | 0.0  | 1.5                                     | 0.20                       | 0.6   |
| 1 000             | 0.0                                    | 0.0      | 0.0  | 1.0                                     | 0.20                       | 0.6   |
| 2 000             | 0.0                                    | 0.0      | 0.0  | 2.0                                     | 0.20                       | 0.6   |
| 4 000             | 0.0                                    | 0.0      | 0.0  | 3.0                                     | 0.20                       | 0.6   |
| 8 000             | 0.0                                    | 0.0      | 0.0  | 5.0                                     | 0.20                       | 0.7   |

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5. Long-term stability

| Time  | Measured Value<br>(dB) | Deviated value<br>(dB) | Acceptance limit<br>class 2 ( $\pm$ dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|-------|------------------------|------------------------|---|----------------------------|---|
| Begin | 94.0                   | 0.0                    | 0.3                                     | 0.10                       | 0.1   |
| End   | 94.0                   |                        |   |                            |   |

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

| Frequency<br>Weighting | Measured Value<br>(dB) | Deviated value<br>(dB) | Acceptance limit<br>class 2 ( $\pm$ dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|------------------------|------------------------|------------------------|---|----------------------------|---|
| A-weight               | 94.0                   | 0.0                    | 0.2                                     | 0.20                       | 0.2   |
| C-weight               | 94.0                   | 0.0                    | 0.2                                     | 0.20                       | 0.2   |
| Flat                   | 94.1                   | 0.1                    | 0.2                                     | 0.20                       | 0.2   |

6.2 Time weightings at 1 kHz

| Frequency<br>Weighting | Measured Value<br>(dB) | Deviated value<br>(dB) | Acceptance limit<br>class 2 ( $\pm$ dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|------------------------|------------------------|------------------------|---|----------------------------|---|
| Fast                   | 94.0                   | 0.0                    | 0.1                                     | 0.20                       | 0.2   |
| Slow                   | 94.0                   | 0.0                    | 0.1                                     | 0.20                       | 0.2   |
| Leq                    | 94.0                   | 0.0                    | 0.1                                     | 0.20                       | 0.2   |

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7. Level linearity on the reference level range

| Anticipated value (dB) | Measured Value (dB) | Deviated value (dB) | Acceptance limit class 2 ( $\pm$ dB) | Uncertainty ( $\pm$ dB) | Maximum-permitted uncertainty of measurement ( $\pm$ dB) |
|------------------------|---------------------|---------------------|--------------------------------------|-------------------------|--|
| 137                    | 137.1               | 0.1                 | 1.1                                  | 0.30                    | 0.3  |
| 136                    | 136.1               | 0.1                 | 1.1                                  | 0.30                    | 0.3  |
| 135                    | 135.1               | 0.1                 | 1.1                                  | 0.30                    | 0.3  |
| 133                    | 133.1               | 0.1                 | 1.1                                  | 0.30                    | 0.3  |
| 132                    | 132.1               | 0.1                 | 1.1                                  | 0.30                    | 0.3  |
| 131                    | 131.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 130                    | 130.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 129                    | 129.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 124                    | 124.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 119                    | 119.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 114                    | 114.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 109                    | 109.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 104                    | 104.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 99                     | 99.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 94                     | 94.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 89                     | 89.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 84                     | 84.1                | 0.1                 | 1.1                                  | 0.30                    | 0.3  |
| 79                     | 79.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 74                     | 74.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 69                     | 69.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 64                     | 64.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 59                     | 59.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |

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7. Level linearity on the reference level range (cont.)

| Anticipated value (dB) | Measured Value (dB) | Deviated value (dB) | Acceptance limit class 2 ( $\pm$ dB) | Uncertainty ( $\pm$ dB) | Maximum-permitted uncertainty of measurement ( $\pm$ dB) |
|------------------------|---------------------|---------------------|--------------------------------------|-------------------------|--|
| 54                     | 54.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 49                     | 48.9                | -0.1                | 1.1                                  | 0.30                    | 0.3  |
| 44                     | 44.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 39                     | 38.9                | -0.1                | 1.1                                  | 0.30                    | 0.3  |
| 34                     | 33.9                | -0.1                | 1.1                                  | 0.30                    | 0.3  |
| 29                     | 28.8                | -0.2                | 1.1                                  | 0.30                    | 0.3  |
| 28                     | 27.8                | -0.2                | 1.1                                  | 0.30                    | 0.3  |
| 27                     | 26.9                | -0.1                | 1.1                                  | 0.30                    | 0.3  |
| 26                     | 25.9                | -0.1                | 1.1                                  | 0.30                    | 0.3  |
| 25                     | 24.8                | -0.2                | 1.1                                  | 0.30                    | 0.3  |

8. Level linearity including the level range control

At reference sound level on the reference level range

| Range  | Anticipated value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limit class 2 ( $\pm$ dB) | Uncertainty ( $\pm$ dB) | Maximum-permitted uncertainty of measurement ( $\pm$ dB) |
|--------|------------------------|---------------------|---------------------|--------------------------------------|-------------------------|--|
| 30-130 | 94.0                   | 94.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |

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

At reference level at 5 dB greater than the under-range on a level range

| Range  | Anticipated value<br>(dB) | Measured value<br>(dB) | Deviated<br>value (dB) | Acceptance limit<br>class 2 ( $\pm$ dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|--------|---------------------------|------------------------|------------------------|---|----------------------------|---|
| 30-130 | 25                        | 25.0                   | 0.0                    | 1.1                                     | 0.30                       | 0.3   |

### 9. Tone burst response

| Time<br>Weighting | Toneburst<br>Duration, Tb (ms) | Measured value<br>(dB) | Deviated<br>value (dB) | Acceptance limit<br>class 2 ( $\pm$ dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|-------------------|--------------------------------|------------------------|------------------------|---|----------------------------|---|
| Fast              | 200                            | 126.0                  | 0.0                    | $\pm 1.0$                               | 0.20                       | 0.3   |
|                   | 2                              | 108.9                  | -0.1                   | +1.0; -2.5                              | 0.20                       | 0.3   |
|                   | 0.25                           | 100.0                  | 0.0                    | +1.5; -5.0                              | 0.20                       | 0.3   |
| Slow              | 200                            | 119.5                  | -0.1                   | $\pm 1.0$                               | 0.20                       | 0.3   |
|                   | 2                              | 100.0                  | 0.0                    | +1.0; -5.0                              | 0.20                       | 0.3   |

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### 10. Peak C sound level

| Number of cycles in test signal | Anticipated value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limit class 2 ( $\pm$ dB) | Uncertainty ( $\pm$ dB) | Maximum-permitted uncertainty of measurement ( $\pm$ dB) |
|---------------------------------|------------------------|---------------------|---------------------|--------------------------------------|-------------------------|--|
| Complete cycle                  | 125.4                  | 125.5               | 0.1                 | 3.0                                  | 0.20                    | 0.35   |
| Positive half cycle             | 124.4                  | 124.1               | -0.3                | 2.0                                  | 0.20                    | 0.35   |
| Negative half cycle             | 124.4                  | 124.1               | -0.3                | 2.0                                  | 0.20                    | 0.35   |

### 11. Overload indication

| Measured value (dB)     |                         | Deviated value (dB) | Acceptance limit class 2 ( $\pm$ dB) | Uncertainty ( $\pm$ dB) | Maximum-permitted uncertainty of measurement ( $\pm$ dB) |
|-------------------------|-------------------------|---------------------|--------------------------------------|-------------------------|--|
| Positive one-half cycle | Negative one-half cycle |                     |                                      |                         |  |
| 135.4                   | 135.4                   | 0.0                 | 1.5                                  | 0.55                    | 0.25   |

### 12. High-level stability

| Time  | Measured value (dB) | Deviated value (dB) | Acceptance limit class 2 ( $\pm$ dB) | Uncertainty ( $\pm$ dB) | Maximum-permitted uncertainty of measurement ( $\pm$ dB) |
|-------|---------------------|---------------------|--------------------------------------|-------------------------|--|
| Begin | 129.0               | 0.0                 | 0.3                                  | 0.10                    | 0.1  |
| End   | 129.0               |                     |                                      |                         |  |

Calibrated by :



(Mr. Pannasit Phasingsri)

Approved by :



(Mr. Prawate Kluaypa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 22-28 Feb. 2024

Date of Issue : 29 Feb. 2024

Ref : 2011267012400347003

End of Certificate

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL. BP. 174/0167

## CALIBRATION CERTIFICATE

**Submitted by** : ALS Laboratory Group (Thailand) Co., Ltd.

**Address** : 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phattankan, Khet Suan Luang, Bangkok 10250.

**Calibrated at** : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.  
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

**Instrument Calibrated :**

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00296517 (ID: RYG\_FS0434)

Microphone : Type UC-52 No.135220

Preamplifier : Type NH-24 No.87527

**Standards used :**

1. Band Pass Filter Wavetek 752A S/N 90010494.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

**Ambient Environment**

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

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

Ambient Pressure :  $(101.325 \pm 1.5) \text{ kPa}$

|                |             |
|----------------|-------------|
| REVIEW BY      | Manakorn P. |
| APPROVED BY    | [Signature] |
| NEXT CAL. DATE | 21/2/25     |

**Date of Receipt** : 24 Jan. 2024

**Date of Calibration** : 22-28 Feb. 2024

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Request No. 21-67/0232

MTC No. EEL. BP. 174/0167

9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

**Calibration Procedure :**

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

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

**Date of Calibration** : 22-28 Feb. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL. BP. 174/0167

1. Absolute Sensitivity

| Reference Acoustic<br>Signal (dB) | Measured value (dB) |              | Deviation<br>value (dB) | Acceptance limit<br>Class 2 ( $\pm$ dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|-----------------------------------|---------------------|--------------|-------------------------|---|----------------------------|---|
|                                   | Before adjust       | After adjust |                         |   |                            |   |
| 113.96                            | 114.3               | 113.9        | -0.1                    | 1.0                                     | 0.30                       | N/A   |

**Note:** The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 123.5 dB.

2. Self-generated noise

2.1 Normal test

| Measured value<br>(dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|------------------------|----------------------------|---|
| 19.7                   | 0.10                       | N/A   |

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

| Frequency<br>Weighting | Measured value<br>(dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|------------------------|------------------------|----------------------------|---|
| A-Weight               | 14.1                   | 0.10                       | N/A   |
| C-Weight               | 19.6                   | 0.10                       | N/A   |
| Flat                   | 24.9                   | 0.10                       | N/A   |

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### 3. Acoustical signal test of frequency weightings

| Frequency<br>(Hz) | Deviation from frequency response (dB) |          |         | Acceptance limit<br>class 2 (±dB) | Uncertainty<br>(±dB) | Maximum-permitted uncertainty<br>of measurement (±dB) |
|-------------------|--|----------|---------|-----------------------------------|----------------------|---|
|                   | A-weight                               | C-weight | Flat    |                                   |                      |   |
| 125               | #DIV/0!                                | #DIV/0!  | #DIV/0! | 1.5                               | #DIV/0!              | 0.6   |
| 1 000             | #DIV/0!                                | #DIV/0!  | #DIV/0! | 1.0                               | #DIV/0!              | 0.6   |
| 8 000             | #DIV/0!                                | #DIV/0!  | #DIV/0! | 5.0                               | #DIV/0!              | 0.7   |

### 4. Electrical signal test of frequency weightings

| Frequency<br>(Hz) | Deviation from frequency response (dB) |          |      | Acceptance limit<br>class 2 (±dB) | Uncertainty<br>(±dB) | Maximum-permitted uncertainty<br>of measurement (±dB) |
|-------------------|--|----------|------|-----------------------------------|----------------------|---|
|                   | A-weight                               | C-weight | Flat |                                   |                      |   |
| 63                | -0.1                                   | -0.1     | -0.1 | 2.0                               | 0.20                 | 0.6   |
| 125               | -0.1                                   | 0.0      | 0.0  | 1.5                               | 0.20                 | 0.6   |
| 250               | -0.1                                   | 0.0      | 0.0  | 1.5                               | 0.20                 | 0.6   |
| 500               | -0.1                                   | 0.0      | 0.0  | 1.5                               | 0.20                 | 0.6   |
| 1 000             | 0.0                                    | 0.0      | 0.0  | 1.0                               | 0.20                 | 0.6   |
| 2 000             | 0.0                                    | 0.0      | -0.1 | 2.0                               | 0.20                 | 0.6   |
| 4 000             | 0.0                                    | 0.0      | 0.0  | 3.0                               | 0.20                 | 0.6   |
| 8 000             | 0.0                                    | 0.0      | 0.0  | 5.0                               | 0.20                 | 0.7   |

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### 5. Long-term stability

| Time  | Measured Value<br>(dB) | Deviated value<br>(dB) | Acceptance limit<br>class 2 ( $\pm$ dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|-------|------------------------|------------------------|---|----------------------------|---|
| Begin | 94.0                   | 0.0                    | 0.3                                     | 0.10                       | 0.1   |
| End   | 94.0                   |                        |   |                            |   |

### 6. Frequency and time weightings at 1 kHz

#### 6.1 Frequency weightings at 1 kHz

| Frequency<br>Weighting | Measured Value<br>(dB) | Deviated value<br>(dB) | Acceptance limit<br>class 2 ( $\pm$ dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|------------------------|------------------------|------------------------|---|----------------------------|---|
| A-weight               | 94.0                   | 0.0                    | 0.2                                     | 0.20                       | 0.2   |
| C-weight               | 94.0                   | 0.0                    | 0.2                                     | 0.20                       | 0.2   |
| Flat                   | 94.1                   | 0.1                    | 0.2                                     | 0.20                       | 0.2   |

#### 6.2 Time weightings at 1 kHz

| Frequency<br>Weighting | Measured Value<br>(dB) | Deviated value<br>(dB) | Acceptance limit<br>class 2 ( $\pm$ dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|------------------------|------------------------|------------------------|---|----------------------------|---|
| Fast                   | 94.0                   | 0.0                    | 0.1                                     | 0.20                       | 0.2   |
| Slow                   | 94.0                   | 0.0                    | 0.1                                     | 0.20                       | 0.2   |
| Leq                    | 94.0                   | 0.0                    | 0.1                                     | 0.20                       | 0.2   |

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7. Level linearity on the reference level range

| Anticipated value (dB) | Measured Value (dB) | Deviated value (dB) | Acceptance limit class 2 ( $\pm$ dB) | Uncertainty ( $\pm$ dB) | Maximum-permitted uncertainty of measurement ( $\pm$ dB) |
|------------------------|---------------------|---------------------|--------------------------------------|-------------------------|--|
| 137                    | 137.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 136                    | 136.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 135                    | 135.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 133                    | 133.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 132                    | 132.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 131                    | 131.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 130                    | 130.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 129                    | 129.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 124                    | 124.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 119                    | 119.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 114                    | 114.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 109                    | 109.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 104                    | 104.0               | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 99                     | 99.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 94                     | 94.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 89                     | 89.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 84                     | 84.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 79                     | 79.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 74                     | 74.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 69                     | 69.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 64                     | 63.9                | -0.1                | 1.1                                  | 0.30                    | 0.3  |
| 59                     | 59.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |

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7. Level linearity on the reference level range (cont.)

| Anticipated value (dB) | Measured Value (dB) | Deviated value (dB) | Acceptance limit class 2 ( $\pm$ dB) | Uncertainty ( $\pm$ dB) | Maximum-permitted uncertainty of measurement ( $\pm$ dB) |
|------------------------|---------------------|---------------------|--------------------------------------|-------------------------|--|
| 54                     | 53.9                | -0.1                | 1.1                                  | 0.30                    | 0.3  |
| 49                     | 49.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 44                     | 44.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 39                     | 38.9                | -0.1                | 1.1                                  | 0.30                    | 0.3  |
| 34                     | 33.9                | -0.1                | 1.1                                  | 0.30                    | 0.3  |
| 29                     | 29.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |
| 28                     | 27.9                | -0.1                | 1.1                                  | 0.30                    | 0.3  |
| 27                     | 26.9                | -0.1                | 1.1                                  | 0.30                    | 0.3  |
| 26                     | 25.9                | -0.1                | 1.1                                  | 0.30                    | 0.3  |
| 25                     | 24.9                | -0.1                | 1.1                                  | 0.30                    | 0.3  |

8. Level linearity including the level range control

At reference sound level on the reference level range

| Range  | Anticipated value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limit class 2 ( $\pm$ dB) | Uncertainty ( $\pm$ dB) | Maximum-permitted uncertainty of measurement ( $\pm$ dB) |
|--------|------------------------|---------------------|---------------------|--------------------------------------|-------------------------|--|
| 30-130 | 94.0                   | 94.0                | 0.0                 | 1.1                                  | 0.30                    | 0.3  |

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

At reference level at 5 dB greater than the under-range on a level range

| Range  | Anticipated value<br>(dB) | Measured value<br>(dB) | Deviated<br>value (dB) | Acceptance limit<br>class 2 ( $\pm$ dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|--------|---------------------------|------------------------|------------------------|---|----------------------------|---|
| 30-130 | 25                        | 25.0                   | 0.0                    | 1.1                                     | 0.30                       | 0.3   |

### 9. Tone burst response

| Time<br>Weighting | Toneburst<br>Duration, Tb (ms) | Measured value<br>(dB) | Deviated<br>value (dB) | Acceptance limit<br>class 2 ( $\pm$ dB) | Uncertainty<br>( $\pm$ dB) | Maximum-permitted uncertainty<br>of measurement ( $\pm$ dB) |
|-------------------|--------------------------------|------------------------|------------------------|---|----------------------------|---|
| Fast              | 200                            | 126.0                  | 0.0                    | $\pm 1.0$                               | 0.20                       | 0.3   |
|                   | 2                              | 108.9                  | -0.1                   | +1.0; -2.5                              | 0.20                       | 0.3   |
|                   | 0.25                           | 100.0                  | 0.0                    | +1.5; -5.0                              | 0.20                       | 0.3   |
| Slow              | 200                            | 119.5                  | -0.1                   | $\pm 1.0$                               | 0.20                       | 0.3   |
|                   | 2                              | 100.0                  | 0.0                    | +1.0; -5.0                              | 0.20                       | 0.3   |

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL. BP. 174/0167

### 10. Peak C sound level

| Number of cycles in test signal | Anticipated value (dB) | Measured value (dB) | Deviated value (dB) | Acceptance limit class 2 ( $\pm$ dB) | Uncertainty ( $\pm$ dB) | Maximum-permitted uncertainty of measurement ( $\pm$ dB) |
|---------------------------------|------------------------|---------------------|---------------------|--------------------------------------|-------------------------|--|
| Complete cycle                  | 125.4                  | 125.5               | 0.1                 | 3.0                                  | 0.20                    | 0.35   |
| Positive half cycle             | 124.4                  | 124.1               | -0.3                | 2.0                                  | 0.20                    | 0.35   |
| Negative half cycle             | 124.4                  | 124.1               | -0.3                | 2.0                                  | 0.20                    | 0.35   |


### 11. Overload indication

| Measured value (dB)     |                         | Deviated value (dB) | Acceptance limit class 2 ( $\pm$ dB) | Uncertainty ( $\pm$ dB) | Maximum-permitted uncertainty of measurement ( $\pm$ dB) |
|-------------------------|-------------------------|---------------------|--------------------------------------|-------------------------|--|
| Positive one-half cycle | Negative one-half cycle |                     |                                      |                         |  |
| 135.4                   | 135.4                   | 0.0                 | 1.5                                  | 0.55                    | 0.25   |

### 12. High-level stability

| Time  | Measured value (dB) | Deviated value (dB) | Acceptance limit class 2 ( $\pm$ dB) | Uncertainty ( $\pm$ dB) | Maximum-permitted uncertainty of measurement ( $\pm$ dB) |
|-------|---------------------|---------------------|--------------------------------------|-------------------------|--|
| Begin | 129.0               | 0.0                 | 0.3                                  | 0.10                    | 0.1  |
| End   | 129.0               |                     |                                      |                         |  |

Calibrated by :



(Mr. Pannasit Phasingsri)

Approved by :



Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 22-28 Feb. 2024

Date of Issue : 29 Feb. 2024

Ref : 2011267012400347004

End of Certificate

9 / 9

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

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

FM.BL.MTC.002 Rev.4

#### Head Office

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Changwat Pathumthani 12120, Thailand

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#### Office/Laboratory

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Amphoe Muang, Changwat Samutprakan 10280, Thailand

Tel. (66) 0 2323 1672-80 ext. 115, 116

Fax. (66) 0 2323 9165

E-mail : mtc@tistr.or.th

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Thailand

Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217

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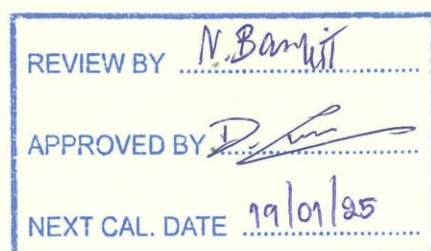


Cert.No.: 24CH96

Page.: 1 of 3

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : SevenCompact S220  
Serial No. : C104059460  
ID No. : RYG\_EN0183  
Condition As-Received: Used Item  
Received Date : 18 January 2024  
Calibration Date : 19 January 2024  
Reference : 2401-0579DSC-2  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
616/10 Moo 5, T.Maenam Khu,  
A.Pluakdaeng, Rayong 21140, Thailand



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

Calibrated by : Warakorn Lerngatrakul

Approved by :

Approved Signatory

- (✓) Saithip Meangmai  
( ) Warakorn Lerngatrakul  
( ) Ponpan Paipim

Issue Date : 24 January 2024

The Uncertainties are for a confidence probability of approximately 95%

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

A 0062854





Cert.No.: 24CH96

Page.: 2 of 3

**Condition of this calibration result**

## 1. Reference Standard Instrument

| <u>Instrument</u>              | <u>Serial No.</u> | <u>ID No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|--------------------------------|-------------------|---------------|------------------|-----------------|
| 1) Document Process Calibrator | 54030049          | 130RC116      | 23E2802          | 27 Aug 2024     |
| 2) Ref. Standard Thermometer   | 4982054           | 110RC044      | 23I908           | 26 July 2024    |

This certification is traceable to the International System of Unit maintained through:-

- Technology Promotion Association (Thailand-Japan)

2. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd.,  
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

| <u>Buffer Solution</u> | <u>Manufacturer</u> | <u>Lot No.</u> | <u>Exp. date</u> |
|------------------------|---------------------|----------------|------------------|
| pH 4.008               | CPA chem            | 940102         | 27 Nov 2025      |
| pH 6.986               | CPA chem            | 940104         | 02 Nov 2024      |
| pH 9.997               | CPA chem            | 940106         | 02 Nov 2024      |

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

**Calibration Results****Function : mV Measurement****Performing standard curve by Fluke at pH (4,7,10)**

| Unit Under Calibration       | Nominal Value | Standard Voltage Input | Actual Reading |        | Uncertainty of Measurement<br>( $\pm$ mV) | Coverage factor<br><i>k</i> |
|------------------------------|---------------|------------------------|----------------|--------|---|-----------------------------|
|                              | pH            | mV                     | mV             | pH     |   |                             |
| pH Meter<br>S/N.: C104059460 | 4.000         | 177.48                 | 177.4          | 4.000  | 0.058                                     | 2.00                        |
|                              | 7.000         | 0.00                   | 0.0            | 7.000  | 0.058                                     | 2.00                        |
|                              | 10.000        | -177.48                | -177.5         | 10.000 | 0.058                                     | 2.00                        |

Santhip



Cert.No.: 24CH96

Page.: 3 of 3

**Calibration Results****Function : pH Measurement**

Performing three buffers standard curve by using buffer nominal pH (4.01,7.00,10.01)

| Unit Under Calibration        | Standard pH Buffer Solution | Actual pH Reading | Actual mV Reading (mV) | Uncertainty of pH Measurement ( $\pm$ ) | Coverage factor $k$ |
|-------------------------------|-----------------------------|-------------------|------------------------|---|---------------------|
| pH Electrode<br>S/N.: 3225367 | 4.008                       | 4.013             | 176.0                  | 0.0054                                  | 2.07                |
|                               | 6.986                       | 6.983             | 2.2                    | 0.0084                                  | 2.00                |
|                               | 9.997                       | 9.996             | -174.1                 | 0.0065                                  | 2.00                |

**Function : Temperature Measurement****( \* ) Without adjustment**

This equipment was connected with Temperature Probe;

- Model : InLab®Expert Pro-ISM

- Serial No. : 3225367

Dimension of probe

- Length : 120 mm.

- Diameter : 12 mm.

- Immersion Depth : 100 mm.

| Calibration Point (°C) | Standard Temperature (°C) | UUC* Reading (°C) | Error (°C) | Uncertainty of measurement ( $\pm$ °C) | Coverage factor $k$ |
|------------------------|---------------------------|-------------------|------------|--|---------------------|
| 25.0                   | 25.001                    | 25.2              | 0.199      | 0.13                                   | 2.00                |

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

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Santhip





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## Certificate of Calibration

Certificate No. : 24E289

Page : 1 of 2

Equipment : pH Meter  
Manufacturer: Mettler Toledo  
Model : SevenCompact S220  
Serial No.: C104059460  
ID No.: RYG\_EN0183  
Condition As-Received: Used Item  
Received Date: 18 January 2024  
Calibration Date: 23 January 2024

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

Reference: 2401-0579DSC  
Ambient Temperature: ( 23  $\pm$  2 ) °C  
Relative Humidity: ( 50  $\pm$  10 ) %  
Submitted by: ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,  
Rayong 21140, Thailand

Procedure used: Calibration were conducted using calibration procedure No. CP-E17 According to EURAMET cg-15.

### Condition of this result of calibration

1.Reference standards instruments :

| <u>Instrument</u>           | <u>Model</u> | <u>Serial No.</u> | <u>Certificate No.</u> | <u>Due Date</u> |
|-----------------------------|--------------|-------------------|------------------------|-----------------|
| 1) Multi-Product Calibrator | 5500A        | 6315011           | E2U2300035             | 29 May 2024     |

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

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

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

-NA Caltechnologies Co.,Ltd., ANAB Accredited No. Calibration AC-2658

Calibrated by : Wutchareeporn Wongchutikrane  
Issue Date : 24 January 2024

Approved Signatory : \_\_\_\_\_

[ ] Phalinee Prabpaipal

[x] Nuntawat Khamchai

[ ] Pongsagorn Boonyaporn

B 0333296



Cert. No.: 24E289

Page.: 2 of 2

**Result of calibration :-** (\*) Without adjustment ( ) After adjustment

|                  |                        |                     |               |                    |    |
|------------------|------------------------|---------------------|---------------|--------------------|----|
| <b>Function:</b> | DC voltage measurement |                     | <b>Range:</b> | 2000               | mV |
|                  | <u>Standard Value</u>  | <u>UUC* Reading</u> | <u>Error</u>  | <u>Uncertainty</u> |    |
|                  | ( mV )                 | ( mV )              | ( mV )        | ( $\pm$ $\mu$ V )  |    |
|                  | -200.0000              | -200.0              | 0.0           | 68                 |    |
|                  | -150.0000              | -150.0              | 0.0           | 65                 |    |
|                  | -100.0000              | -100.0              | 0.0           | 63                 |    |
|                  | -50.0000               | -50.0               | 0.0           | 61                 |    |
|                  | 0.0000                 | 0.0                 | 0.0           | 58                 |    |
|                  | 50.0000                | 50.0                | 0.0           | 61                 |    |
|                  | 100.0000               | 99.9                | -0.1          | 63                 |    |
|                  | 150.0000               | 149.9               | -0.1          | 65                 |    |
|                  | 200.0000               | 199.9               | -0.1          | 68                 |    |

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

**UUC\* = Unit Under Calibration.**

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Cert.No.: 23TW168

Page.: 1 of 2

## Certificate of Testing

Equipment : DO Meter  
Manufacturer : YSI  
Model : 5000-115V  
Serial No. : 15E102796  
ID No. : RYG\_EN0032  
Received Date : 21 July 2023  
Test Date : 24 July 2023  
Reference : 2307-0713DSC-1  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.  
Rayong Branch  
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,  
Rayong 21140, Thailand

|                |                    |
|----------------|--------------------|
| REVIEW BY      | <i>N. Bamait</i>   |
| APPROVED BY    | <i>D. Sirithan</i> |
| NEXT CAL. DATE | 24/01/25           |

Laboratory Condition : Temperature (  $25 \pm 5$  ) °C  
Humidity (  $50 \pm 20$  ) %  
Test Procedure : In - house method : CP-CH9  
by Comparison Technique with Azide Modification Method

Tested by : Walalak Sirithean

Approved by : *Saithip*  
Approved Signatory

- ( ) Malee Butkruea  
(☒) Saithip Meangmai  
( ) Warakorn Lerngagtrakul

Issue Date : 26 July 2023



Cert.No.: 23TW168

Page.: 2 of 2

**Condition of this result of calibration**

1. Reference Standard Instruments :

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

| <u>Instruments</u> | <u>Serial No.</u> | <u>ID No.</u> | <u>Certificate No.</u> | <u>Due Date</u> |
|--------------------|-------------------|---------------|------------------------|-----------------|
| 1) Burette         | -                 | 130BU10       | 23CG1172               | 22 Mar 2025     |
| 2) Balance         | 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.: 15E100464

| <b>Titration Method<br/>(Azide Modification Method)</b><br>(mg/L) | <b>DO Meter<br/>Reading</b><br>(mg/L) | <b>Standard Deviation</b><br>(mg/L) |
|---|---------------------------------------|-------------------------------------|
| 8.18  | 8.17                                  | 0.0055                              |

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

-o0o-

*Saitthip*

a 1172155





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Cert. No.: 23LM125

Page.: 1 of 2

## Certificate of Calibration

**Equipment :** DO Meter with Sensor

**Manufacturer :** YSI

**Model :** 5000-115V

**Serial No. :** 15E102796

**ID No. :** RYG\_EN0032

**Submitted by :** ALS Laboratory Group (Thailand) Co.,Ltd.  
Rayong Branch  
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng,  
Rayong 21140 Thailand

**Location :** TPA On Site Calibration Laboratory

**Received Order :** 25 July 2023


**Calibrated Date :** 27 July 2023

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

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

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

**Calibrated by :** Preecha Hlahib

**Approved by :**   
Approved Signatory

( ) Pornthippa Tameyakul  
( ) Malee Butkruea  
☒ Suwit Imjai

**Issue Date :** 31 July 2023

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 0053616



Equipment : DO Meter with Sensor  
Condition As-Received : Used Item  
Reference : 2307-0713DSC-2

Cert. No.: 23LM125  
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>Serial No.</u> | <u>Cert. No.</u> | <u>Traceable</u> | <u>Due Date</u> |
|------------------------|-------------------|------------------|------------------|-----------------|
| 1) Digital Thermometer | 2188080           | 2211285          | TPA              | 21 Oct 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.

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

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

**Function :** Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 1228475367

| <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                              | 100                              | 20.011                                | 19.91                         | -0.101 *               | 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 %.

-o0o-

*Yen!*





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



Cert. No.: 23TM962

Page : 1 of 3

## Certificate of Calibration

**Equipment :** Low Temp. Incubator

**Manufacturer :** Memmert

**Model :** IPP750

**Serial No. :** V818.0084

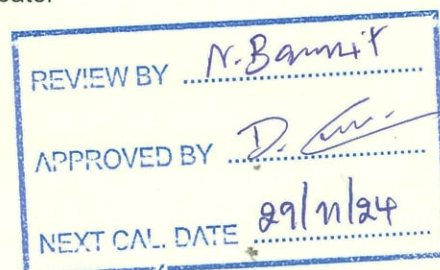
**ID No. :** RYG\_EN0154

**Submitted by :** ALS Laboratory Group (Thailand) Co.,Ltd.  
(Rayong Branch)  
616/10 Moo 5 T. Maenam Khu,  
A. Pluakdaeng, Rayong 21140 Thailand

**Location :** BOD Room

**Received Order :** 29 May 2023  
**Calibration Date :** 29 May 2023  
**Ambient Temperature :** ( 26 ± 10 ) °C  
**Relative Humidity :** ( 50 ± 30 ) %

**Calibrated by :** Man Pattanapongpaiboon



**Approved by :**

Approved Signatory

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

**Issue Date :**

7 June 2023

**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 0054967



Equipment : Low Temp. Incubator  
Condition As-Received : Used Item  
Reference : 2305-0898OC-2

Cert. No.: 23TM962

Page : 2 of 3

**Procedure Used :-**

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:-

| <u>Instrument</u>    | <u>Model</u> | <u>Serial No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|----------------------|--------------|-------------------|------------------|-----------------|
| 1 ) Data Acquisition | 34972A       | MY57013711        | 22LM93           | 02 Jul 2023     |

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

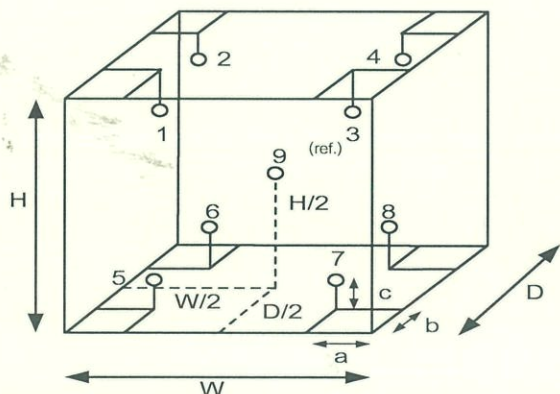
3. This certification is traceable to the International System of Unit.

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

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Close

| Environment during calibration |           |          |
|--------------------------------|-----------|----------|
|                                | Beginning | Finished |
| Temp. ( °C )                   | 23        | 23       |
| REL.Humid. ( % )               | 54        | 56       |
| AC Supply ( Volt )             | 223       | 222      |



| Position : | Ref. Std. ID No.: |
|------------|-------------------|
| 1          | 18-18RTD-01       |
| 2          | 18-18RTD-02       |
| 3          | 18-18RTD-03       |
| 4          | 18-18RTD-04       |
| 5          | 18-18RTD-05       |
| 6          | 18-18RTD-10       |
| 7          | 18-18RTD-07       |
| 8          | 22-18RTD-08       |
| 9 (ref.)   | 18-18RTD-09       |

**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>

*Signature*

a 1165130





Equipment : Low Temp. Incubator  
Condition As-Received : Used Item  
Reference : 2305-0898OC-2  
**Result of Calibration :-** ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 23TM962

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 ) | Coverage Factor<br><i>k</i> |
|-----------------------------|------------------------|------------------------|-----------------------------------|----------------------------------|-----------------------------|-----------------------------|
| 20.0                        | 20.0                   | 20.0                   | 0.019                             | 0.72                             | 1.0                         | 2                           |

| Calibration<br>Point<br>( °C ) | Measured Temperature ( °C ) |        |        |        |        |        |        |        |          | Uncertainty<br>( ±°C ) |
|--------------------------------|-----------------------------|--------|--------|--------|--------|--------|--------|--------|----------|------------------------|
|                                | Position                    |        |        |        |        |        |        |        |          |                        |
|                                | 1                           | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9 (ref.) |                        |
| 20.0                           | 19.547                      | 19.780 | 19.487 | 19.529 | 19.408 | 20.139 | 20.112 | 20.406 | 20.116   | 0.30                   |

**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

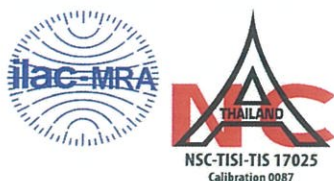
**Note** : The reported uncertainty of measurement was included stability and excluded uniformity .

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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*Sevrit*





# Certificate of Calibration

**Equipment:** SPECTROPHOTOMETER  
**Model:** DR6000  
**Serial No. (or ID.):** 1627845 (RYG\_EN0037)  
**Manufacturer:** HACH  
**Condition:** In Condition

**Certificate No.:** C06230441  
**Issued Date:** 19 September 2023  
**Job No.:** WO-00005382  
**Page:** 1 of 3

**Customer:** ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
616/10 Moo 5 T.Maenam Khu,  
A.Pluakdaeng, Rayong 21140, Thailand.

**Environment Condition:**


|             |      |     |   |     |
|-------------|------|-----|---|-----|
| Temperature | 23.9 | °C  | ± | 0.2 |
| Humidity    | 65.3 | %RH | ± | 1.4 |


|                |                    |
|----------------|--------------------|
| REVIEW BY      | <i>N. Banerjee</i> |
| APPROVED BY    | <i>D. Nitinun</i>  |
| NEXT CAL. DATE | 18/3/25            |

**Calibration Place:** ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) (Wet Chemistry)  
616/10 Moo 5 T.Maenam Khu,  
A.Pluakdaeng, Rayong 21140, Thailand.

**Calibration By:** Mr.Nattapat Rungrueang  
**Calibration Date:** 18 September 2023  
**The Method used:** In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04  
**Traceability:** This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Starna Scientific Limited.

The standard for Wavelength Certificate No. 111583 and 111584  
The standard for Photometric Certificate No. 9114984 and 111588  
The standard for Stray light Certificate No. 111586 and 111585  
The standard for Spectral resolution Certificate No. 111587

  
(Mr. Nattapat Rungrueang)  
Person in charge

  
(Mr. Nitinun Srihawan)  
Authorized signatory

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

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

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

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด  
DKSH Technology Limited  
2533 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260  
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260  
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

## Calibration Results:

### Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 2 nm and UUC at 2 nm

| Standard Wavelength | Unit Under Calibration | Correction | Uncertainty |
|---------------------|------------------------|------------|-------------|
| 418.61              | 418.3                  | 0.31       | 0.13        |
| 536.66              | 536.6                  | 0.06       | 0.13        |
| 637.98              | 638.3                  | -0.32      | 0.13        |
| 748.48              | 748.7                  | -0.22      | 0.13        |
| 807.03              | 807.4                  | -0.37      | 0.13        |

Photometric Accuracy (Absorbance)

| Wavelength | Standard absorbance | Unit Under Calibration | Correction | Uncertainty |
|------------|---------------------|------------------------|------------|-------------|
| 420 nm     | 0.0000              | 0.000                  | 0.0000     | 0.0045      |
|            | 0.2930              | 0.289                  | 0.0040     | 0.0045      |
|            | 0.5168              | 0.519                  | -0.0022    | 0.0045      |
|            | 1.0298              | 1.029                  | 0.0008     | 0.0045      |
| 440 nm     | 0.0000              | 0.000                  | 0.0000     | 0.0045      |
|            | 0.2867              | 0.283                  | 0.0037     | 0.0045      |
|            | 0.5073              | 0.509                  | -0.0017    | 0.0045      |
|            | 1.0083              | 1.007                  | 0.0013     | 0.0045      |
| 465 nm     | 0.0000              | 0.000                  | 0.0000     | 0.0045      |
|            | 0.2516              | 0.250                  | 0.0016     | 0.0045      |
|            | 0.4595              | 0.462                  | -0.0025    | 0.0045      |
|            | 0.9334              | 0.933                  | 0.0004     | 0.0045      |
| 546.1 nm   | 0.0000              | 0.000                  | 0.0000     | 0.0045      |
|            | 0.2461              | 0.245                  | 0.0011     | 0.0045      |
|            | 0.4652              | 0.466                  | -0.0008    | 0.0045      |
|            | 0.9468              | 0.946                  | 0.0008     | 0.0045      |
| 590 nm     | 0.0000              | 0.000                  | 0.0000     | 0.0045      |
|            | 0.2594              | 0.259                  | 0.0004     | 0.0045      |
|            | 0.5040              | 0.505                  | -0.0010    | 0.0045      |
|            | 1.0032              | 1.002                  | 0.0012     | 0.0045      |
| 635 nm     | 0.0000              | 0.000                  | 0.0000     | 0.0045      |
|            | 0.2579              | 0.257                  | 0.0009     | 0.0045      |
|            | 0.4971              | 0.497                  | 0.0001     | 0.0045      |
|            | 0.9720              | 0.971                  | 0.0010     | 0.0045      |

## Calibration Results:

### Without Adjustment

#### Photometric Accuracy (Absorbance)

| Wavelength | Standard absorbance | Unit Under Calibration | Correction | Uncertainty |
|------------|---------------------|------------------------|------------|-------------|
| 235 nm     | 0.0000              | 0.000                  | 0.0000     | 0.0080      |
|            | 0.7355              | 0.737                  | -0.0015    | 0.0080      |
| 257 nm     | 0.0000              | 0.000                  | 0.0000     | 0.0080      |
|            | 0.8574              | 0.857                  | 0.0004     | 0.0080      |
| 313 nm     | 0.0000              | 0.000                  | 0.0000     | 0.0080      |
|            | 0.2864              | 0.290                  | -0.0036    | 0.0080      |
| 350 nm     | 0.0000              | 0.000                  | 0.0000     | 0.0080      |
|            | 0.6374              | 0.637                  | 0.0004     | 0.0080      |

#### Stray light \*

| Standard: cut-off  | UUC: Wavelength (nm) | UUC: Transmission (%T) | Absorbance (A) |
|--------------------|----------------------|------------------------|----------------|
| 260.62 +/- 0.11 nm | 260.6                | 1.3                    | 1.886          |
| 391.44 +/- 0.11 nm | 391.4                | 1.3                    | 1.886          |

#### Spectral Resolution \*

| Nominal Concentration 0.02 % v/v | Peak   | Trough | Ratio | SBW  |
|----------------------------------|--------|--------|-------|------|
| Standard Wavelength ( nm )       | 268.66 | 266.69 | 1.38  | 2.00 |
| UUC: Wavelength (nm)             | 268.2  | 266.1  |       |      |
| Std Absorbance ( A )             | 0.4566 | 0.2780 |       |      |
| Absorbance ( A )                 | 0.413  | 0.300  |       |      |

\* Calibration Marked " Not TISI Accredited " in this Certificate have been included for completeness.

**The End of Certificate**



## ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00005382

ชนิดเครื่องมือ: SPECTROPHOTOMETER

รุ่น: DR6000

หมายเลขเครื่อง: 1627845

| ตรวจสอบ (รับ)                       |                          | รายการตรวจเช็ค                                    | ตรวจสอบ (ส่ง)                       |                          | หมายเหตุ    |
|-------------------------------------|--------------------------|---|-------------------------------------|--------------------------|-------------|
| 18 Sep 2023                         |                          |   | 18 Sep 2023                         |                          |             |
| ปกติ                                | ไม่ปกติ                  |   | ปกติ                                | ไม่ปกติ                  |             |
|                                     |                          | General   |                                     |                          |             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 1. ความสมบูรณ์เครื่อง                             | <input checked="" type="checkbox"/> | <input type="checkbox"/> |             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 2. ความสะอาด ( ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง) | <input checked="" type="checkbox"/> | <input type="checkbox"/> |             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 3. สวิทช์ ปิด – เปิด เครื่อง (On-Off Swicth)      | <input checked="" type="checkbox"/> | <input type="checkbox"/> |             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 4. ปุ่มกด (Keypad)                                | <input checked="" type="checkbox"/> | <input type="checkbox"/> |             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 5. หน้าจอ (Display, Screen Contrast)              | <input checked="" type="checkbox"/> | <input type="checkbox"/> |             |
|                                     |                          | Spectrophotometer                                 |                                     |                          |             |
| <input type="checkbox"/>            | <input type="checkbox"/> | 6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC        | <input type="checkbox"/>            | <input type="checkbox"/> |             |
| <input type="checkbox"/>            | <input type="checkbox"/> | 7. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control)  | <input type="checkbox"/>            | <input type="checkbox"/> |             |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 8. ความยาวคลื่น (Wavelength Check)                | <input checked="" type="checkbox"/> | <input type="checkbox"/> | *           |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 9. แหล่งกำเนิดแสง (UV < 3,000 hour)               | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 9.2 Hours   |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 10. แหล่งกำเนิดแสง (Visible < 5,000 hour)         | <input checked="" type="checkbox"/> | <input type="checkbox"/> | 741.5 Hours |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 11. ช่องวัดหลายตัวอย่าง (Carousel Module)         | <input checked="" type="checkbox"/> | <input type="checkbox"/> |             |
|                                     |                          | pH Meter and Conductivity Meter                   |                                     |                          |             |
| <input type="checkbox"/>            | <input type="checkbox"/> | 12. อิเล็กโทรด ( Electrode and Connection Cable ) | <input type="checkbox"/>            | <input type="checkbox"/> |             |
| <input type="checkbox"/>            | <input type="checkbox"/> | 13. ระดับสารละลายใน Electrode (Level KCl )        | <input type="checkbox"/>            | <input type="checkbox"/> |             |
| <input type="checkbox"/>            | <input type="checkbox"/> | 14. ฝาปิดกันปลาย Electrode (Dust Protection Hood) | <input type="checkbox"/>            | <input type="checkbox"/> |             |
| <input type="checkbox"/>            | <input type="checkbox"/> | 15. ขาจับอิเล็กโทรด (Stand)                       | <input type="checkbox"/>            | <input type="checkbox"/> |             |
|                                     |                          | Turbidimeter                                      |                                     |                          |             |
| <input type="checkbox"/>            | <input type="checkbox"/> | 16. ค่าความขุ่นที่ต่ำสุด (No Sample)              | <input type="checkbox"/>            | <input type="checkbox"/> |             |
| <input type="checkbox"/>            | <input type="checkbox"/> | 17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่เกิน 3.0)  | <input type="checkbox"/>            | <input type="checkbox"/> |             |
|                                     |                          | Automatic titrator                                |                                     |                          |             |
| <input type="checkbox"/>            | <input type="checkbox"/> | 18. สภาพ Piston Burettes                          | <input type="checkbox"/>            | <input type="checkbox"/> |             |
| <input type="checkbox"/>            | <input type="checkbox"/> | 19. Function Rinsing and Dosing                   | <input type="checkbox"/>            | <input type="checkbox"/> |             |
| <input type="checkbox"/>            | <input type="checkbox"/> | 20. ระบบท่อสายยางและอุปกรณ์ประกอบ                 | <input type="checkbox"/>            | <input type="checkbox"/> |             |

เพิ่มเติม/ข้อแนะนำ : \*656.1nm=656.1nm

\*486.0nm=485.5nm

Mr.Nattapat Rungreang

Service Engineer



**SARTORIUS**

NSC-TISI-TIS 17025  
CALIBRATION 0426

# Certificate

## of Calibration

REVIEW BY Thavitall.

APPROVED BY D. [Signature]

NEXT CAL. DATE 02/02/2025

Model Number : MSE224S-100-DU

Certificate No. : 24BC10069

Description : Analytical Balance

Issued Date : Friday, February 23, 2024

Serial Number : 0026207038

Reference No. : 229196

ID No. : RYG\_EN0002

Manufacturer : Sartorius

Page No. : 1 of 2

Customer Name : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)

616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd.(Balance Room)

616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong.21140, Thailand.

Calibrated By : Mr.Chonchai Inthana

Calibration Date : Thursday, February 22, 2024

Calibration

Procedure No. : This calibration was conducted by

Using 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 : 24.2 °C ± 5.0 °C

Humidity : 57.0 % RH ± 10.0 % RH

Pressure :                      ±                     

*Reasons for calibration*

☐ New Installation ☐ Service / Repaired ☒ Re-calibration/ Maintenance

*Equipment Condition:* ☒ Good Operate ☐ Fair

## Measurement Method UKAS Publication Ref :Lab 14

The measurement uncertainty stated is the expended 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 form list of Sartorius Metrological Specifications.

## Traceability:

| Model Number  | Description                                       | Traceability | Certificate No. | Due Date    |
|---------------|---|--------------|-----------------|-------------|
| YCS011-522-00 | Sartorius weight set 1mg - 5000g E2,YCS011-522-00 | TCS          | M2308197S       | 23-Aug-2025 |
| MHB-382SD     | Humidity/Barometer/Temp Lutron MHB-382SD          | DKSH         | C19231845       | 23-Aug-2024 |

This certificate relate and apply this equipment only.

This certificate may not be reproduced other than in full except with the prior written approval of the Verification Operation Division  
Sartorius (Thailand) Co., Ltd.

[Signature]

Mr.chonchai Inthana(Technical Manager)

S  
T  
A  
M  
P



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

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310

Tel: +66 2643 8361-6 Fax: +66 2643-8367, e-mail: service.thailand@sartorius.com

**SARTORIUS**

# Certificate of Calibration

Model Number : MSE224S-100-DUDescription : Analytical BalanceSerial Number : 0026207038ID No. : RYG\_EN0002Manufacturer : SartoriusCertificate No. : 24BCI0069Issued Date : Friday, February 23, 2024Reference No. : 229196Page No. : 2 of 2

## Calibration Results : Without Adjustment

### Repeatability

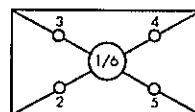
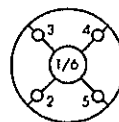
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

|                             |         |          |
|-----------------------------|---------|----------|
| Nominal Value : (Low Load)  | 20.0000 | 199.9999 |
| 20 g                        | 20.0000 | 200.0000 |
| Tolerance                   | 20.0001 | 200.0000 |
| 0.0001 g                    | 20.0000 | 199.9999 |
|                             | 20.0001 | 200.0000 |
| Nominal Value : (High Load) | 19.9999 | 200.0000 |
| 200 g                       | 20.0000 | 200.0000 |
| Tolerance                   | 20.0000 | 199.9999 |
| 0.0001 g                    | 19.9999 | 200.0001 |
|                             | 19.9999 | 200.0000 |
| Standard Deviation          | 0.00007 | 0.00006  |

### 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 : 100 g  
Tolerance 0.0004 g



#### Difference

|   |         |
|---|---------|
| 1 | -       |
| 2 | -0.0001 |
| 3 | -0.0001 |
| 4 | 0.0000  |
| 5 | -0.0001 |
| 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           | 0.00018            |
| 0.05                 | 0.0500                         | 0.0500                 | 0.0000           | 0.00018            |
| 0.1                  | 0.1000                         | 0.1000                 | 0.0000           | 0.00018            |
| 0.5                  | 0.5000                         | 0.5000                 | 0.0000           | 0.00018            |
| 1                    | 1.0000                         | 1.0000                 | 0.0000           | 0.00018            |
| 5                    | 5.0000                         | 5.0000                 | 0.0000           | 0.00018            |
| 10                   | 10.0000                        | 10.0000                | 0.0000           | 0.00018            |
| 20                   | 20.0000                        | 20.0000                | 0.0000           | 0.00024            |
| 50                   | 50.0000                        | 49.9999                | -0.0001          | 0.00019            |
| 100                  | 100.0000                       | 100.0000               | 0.0000           | 0.00023            |
| 200                  | 200.0000                       | 199.9999               | -0.0001          | 0.00032            |

End of Report.





## Certificate of Calibration

Cert. No.: 24TM632

Page : 1 of 3

**Equipment :** Hot Air Oven  
**Manufacturer :** Memmert  
**Model :** UFE 500  
**Serial No. :** G511.1572  
**ID No. :** RYG\_EN0010

REVIEW BY *Thanitak.*

APPROVED BY *D. J. J. J.*

NEXT CAL DATE *21/09/25*

**Submitted by :** ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
616/10 Moo 5 T. Maenam Khu,  
A. Pluakdaeng,  
Rayong 21140 Thailand

**Location :** Oven Room

**Received Order :** 21 March 2024

**Calibration Date :** 21 March 2024

**Ambient Temperature :** ( 26 ± 10 ) °C

**Relative Humidity :** ( 50 ± 30 ) %

**Calibrated by :** Man Pattanapongpaiboon

**Approved by :**

Approved Signatory

( ) Pornthippa Tameyakul

( ) Unnopphol Harachai

(✓) Suwit Imjai

**Issue Date :** 22 March 2024

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

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





**Equipment :** Hot Air Oven  
**Condition As-Received :** Used Item  
**Reference :** 2403-0563OC-1  
**Procedure Used :-**

**Cert. No.:** 24TM632  
**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 ) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

#### Condition of this result of calibration

1. Reference standard instrument:-

| Instrument           | Serial No. | Cert. No. | Traceable | Due Date    |
|----------------------|------------|-----------|-----------|-------------|
| 1 ) Data Acquisition | MY57013711 | 23LM115   | TPA       | 11 Jul 2024 |

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

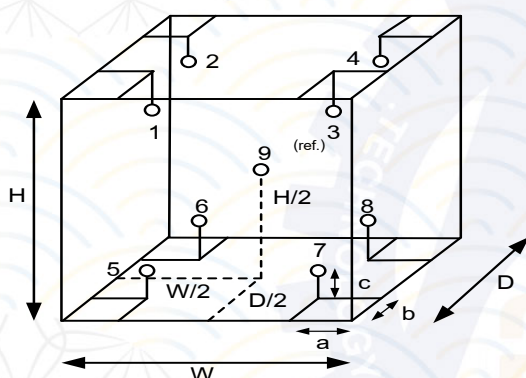
3. This certification is traceable to the International System of Unit.

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

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

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Close



| Environment during calibration |           |          |
|--------------------------------|-----------|----------|
|                                | Beginning | Finished |
| Temp. ( °C )                   | 27        | 27       |
| REL.Humid. ( % )               | 57        | 59       |
| AC Supply ( Volt )             | 222       | 224      |

#### Ref. Std. ID No.: @ Calibration Point

| Position : | ( 180 ) °C | ( 104 ) °C  |
|------------|------------|-------------|
| 1          | 18-18TC-01 | 18-18RTD-01 |
| 2          | 18-18TC-02 | 18-18RTD-02 |
| 3          | 18-18TC-03 | 18-18RTD-03 |
| 4          | 18-18TC-04 | 18-18RTD-04 |
| 5          | 18-18TC-05 | 18-18RTD-05 |
| 6          | 18-18TC-06 | 23-18RTD-06 |
| 7          | 18-18TC-07 | 18-18RTD-07 |
| 8          | 18-18TC-08 | 22-18RTD-08 |
| 9 (ref.)   | 18-18TC-09 | 18-18RTD-09 |

#### Probe Installation Details :

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

#### Dimension of Chamber :

D = 0.40 m  
 W = 0.56 m  
 H = 0.48 m  
 Capacity = 0.11 m<sup>3</sup>



**Equipment :** Hot Air Oven  
**Condition As-Received :** Used Item  
**Reference :** 2403-0563OC-1  
**Result of Calibration :-** ( \* ) Without Adjustment  
**Function of UUC\* :** Temperature Source  
**Fresh air setting :** Close

**Cert. No.:** 24TM632

**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 ) | Coverage Factor<br><i>k</i> |
|-----------------------------|------------------------|------------------------|-----------------------------------|----------------------------------|-----------------------------|-----------------------------|
| 104.0                       | 104.0                  | 104.0                  | 0.051                             | 0.59                             | 0.62                        | 2                           |
| 180.0                       | 180.0                  | 180.0                  | 0.15                              | 1.3                              | 1.7                         | 2                           |

| Calibration<br>Point<br>( °C ) | Measured Temperature ( °C ) |         |         |         |         |         |         |         |          | Uncertainty<br><br>( ± °C ) |
|--------------------------------|-----------------------------|---------|---------|---------|---------|---------|---------|---------|----------|-----------------------------|
|                                | Position                    |         |         |         |         |         |         |         |          |                             |
|                                | 1                           | 2       | 3       | 4       | 5       | 6       | 7       | 8       | 9 (ref.) |                             |
| 104.0                          | 103.921                     | 103.786 | 103.757 | 103.759 | 103.950 | 103.817 | 104.213 | 103.672 | 103.673  | 0.42                        |
| 180.0                          | 179.614                     | 179.270 | 179.145 | 179.599 | 180.001 | 180.423 | 180.293 | 180.629 | 179.429  | 1.1                         |

**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 %.

-o0o-





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL.0-2717-3000-29 FAX.0-2719-9484



## Certificate of Calibration

Cert. No.: 24TM634

Page : 1 of 3

Equipment : Hot Air Oven  
Manufacturer : Memmert  
Model : UF 110  
Serial No. : B423.0853  
ID No. : RYG\_EN0213

Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
616/10 Moo 5 T. Maenam Khu,  
A. Pluakdaeng,  
Rayong 21140 Thailand

Location : Oven Room

Received Order : 21 March 2024  
Calibration Date : 21 - 22 March 2024  
Ambient Temperature : (  $26 \pm 10$  ) °C  
Relative Humidity : (  $50 \pm 30$  ) %

Calibrated by : Man Pattanapongpaiboon

Approved by :

Approved Signatory

( ) Pornthippa Tameyakul  
( ) Unnopphol Harachai  
(✓) Suwit Imjai

Issue Date : 23 March 2024

REVIEW BY *Thanita K.*  
APPROVED BY *D. Khunon.*  
NEXT CAL DATE *21/03/25*

**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.





**Equipment :** Hot Air Oven  
**Condition As-Received :** Used Item  
**Reference :** 2403-0563OC-3  
**Procedure Used :-**

**Cert. No.:** 24TM634

**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 ) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

| <u>Instrument</u>    | <u>Serial No.</u> | <u>Cert. No.</u> | <u>Traceable</u> | <u>Due Date</u> |
|----------------------|-------------------|------------------|------------------|-----------------|
| 1 ) Data Acquisition | MY57013711        | 23LM115          | TPA              | 11 Jul 2024     |

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

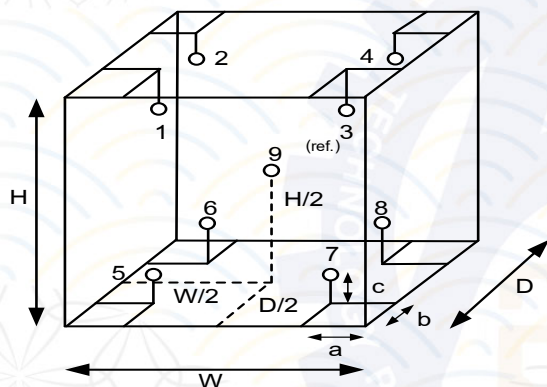
3. This certification is traceable to the International System of Unit.

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

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

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Close



| <b>Environment during calibration</b> |                  |                 |
|---------------------------------------|------------------|-----------------|
|                                       | <b>Beginning</b> | <b>Finished</b> |
| Temp. ( °C )                          | 27               | 27              |
| REL.Humid. ( % )                      | 59               | 59              |
| AC Supply ( Volt )                    | 224              | 223             |

**Ref. Std. ID No.: @  
Calibration Point**

| <b>Position :</b> | <b>( 180 ) °C</b> | <b>( 104 ) °C</b> |
|-------------------|-------------------|-------------------|
| 1                 | 18-18TC-01        | 18-18RTD-01       |
| 2                 | 18-18TC-02        | 18-18RTD-02       |
| 3                 | 18-18TC-03        | 18-18RTD-03       |
| 4                 | 18-18TC-04        | 18-18RTD-04       |
| 5                 | 18-18TC-05        | 18-18RTD-05       |
| 6                 | 18-18TC-06        | 23-18RTD-06       |
| 7                 | 18-18TC-07        | 18-18RTD-07       |
| 8                 | 18-18TC-08        | 22-18RTD-08       |
| 9 (ref.)          | 18-18TC-09        | 18-18RTD-09       |

**Probe Installation Details :**

**Dimension of Chamber :**

|     |     |    |            |      |                |
|-----|-----|----|------------|------|----------------|
| a = | 5.0 | cm | D =        | 0.40 | m              |
| b = | 5.0 | cm | W =        | 0.56 | m              |
| c = | 5.0 | cm | H =        | 0.48 | m              |
|     |     |    | Capacity = | 0.11 | m <sup>3</sup> |



**Equipment :** Hot Air Oven  
**Condition As-Received :** Used Item  
**Reference :** 2403-0563OC-3  
**Result of Calibration :-** ( \* ) Without Adjustment  
**Function of UUC\* :** Temperature Source  
**Fresh air setting :** Close

**Cert. No.:** 24TM634

**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 ) | Coverage Factor<br><i>k</i> |
|-----------------------------|------------------------|------------------------|-----------------------------------|----------------------------------|-----------------------------|-----------------------------|
| 104.0                       | 104.0                  | 104.0                  | 0.065                             | 0.52                             | 0.90                        | 2                           |
| 180.0                       | 180.0                  | 180.0                  | 0.20                              | 1.2                              | 2.0                         | 2                           |

| Calibration<br>Point<br>( °C ) | Measured Temperature ( °C ) |         |         |         |         |         |         |         |          | Uncertainty<br><br>( ±°C ) |
|--------------------------------|-----------------------------|---------|---------|---------|---------|---------|---------|---------|----------|----------------------------|
|                                | Position                    |         |         |         |         |         |         |         |          |                            |
|                                | 1                           | 2       | 3       | 4       | 5       | 6       | 7       | 8       | 9 (ref.) |                            |
| 104.0                          | 104.169                     | 103.506 | 103.898 | 103.712 | 103.772 | 103.730 | 104.289 | 103.805 | 103.798  | 0.42                       |
| 180.0                          | 180.701                     | 179.239 | 179.935 | 179.999 | 180.127 | 180.138 | 180.895 | 179.313 | 180.211  | 1.1                        |

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

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

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

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

**UUC\* :** Unit Under Calibration

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

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL.0-2717-3000-29 FAX.0-2719-9484



## Certificate of Calibration

Cert. No.: 24TM635

Page : 1 of 3

Equipment : Water Bath  
Manufacturer : Memmert  
Model : WNB22  
Serial No. : L513.0648  
ID No. : RYG\_EN0061

Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
616/10 Moo 5, T. Maenam Khu,  
A. Pluakdaeng,  
Rayong 21140, Thailand

Location : Wet Chemistry Lab

Received Order : 21 March 2024

Calibration Date : 21 March 2024

Ambient Temperature : ( 26 ± 10 ) °C

Relative Humidity : ( 50 ± 30 ) %

Calibrated by : Man Pattanapongpaiboon

Approved by :

Approved Signatory

( ) Pornthippa Tameyakul

( ) Unnoppol Harachai

(✓) Suwit Imjai

Issue Date : 23 March 2024

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

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



**Equipment :** Water Bath  
**Condition As-Received :** Used Item  
**Reference :** 2403-0563OC-4  
**Procedure Used :-**

**Cert. No.:** 24TM635

**Page :** 2 of 3

Calibration were conducted using in-house calibration procedure CP-OT04 Based on ASTM E715 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer ( IPRT ).

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

| <u>Instrument</u>    | <u>Serial No.</u> | <u>Cert. No.</u> | <u>Traceable</u> | <u>Due Date</u> |
|----------------------|-------------------|------------------|------------------|-----------------|
| 1 ) Data Acquisition | MY57013711        | 23LM115          | TPA              | 11 Jul 2024     |

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

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

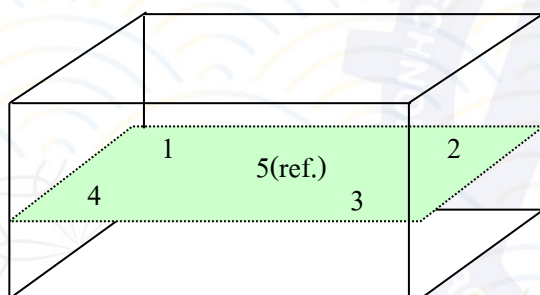
**Remark :** TPA : Technology Promotion Association ( Thailand - Japan )

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

**Function of UUC\* :** Temperature Source

**Heat transfer medium used :** Water

|                                 | <u>Environmental</u> |           | <u>AC Voltage Supply</u> |
|---------------------------------|----------------------|-----------|--------------------------|
|                                 | ( °C )               | ( %R.H. ) | ( Volt )                 |
| <b>Beginning of Calibration</b> | 25                   | 55        | 222                      |
| <b>Finished of Calibration</b>  | 25                   | 57        | 223                      |



Front

| <u>Position :</u> | <u>Ref. Std. ID No.:</u> |
|-------------------|--------------------------|
| 1                 | 4803988-001              |
| 2                 | 4803988-002              |
| 3                 | 4803988-003              |
| 4                 | 4803988-004              |
| 5(ref.)           | 4803988-005              |





**Equipment :** Water Bath  
**Condition As-Received :** Used Item  
**Reference :** 2403-0563OC-4  
**Result of Calibration :-** ( \* ) Without Adjustment  
**Function of UUC\* :** Temperature Source

**Cert. No.:** 24TM635

**Page :** 3 of 3

| Calibration<br>point<br>( °C ) | UUC*<br>Setting<br>( °C ) | UUC*<br>Reading<br>( °C ) | Average* Standard Reading ( °C ) |        |        |        |          | Uncertainty<br><br>( ± °C ) |
|--------------------------------|---------------------------|---------------------------|----------------------------------|--------|--------|--------|----------|-----------------------------|
|                                |                           |                           | Position                         |        |        |        |          |                             |
|                                |                           |                           | 1                                | 2      | 3      | 4      | 5 (ref.) |                             |
| 85.0                           | 85.0                      | 85.0                      | 84.428                           | 84.424 | 84.489 | 84.507 | 84.477   | 0.18                        |

| Calibration<br>point<br>( °C ) | Uniformity<br>( °C ) | Stability<br>( ± °C ) | Coverage<br>Factor<br><b>k</b> |
|--------------------------------|----------------------|-----------------------|--------------------------------|
| 85.0                           | 0.19                 | 0.11                  | 2                              |

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

**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.

**Stability :** One-half of the greatest maximum difference of measured temperature at any one probe.

**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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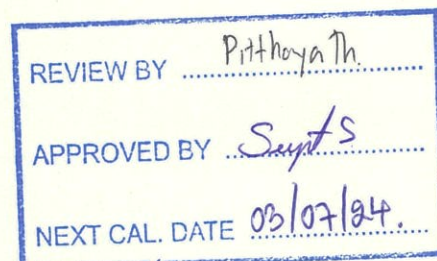


Cert.No.: 23CH830  
Page.: 1 of 3

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : Seven2Go S2  
Serial No. : C221115514  
ID No. : RYG\_FS0596  
Condition As-Received: Used Item  
Received Date : 30 June 2023  
Calibration Date : 03 July 2023  
Reference : 2306-0984DSC-6  
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch  
616/10 Moo 5, T.Maenam Khu,  
A.Pluakdaeng, Rayong 21140, Thailand

Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 15) %  
Calibration Procedure : In - house method :



- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)  
- CP-CH8 by comparison with standard thermometer

Calibrated by : Warakorn Lerngagtrakul

Approved by :

Malee

Approved Signatory

- (☒) Malee Butkruea  
( ) Saithip Meangmai  
( ) Warakorn Lerngagtrakul

Issue Date : 6 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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Cert.No.: 23CH830

Page.: 2 of 3

**Condition of this calibration result**

1. Reference Standard Instrument : -

| <u>Instrument</u>              | <u>Serial No.</u> | <u>ID No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|--------------------------------|-------------------|---------------|------------------|-----------------|
| 1) Document Process Calibrator | 54030049          | 130RC116      | 22E2769          | 24 Aug 2023     |
| 2) Ref. Standard Thermometer   | 4982054           | 110RC044      | 22I1306          | 27 Oct 2023     |

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

- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd.,  
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

| <u>Buffer Solution</u> | <u>Manufacturer</u> | <u>Lot No.</u> | <u>Exp. date</u> |
|------------------------|---------------------|----------------|------------------|
| pH 4.008               | CPA chem            | 863832         | 28 Dec 2024      |
| pH 6.986               | CPA chem            | 863833         | 28 Dec 2023      |
| pH 10.010              | CPA chem            | 863835         | 28 Dec 2023      |

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

**Calibration Results**

**Function :** mV Measurement

**Performing standard curve by Fluke at pH (4,7,10)**

| Unit Under Calibration       | Nominal Value | Standard Voltage Input | Actual Reading |       | Uncertainty of Measurement<br>( $\pm$ mV ) | Coverage factor<br><i>k</i> |
|------------------------------|---------------|------------------------|----------------|-------|--|-----------------------------|
|                              | pH            | mV                     | mV             | pH    |  |                             |
| pH Meter<br>S/N.: C221115514 | 4.00          | 177.48                 | 178            | 4.00  | 0.58                                       | 2.00                        |
|                              | 7.00          | 0.00                   | 0              | 7.00  | 0.58                                       | 2.00                        |
|                              | 10.00         | -177.48                | -178           | 10.00 | 0.58                                       | 2.00                        |

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Cert.No.: 23CH830

Page.: 3 of 3

**Calibration Results****Function : pH Measurement**

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

| Unit Under Calibration        | Standard pH Buffer Solution | Actual pH Reading | Actual mV Reading ( mV ) | Uncertainty of pH measurement ( $\pm$ ) | Coverage factor $k$ |
|-------------------------------|-----------------------------|-------------------|--------------------------|---|---------------------|
| pH Electrode<br>S/N.: 2465853 | 4.008                       | 4.01              | 182                      | 0.0085                                  | 2.05                |
|                               | 6.986                       | 6.99              | 10                       | 0.0099                                  | 2.00                |
|                               | 10.010                      | 10.01             | -169                     | 0.0095                                  | 2.00                |

**Function : Temperature Measurement****( \* ) Without adjustment**

This equipment was connected with Temperature Probe;

- Model : InLab®Expert Go-ISM

- Serial No. : 2465853

Dimension of probe;

- Length : 120 mm

- Diameter : 12 mm

- Immersion Depth : 100 mm

| Calibration Point ( °C ) | Standard Temperature ( °C ) | UUC* Reading ( °C ) | Error ( °C ) | Uncertainty of measurement ( $\pm$ °C ) | Coverage factor $k$ |
|--------------------------|-----------------------------|---------------------|--------------|---|---------------------|
| 25.0                     | 25.003                      | 25.2                | 0.197        | 0.13                                    | 2.00                |
| 30.0                     | 30.002                      | 30.2                | 0.198        | 0.13                                    | 2.00                |

**Remark : - UUC\* = Unit Under Calibration**

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

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