

ภาคผนวก ง

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ใบรับรองการสอบเทียบเครื่องมือ



right solutions.  
right partner.

รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

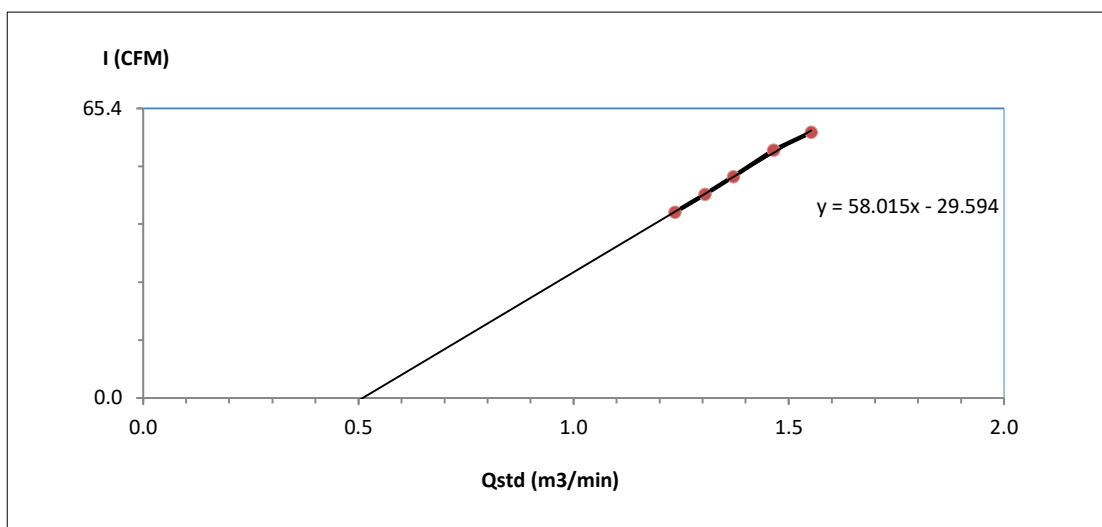
| Sample Name | Parameter                    | Equipment Name              | ID No.     | Calibrated Date | Next Cal  | Freq. Calibrate (Months) |
|-------------|------------------------------|-----------------------------|------------|-----------------|-----------|--------------------------|
| Ambient     | Total Suspended Particulate  | High Volume                 | RYG_FS0177 | -               | -         | On site Calibration      |
| Ambient     | Total Suspended Particulate  | High Volume                 | RYG_FS0175 | -               | -         | On site Calibration      |
| Ambient     | Total Suspended Particulate  | High Volume                 | RYG_FS0395 | -               | -         | On site Calibration      |
| Ambient     | Total Suspended Particulate  | Digital Balance             | RYG_EN0001 | 1-Mar-23        | 1-Mar-24  | 12                       |
| Ambient     | Particulate Matter (PM-10)   | High Volume                 | RYG_FS0397 | -               | -         | On site Calibration      |
| Ambient     | Particulate Matter (PM-10)   | High Volume                 | RYG_FS0295 | -               | -         | On site Calibration      |
| Ambient     | Particulate Matter (PM-10)   | High Volume                 | RYG_FS0668 | -               | -         | On site Calibration      |
| Ambient     | Particulate Matter (PM-10)   | Digital Balance             | RYG_EN0001 | 1-Mar-23        | 1-Mar-24  | 12                       |
| Ambient     | Wind Speed / Wind Direction  | Wind Speed / Wind Direction | RYG_FS0530 | 19-Jan-23       | 19-Jul-24 | 18                       |
| Ambient     | Wind Speed / Wind Direction  | Wind Speed / Wind Direction | RYG_FS0608 | 17-Nov-22       | 17-May-24 | 18                       |
| Ambient     | Wind Speed / Wind Direction  | Wind Speed / Wind Direction | RYG_FS0545 | 21-Jul-23       | 21-Jan-25 | 18                       |
| Stack       | Butyl Acrylate               | Pitot Tube                  | BKK_FS0522 | 13-Jul-23       | 13-Jan-24 | 6                        |
| Stack       | Butyl Acrylate               | Flue gas Analyzer           | RYG_FS0564 | 20-Jan-23       | 20-Jan-24 | 12                       |
| Stack       | Butyl Acrylate               | Field Rotameter             | BKK_FS1004 | 2-Oct-23        | 2-Jan-24  | 3                        |
| Stack       | Butyl Acrylate               | GC-MSD                      | BKK_EN0119 | 18-Apr-23       | 18-Oct-24 | 18                       |
| Stack       | Methyl Methacrylate          | Pitot Tube                  | BKK_FS0522 | 13-Jul-23       | 13-Jan-24 | 6                        |
| Stack       | Methyl Methacrylate          | Flue gas Analyzer           | RYG_FS0564 | 20-Jan-23       | 20-Jan-24 | 12                       |
| Stack       | Methyl Methacrylate          | Field Rotameter             | BKK_FS1004 | 2-Oct-23        | 2-Jan-24  | 3                        |
| Stack       | Methyl Methacrylate          | GC-MSD                      | BKK_EN0119 | 18-Apr-23       | 18-Oct-24 | 18                       |
| Stack       | Total Suspended Particulate  | Console Control Unit        | BKK_FS0518 | 13-Jul-23       | 13-Jan-24 | 6                        |
| Stack       | Total Suspended Particulate  | Flue gas Analyzer           | RYG_FS0564 | 20-Jan-23       | 20-Jan-24 | 12                       |
| Stack       | Total Suspended Particulate  | Digital Balance             | RYG_EN0003 | 1-Mar-23        | 1-Mar-24  | 12                       |
| Stack       | Total VOCs as Propane        | Pitot Tube                  | BKK_FS0522 | 13-Jul-23       | 13-Jan-24 | 6                        |
| Stack       | Total VOCs as Propane        | Flue gas Analyzer           | RYG_FS0564 | 20-Jan-23       | 20-Jan-24 | 12                       |
| Stack       | Total VOCs as Propane        | FID Analyzer                | BKK_FS0758 | 1-Jul-23        | 1-Jan-24  | 6                        |
| Workplace   | Total Dust                   | Field Rotameter             | RYG_FS0198 | 1-Jul-23        | 1-Oct-23  | 3                        |
| Workplace   | Total Dust                   | Field Rotameter             | RYG_FS0659 | 2-Oct-23        | 2-Jan-24  | 3                        |
| Workplace   | Total Dust                   | Digital Balance             | RYG_EN0004 | 1-Mar-23        | 1-Mar-24  | 12                       |
| Workplace   | Total VOC                    | Field Rotameter             | RYG_FS0658 | 2-Oct-23        | 2-Jan-24  | 3                        |
| Workplace   | Total VOC                    | TVOC Analyzer               | BKK_FS0821 | 26-Oct-22       | 25-Apr-24 | 18                       |
| Noise       | Leq 24 hrs                   | Sound Calibrator            | RYG_FS0496 | 17-Jan-23       | 17-Jan-24 | 12                       |
| Noise       | Leq 24 hrs                   | Sound Level Meter           | RYG_FS0437 | 19-Oct-23       | 19-Oct-24 | 12                       |
| Noise       | Leq 24 hrs                   | Sound Level Meter           | RYG_FS0439 | 19-Oct-23       | 19-Oct-24 | 12                       |
| Noise       | Leq 8 hrs                    | Sound Calibrator            | RYG_FS0496 | 17-Jan-23       | 17-Jan-24 | 12                       |
| Noise       | Leq 8 hrs                    | Sound Level Meter           | RYG_FS0017 | 3-Jan-23        | 3-Jan-24  | 12                       |
| Noise       | Leq 8 hrs                    | Sound Level Meter           | RYG_FS0018 | 3-Jan-23        | 3-Jan-24  | 12                       |
| Rayong Lab  | pH at 25 °C                  | pH meter                    | RYG_EN0183 | 27-Feb-23       | 27-Feb-24 | 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 | 27-Sep-22       | 27-Mar-24 | 18                       |
| Rayong Lab  | Total Suspended Solids       | Electronic Balance          | RYG_EN0002 | 1-Mar-23        | 1-Mar-24  | 12                       |
| Rayong Lab  | Total Suspended Solids       | Hot Air Oven                | RYG_EN0010 | 20-Oct-22       | 20-Apr-24 | 18                       |
| Rayong Lab  | Total Dissolved Solids 180°C | Electronic Balance          | RYG_EN0002 | 1-Mar-23        | 1-Mar-24  | 12                       |
| Rayong Lab  | Total Dissolved Solids 180°C | Hot Air Oven                | RYG_EN0010 | 20-Oct-22       | 20-Apr-24 | 18                       |
| Rayong Lab  | Oil & Grease                 | Electronic Balance          | RYG_EN0002 | 1-Mar-23        | 1-Mar-24  | 12                       |
| Rayong Lab  | Oil & Grease                 | Hot Air Oven                | RYG_EN0006 | 20-Oct-22       | 20-Apr-24 | 18                       |
| Rayong Lab  | Oil & Grease                 | Water Bath                  | RYG_EN0061 | 20-Oct-22       | 20-Apr-24 | 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) : | 758        |
| Calibrate Location :  | บ้านบน              | Temperature ( °C ) :          | 28         |
| Calibrate Date :      | 6-Nov-23            | High Volume ID :              | RYG_FS0177 |
| CalibrationSheet No.: | C-061123-RYG_FS0177 | High Volume Model :           | TE-5170D   |
| Calibrator ID:        | RYG_FS0205          | High Volume S/N :             | 4803       |
| Calibrator Model :    | TE-5028A            | Calibrator Slope :            | 1.50765    |
| Calibrator S/N :      | 1166                | Calibrator Intercept :        | -0.02043   |

| 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        | 3.4                              | 1.2357                                    | 42                 | Slope : 58.0155<br>Intercept : -29.5937<br>Correlation Coefficient : 0.9985 |
| 2        | 3.8                              | 1.3052                                    | 46                 |                                                                             |
| 3        | 4.2                              | 1.3712                                    | 50                 |                                                                             |
| 4        | 4.8                              | 1.4644                                    | 56                 |                                                                             |
| 5        | 5.4                              | 1.5520                                    | 60                 |                                                                             |



Calibrated by

Mongkon Ph.

( Mr.Mongkon Phalathip )  
Field Scientist(1)

Approved by :

N. Noppong

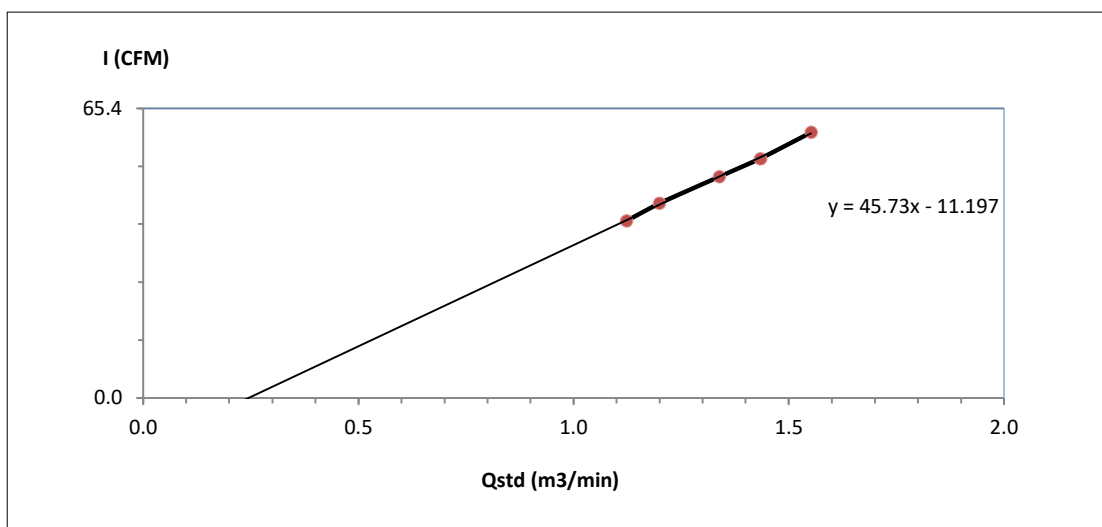
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)



### High Volume Air Sampler Calibration Worksheet

|                        |                     |                               |            |
|------------------------|---------------------|-------------------------------|------------|
| Project Site :         | Thai MMA Co., Ltd   | Barometric Pressure (mm Hg) : | 758        |
| Calibrate Location :   | บ้านนาบวช           | Temperature ( °C ) :          | 28         |
| Calibrate Date :       | 6-Nov-23            | High Volume ID :              | RYG_FS0175 |
| Calibration Sheet No.: | C-061123-RYG_FS0175 | High Volume Model :           | TE-5170D   |
| Calibrator ID:         | RYG_FS0205          | High Volume S/N :             | 4801       |
| Calibrator Model :     | TE-5028A            | Calibrator Slope :            | 1.50765    |
| Calibrator S/N :       | 1166                | Calibrator Intercept :        | -0.02043   |

| 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                              | 1.1233                                    | 40                 | Slope : 45.7298<br>Intercept : -11.1974<br>Correlation Coefficient : 0.9993 |
| 2        | 3.2                              | 1.1995                                    | 44                 |                                                                             |
| 3        | 4.0                              | 1.3386                                    | 50                 |                                                                             |
| 4        | 4.6                              | 1.4340                                    | 54                 |                                                                             |
| 5        | 5.4                              | 1.5520                                    | 60                 |                                                                             |



Calibrated by

Mongkon Ph.

( Mr.Mongkon Phalathip )  
Field Scientist(1)

Approved by :

N. Noppong Juntarupan

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

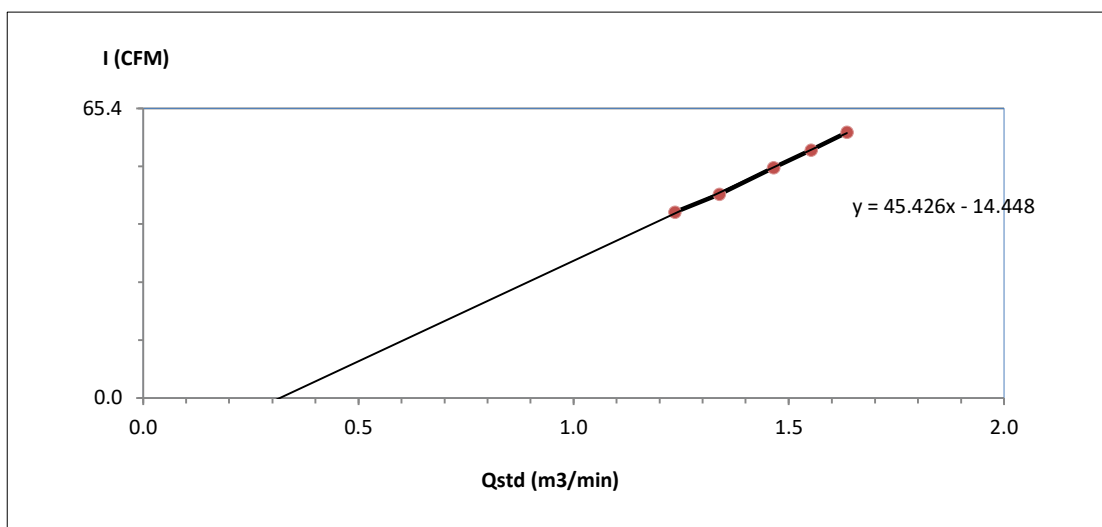




## High Volume Air Sampler Calibration Worksheet

|                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Project Site :</b> <u>Thai MMA Co., Ltd</u><br><b>Calibrate Location :</b> <u>บ้านเนินพยอม</u><br><b>Calibrate Date :</b> <u>6-Nov-23</u><br><b>Calibration Sheet No.:</b> <u>C-061123-RYG_FS0395</u><br><b>Calibrator ID:</b> <u>RYG_FS0205</u><br><b>Calibrator Model :</b> <u>TE-5028A</u><br><b>Calibrator S/N :</b> <u>1166</u> | <b>Barometric Pressure (mm Hg) :</b> <u>758</u><br><b>Temperature ( °C ) :</b> <u>28</u><br><b>High Volume ID :</b> <u>RYG_FS0395</u><br><b>High Volume Model :</b> <u>TE-5170D</u><br><b>High Volume S/N :</b> <u>5692</u><br><b>Calibrator Slope :</b> <u>1.50765</u><br><b>Calibrator Intercept :</b> <u>-0.02043</u> |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| 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        | 3.4                              | 1.2357                                    | 42                 | Slope : 45.4264<br>Intercept : -14.4477<br>Correlation Coefficient : 0.9994 |
| 2        | 4.0                              | 1.3386                                    | 46                 |                                                                             |
| 3        | 4.8                              | 1.4644                                    | 52                 |                                                                             |
| 4        | 5.4                              | 1.5520                                    | 56                 |                                                                             |
| 5        | 6.0                              | 1.6349                                    | 60                 |                                                                             |



Calibrated by

Mongkon Ph.

( Mr.Mongkon Phalathip )  
Field Scientist(1)

Approved by :

N. Noppong Juntarupan

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

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

129 Rama 9 Road, Huaykwang, Bangkok 10310

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



NSC-TISI-TIS 17025

CALIBRATION 0426

**SARTORIUS**REVIEW BY Thaniat U.APPROVED BY D. [Signature]NEXT CAL. DATE 09/03/24

# Certificate of Calibration

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

Certificate No. : 23BCI0110  
 Issued Date : Friday, March 03, 2023  
 Reference No. : 204833  
 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 : 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 : 150 g Readability : 0.0001 g

**Ambients Conditions:**

Temperature : 24.2 °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 | 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.

Mr.chonchai Inthana(Technical Manager)

S  
T  
A  
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. : 23BCI0110

Issued Date : Friday, March 03, 2023

Reference No. : 204833

Page No. : 2 of 2

## Calibration Results : Without Adjustment

### Repeatability

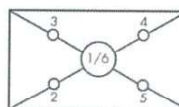
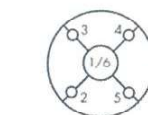
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

|                             |         |          |
|-----------------------------|---------|----------|
| Nominal Value : (Low Load)  | 10.0000 | 100.0001 |
| 10 g                        | 10.0000 | 100.0002 |
| Tolerance                   | 10.0001 | 100.0001 |
| 0.0001 g                    | 10.0000 | 100.0000 |
|                             | 9.9999  | 100.0002 |
| Nominal Value : (High Load) | 10.0000 | 100.0001 |
| 100 g                       | 10.0001 | 100.0001 |
| Tolerance                   | 10.0000 | 100.0001 |
| 0.0001 g                    | 9.9999  | 100.0002 |
|                             | 9.9998  | 100.0001 |
| Standard Deviation          | 0.00009 | 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 : 50 g  
Tolerance 0.0004 g



#### Difference

|   |         |
|---|---------|
| 1 | -       |
| 2 | 0.0000  |
| 3 | -0.0001 |
| 4 | 0.0001  |
| 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           | 0.00022            |
| 0.05                 | 0.0500                         | 0.0500                 | 0.0000           | 0.00023            |
| 0.1                  | 0.1000                         | 0.1000                 | 0.0000           | 0.00023            |
| 0.5                  | 0.5000                         | 0.5000                 | 0.0000           | 0.00023            |
| 1                    | 1.0000                         | 1.0000                 | 0.0000           | 0.00023            |
| 2                    | 2.0000                         | 2.0000                 | 0.0000           | 0.00023            |
| 5                    | 5.0000                         | 5.0000                 | 0.0000           | 0.00022            |
| 10                   | 10.0000                        | 10.0001                | 0.0001           | 0.00024            |
| 20                   | 20.0000                        | 20.0001                | 0.0001           | 0.00023            |
| 100                  | 100.0000                       | 100.0002               | 0.0002           | 0.00026            |

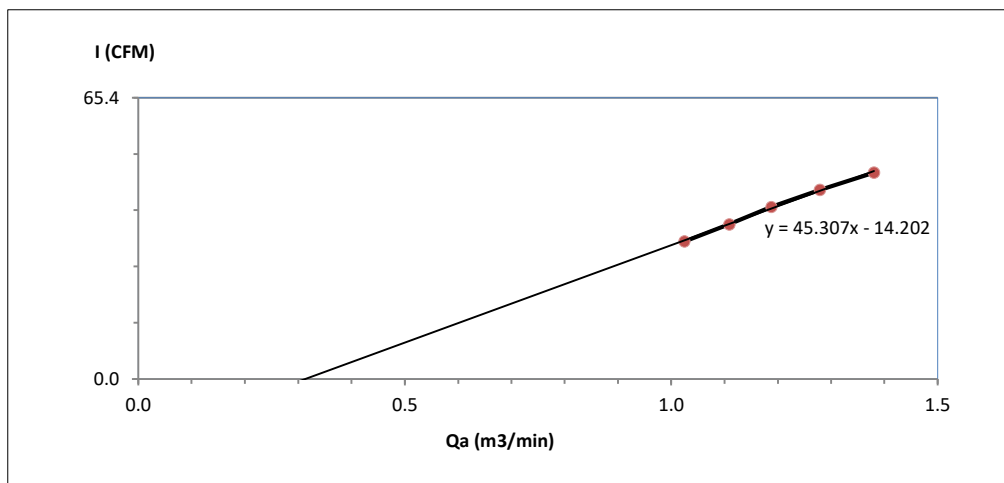
End of Report.



### High Volume Air Sampler Calibration Worksheet

|                        |                     |                               |            |
|------------------------|---------------------|-------------------------------|------------|
| Project Site :         | Thai MMA Co., Ltd   | Barometric Pressure (mm Hg) : | 758        |
| Calibrate Location :   | บ้านนา              | Temperature ( °C ) :          | 28         |
| Calibrate Date :       | 6-Nov-23            | High Volume ID :              | RYG_FS0397 |
| Calibration Sheet No.: | C-061123-RYG_FS0397 | High Volume Model :           | TE-5009X   |
| Calibrator ID:         | RYG_FS0205          | High Volume S/N :             | 5687       |
| Calibrator Model :     | TE-5028A            | Calibrator Slope :            | 0.94434    |
| Calibrator S/N :       | 1166                | Calibrator Intercept :        | -0.01292   |

| 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                              | 1.025                       | 32                 | Slope : 45.3069<br>Intercept : -14.2021<br>Correlation Coefficient : 0.9988 |
| 2        | 2.7                              | 1.109                       | 36                 |                                                                             |
| 3        | 3.1                              | 1.188                       | 40                 |                                                                             |
| 4        | 3.6                              | 1.279                       | 44                 |                                                                             |
| 5        | 4.2                              | 1.380                       | 48                 |                                                                             |



Calibrated by Mongkon Ph.  
( Mr.Mongkon Phalathip )  
Field Scientist(1)

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

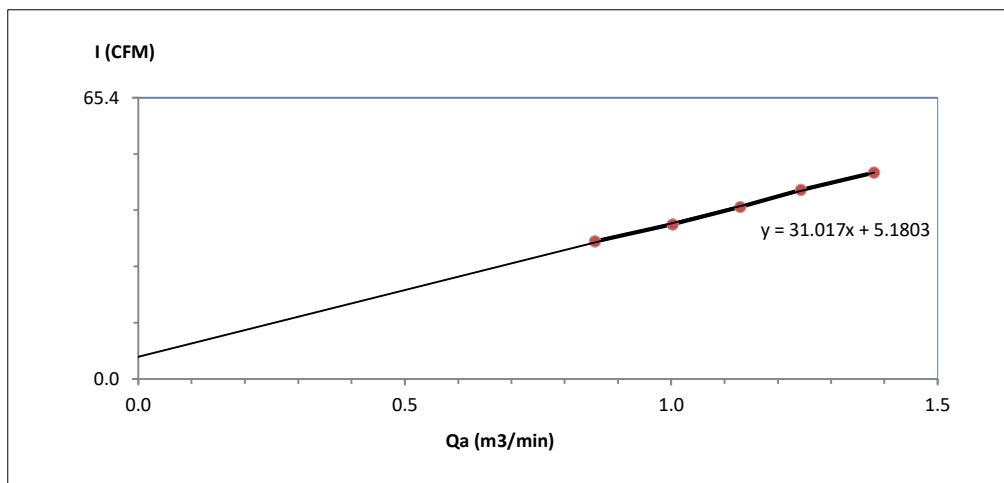




### High Volume Air Sampler Calibration Worksheet

|                        |                     |                               |            |
|------------------------|---------------------|-------------------------------|------------|
| Project Site :         | Thai MMA Co., Ltd   | Barometric Pressure (mm Hg) : | 758        |
| Calibrate Location :   | ระยอง               | Temperature ( °C ) :          | 28         |
| Calibrate Date :       | 6-Nov-23            | High Volume ID :              | RYG_FS0295 |
| Calibration Sheet No.: | C-061123-RYG_FS0295 | High Volume Model :           | TE-5009X   |
| Calibrator ID:         | RYG_FS0205          | High Volume S/N :             | 5502       |
| Calibrator Model :     | TE-5028A            | Calibrator Slope :            | 0.94434    |
| Calibrator S/N :       | 1166                | Calibrator Intercept :        | -0.01292   |

| Test No. | Delta H <sub>2</sub> O<br>(inch) | Qa<br>(m <sup>3</sup> /min) | I : Chart<br>(CFM) | Linear Regression                                                         |
|----------|----------------------------------|-----------------------------|--------------------|---------------------------------------------------------------------------|
| 1        | 1.6                              | 0.857                       | 32                 | Slope : 31.0168<br>Intercept : 5.1803<br>Correlation Coefficient : 0.9992 |
| 2        | 2.2                              | 1.003                       | 36                 |                                                                           |
| 3        | 2.8                              | 1.130                       | 40                 |                                                                           |
| 4        | 3.4                              | 1.243                       | 44                 |                                                                           |
| 5        | 4.2                              | 1.380                       | 48                 |                                                                           |



Calibrated by Mongkon Ph.  
( Mr.Mongkon Phalathip )  
Field Scientist(1)

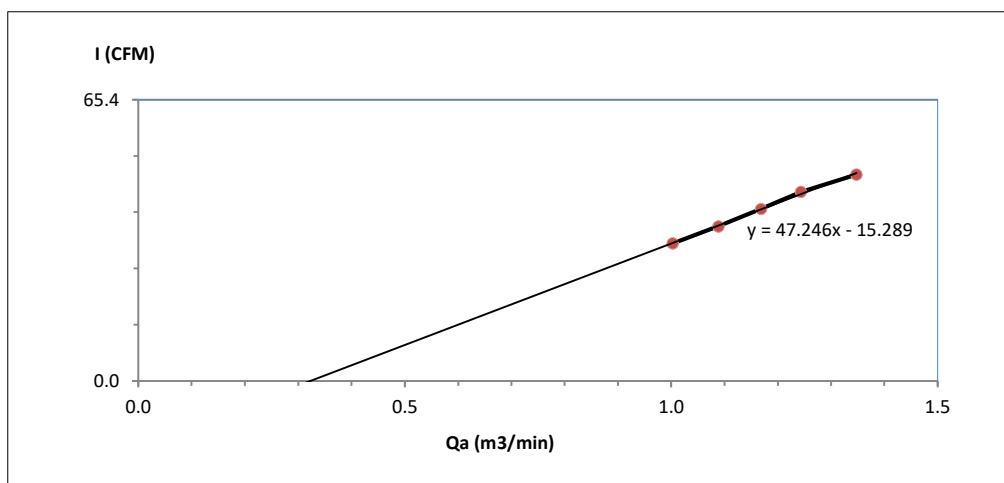
Approved by : Mr. Noppong Juntarupan  
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)



## High Volume Air Sampler Calibration Worksheet

|                       |                     |                               |            |
|-----------------------|---------------------|-------------------------------|------------|
| Project Site :        | Thai MMA Co., Ltd   | Barometric Pressure (mm Hg) : | 758        |
| Calibrate Location :  | บ้านเนินพยอม        | Temperature ( °C) :           | 28         |
| Calibrate Date :      | 6-Nov-23            | High Volume ID :              | RYG_FS0668 |
| CalibrationSheet No.: | C-061123-RYG_FS0668 | High Volume Model :           | TE-5009X   |
| Calibrator ID:        | RYG_FS0205          | High Volume S/N :             | 6267       |
| Calibrator Model :    | TE-5028A            | Calibrator Slope :            | 0.94434    |
| Calibrator S/N :      | 1166                | Calibrator Intercept :        | -0.01292   |

| 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                              | 1.003                       | 32                 | Slope : 47.2459<br>Intercept : -15.2888<br>Correlation Coefficient : 0.9985 |
| 2        | 2.6                              | 1.089                       | 36                 |                                                                             |
| 3        | 3.0                              | 1.169                       | 40                 |                                                                             |
| 4        | 3.4                              | 1.243                       | 44                 |                                                                             |
| 5        | 4.0                              | 1.348                       | 48                 |                                                                             |



Calibrated by Mongkon Ph.  
 ( Mr.Mongkon Phalathip )  
 Field Scientist(1)

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

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

|                    |
|--------------------|
| 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.

**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 (23.7)°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 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 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\*\*\*





## 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 ± 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, (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:** .....

*(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) |
|---------------------------------|---------------------------|--------------------|---------------------------------|----------------|--------------------|
| 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 Jittrapor Lertsomphol



### 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: 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



| Certificate Number |
|--------------------|
| CL-002-65          |

## 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-012  
Data logger: AS909  
**ID NUMBER** : RYG\_FS0608  
**CONDITION AS-RECEIVED** : New item  
**CUSTOMER** : ALS laboratory group (Thailand) co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 09 Nov 2022  
**MEASUREMENT DATE** : 17 Nov 2022  
**ISSUE DATE** : 23 Nov 2022

### 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 (24.0)°C, (50.6) %RH and (1009.4) 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 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 | $D_{std}^6$<br>Degree (°) | $D_{uuc}^7$<br>Degree (°) | Error<br>Degree (°) | $U (k=2)$<br>Degree (°) |
|------------------|---------------------------|---------------------------|---------------------|-------------------------|
| 5.00             | 0.000                     | 0                         | 0                   | 0.58                    |
|                  | 45.000                    | 42                        | -3                  | 0.74                    |
|                  | 89.999                    | 88                        | -2                  | 0.68                    |
|                  | 135.001                   | 133                       | -2                  | 0.68                    |
|                  | 180.001                   | 179                       | -1                  | 0.68                    |
|                  | 225.000                   | 225                       | 0                   | 0.68                    |
|                  | 270.000                   | 271                       | 1                   | 0.68                    |
|                  | 315.000                   | 318                       | 3                   | 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\*\*\*



| Certificate Number |
|--------------------|
| CL-002-65          |

## 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-012  
 Data logger: A5909  
**ID NUMBER** : RYG\_FS0608  
**CONDITION AS-RECEIVED** : New item  
**CUSTOMER** : ALS laboratory group (Thailand) co., Ltd.  
 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
 Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 09 Nov 2022  
**MEASUREMENT DATE** : 17 Nov 2022  
**ISSUE DATE** : 23 Nov 2022

**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 (23.8) °C, (46.3) %RH and (1014.7) 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 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.

| $V_{std}$ <sup>6</sup><br>(m/s) | Temp. wind tunnel<br>(°C) | Temp. room<br>(°C) | $V_{UUC}$ <sup>7</sup><br>(m/s) | Error<br>(m/s) | $U (k=2)$<br>(m/s) |
|---------------------------------|---------------------------|--------------------|---------------------------------|----------------|--------------------|
| 0.988                           | 23.90                     | 23.80              | 0.8                             | -0.2           | 0.15               |
| 2.035                           | 23.70                     | 23.80              | 1.8                             | -0.2           | 0.16               |
| 3.040                           | 23.90                     | 23.80              | 2.8                             | -0.2           | 0.19               |
| 4.194                           | 23.60                     | 23.80              | 3.8                             | -0.4           | 0.20               |
| 5.01                            | 23.70                     | 23.80              | 4.8                             | -0.2           | 0.19               |
| 6.00                            | 23.78                     | 23.80              | 5.8                             | -0.2           | 0.17               |
| 7.08                            | 23.80                     | 23.80              | 6.8                             | -0.2           | 0.18               |
| 8.18                            | 23.60                     | 23.80              | 8.0                             | -0.2           | 0.20               |
| 9.10                            | 23.80                     | 23.80              | 8.9                             | -0.2           | 0.20               |
| 10.09                           | 23.64                     | 23.80              | 9.9                             | -0.2           | 0.21               |
| 11.15                           | 23.56                     | 23.80              | 10.9                            | -0.3           | 0.21               |
| 12.16                           | 23.66                     | 23.80              | 11.9                            | -0.3           | 0.21               |
| 13.20                           | 23.52                     | 23.80              | 12.9                            | -0.3           | 0.22               |
| 14.26                           | 23.60                     | 23.80              | 14.1                            | -0.2           | 0.22               |
| 15.25                           | 23.58                     | 23.80              | 15.0                            | -0.2           | 0.22               |
| 16.30                           | 23.60                     | 23.80              | 16.2                            | -0.1           | 0.24               |

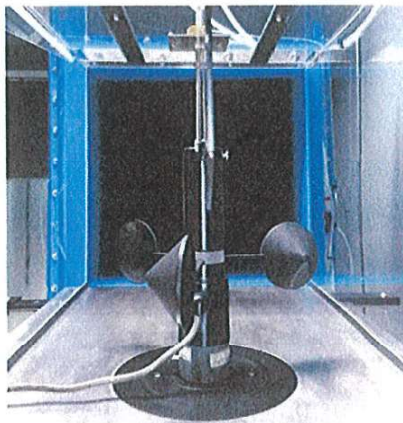
## Remark:

<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.

## CERTIFICATE OF CALIBRATION

Certificate No.: CL-157-65  
Page 1 of 2

Equipment Name: Data Logger with Temperature  
Sensor

Manufacturer: Novalynx  
Model: 110 WS 25DL-D  
Serial No.: A5909  
ID No.: RYG\_FS0608

### 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: 09 Nov 2022  
Calibration date: 18 Nov 2022  
Issue date: 23 Nov 2022

### 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: \_\_\_\_\_

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: U3641220.

Dimension : Diameter 12 mm. Length 80 mm.

| Immersion<br>Depth<br>(mm) | Standard<br>Reading<br>(°C) | UUC<br>Reading<br>(°C) | Error<br>(°C) | Uncertainty<br>(°C) |
|----------------------------|-----------------------------|------------------------|---------------|---------------------|
| 60                         | 19.98                       | 19.9                   | -0.1          | 0.30                |
| 60                         | 25.00                       | 24.8                   | -0.2          | 0.30                |
| 60                         | 30.00                       | 29.8                   | -0.2          | 0.30                |
| 60                         | 35.01                       | 34.7                   | -0.3          | 0.30                |
| 60                         | 40.01                       | 39.5                   | -0.5          | 0.30                |

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-02112022

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger  
Manufacturer : Novalynx  
Model/Type : 110-WS-25DL-D  
Serial Number : A5909  
ID No. : RYG\_FS0608  
Customer : ALS laboratory group (Thailand) Co., Ltd.  
: 104 Phalphanakan 40, Phalphanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok  
10250 Thailand.

### Environmental Condition:

The measurement was carried out in an ambient temperature of  $(25 \pm 3)^{\circ}\text{C}$ , and relative humidity of  $(50 \pm 15)\%$ .

### 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 : Nov 18, 2022

Issued Date : Nov 23, 2022

### Measurement Results:

This equipment was connected with Indoor air quality probe and Displayed (UR) on display. Model: HMP60, Serial number: U3641220

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                  | 19.94                       | 17.4                   | -2.5           | 0.57                       |
| 50                  | 50.31                       | 47.1                   | -3.3           | 0.55                       |
| 80                  | 80.30                       | 77.4                   | -2.9           | 0.57                       |

Performed by

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn Lertsomphot



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

Mr. Parinya Booncharoen.  
Calibration Department Manager

|                    |
|--------------------|
| Certificate Number |
| CWS-002-66         |

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM  
MANUFACTURER  
MODEL/TYPE**

: Cup anemometer  
: Novalynx  
: Sensor: WS-02F  
Data logger: 110-WS-25DL-D

**SERIAL NUMBER**

: Sensor: WSD-A5816  
Data logger: A5816

**ID NUMBER**

: RYG\_FS0545

**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.

**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 (23.9) °C, (45.7) %RH and (1008.2) 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.

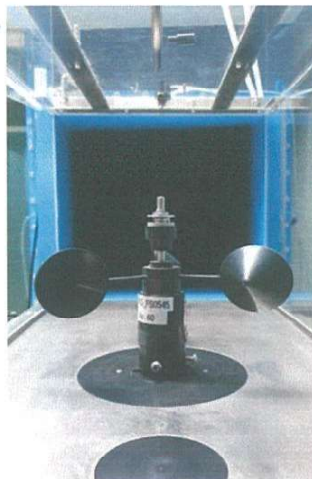
| $V_{std}^6$<br>(m/s) | Temp. wind tunnel<br>(°C) | Temp. room<br>(°C) | $V_{UUC}^7$<br>(m/s) | Error<br>(m/s) | $U (k=2)$<br>(m/s) |
|----------------------|---------------------------|--------------------|----------------------|----------------|--------------------|
| 1.023                | 23.80                     | 23.90              | 0.8                  | -0.2           | 0.31               |
| 2.078                | 24.00                     | 23.90              | 1.8                  | -0.2           | 0.31               |
| 3.021                | 23.78                     | 23.90              | 2.8                  | -0.2           | 0.31               |
| 4.148                | 23.92                     | 23.90              | 3.9                  | -0.2           | 0.31               |
| 5.00                 | 23.60                     | 23.90              | 4.8                  | -0.2           | 0.31               |
| 5.99                 | 23.68                     | 23.90              | 5.8                  | -0.2           | 0.31               |
| 7.03                 | 23.50                     | 23.90              | 6.8                  | -0.2           | 0.31               |
| 8.16                 | 23.60                     | 23.90              | 7.9                  | -0.3           | 0.31               |
| 9.08                 | 23.50                     | 23.90              | 8.9                  | -0.2           | 0.31               |
| 10.06                | 23.78                     | 23.90              | 9.8                  | -0.3           | 0.31               |
| 11.13                | 23.50                     | 23.90              | 10.9                 | -0.2           | 0.31               |
| 12.11                | 23.78                     | 23.90              | 12.0                 | -0.1           | 0.31               |
| 13.16                | 23.50                     | 23.90              | 12.9                 | -0.3           | 0.31               |
| 14.21                | 23.66                     | 23.90              | 14.0                 | -0.2           | 0.31               |
| 15.18                | 23.50                     | 23.90              | 15.0                 | -0.2           | 0.31               |
| 16.26                | 23.58                     | 23.90              | 16.0                 | -0.3           | 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.



Certificate Number

CWD-002-66

## 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-A5816  
 Data logger: A5816  
**ID NUMBER** : RYG\_FS0545  
**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 CONDITION</b> | : Wind tunnel cross-section area <sup>1</sup> | 900   | cm <sup>2</sup> |
|                              | Win direction frontal area <sup>2</sup>       | 129   | cm <sup>2</sup> |
|                              | Diameter of mounting pipe <sup>3</sup>        | -     | mm              |
|                              | Blockage ratio of test object <sup>4</sup>    | 0.143 | [-]             |

**Preconditioning** : 24 hours at ambient conditions.  
**Measurement Condition** : The average values during measurement are (23.8)°C, (46.9) %RH and (1012.4) 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 | $D^6_{std}$<br>Degree (°) | $D^7_{uuc}$<br>Degree (°) | Error<br>Degree (°) | $U (k=2)$<br>Degree (°) |
|------------------|---------------------------|---------------------------|---------------------|-------------------------|
| 5.00             | 45.000                    | 42                        | -3                  | 1.0                     |
|                  | 90.000                    | 87                        | -3                  | 1.0                     |
|                  | 135.000                   | 133                       | -2                  | 1.0                     |
|                  | 180.000                   | 181                       | 1                   | 1.0                     |
|                  | 225.000                   | 229                       | 4                   | 1.0                     |
|                  | 270.001                   | 273                       | 3                   | 1.0                     |
|                  | 315.000                   | 317                       | 2                   | 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-038-66  
Page 1 of 2

**Equipment Name:** Data Logger with Temperature sensor  
**Manufacturer:** Novalynx  
**Model:** 110-WS-25DL-D  
**Serial No.:** A5816  
**ID No.:** RYG\_FS0545

### 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: T2320595.

Dimension : Diameter 12 mm. Length 80 mm.

| <u>Immersion</u><br><u>Depth</u><br>(mm) | <u>Standard</u><br><u>Reading</u><br>(°C) | <u>UUC</u><br><u>Reading</u><br>(°C) | <u>Error</u><br>(°C) | <u>Uncertainty</u><br>(°C) |
|------------------------------------------|-------------------------------------------|--------------------------------------|----------------------|----------------------------|
| 70                                       | 20.060                                    | 19.6                                 | -0.5                 | 0.099                      |
| 70                                       | 25.055                                    | 24.6                                 | -0.4                 | 0.14                       |
| 70                                       | 30.050                                    | 29.7                                 | -0.4                 | 0.099                      |
| 70                                       | 35.043                                    | 34.5                                 | -0.5                 | 0.099                      |
| 70                                       | 40.036                                    | 39.5                                 | -0.5                 | 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-02072023

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger  
Manufacturer : Novalynx  
Model/Type : 110-WS-25DL-D  
Serial Number : A5816  
ID No. : RYG\_FS0545  
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: T2320595.

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                  | 20.05                       | 17.5                   | -2.6           | 0.52                       |
| 50                  | 50.23                       | 46.5                   | -3.7           | 0.51                       |
| 80                  | 80.25                       | 75.5                   | -4.8           | 0.51                       |

### Performed by

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



Approved Signatory: .....

Mr. Parinya Booncharoen.  
Calibration Department Manager



## Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK\_FS0522      Calibration Date : 13 Jul 23  
 Lab test duct Number : 258-1-13-01      Standard Pitot ID : BKK\_FS0441  
 Calibration Sheet No. : C-130723-BKK\_FS0522      Cp Standard : 0.99

| Type S Pitot Tube Coefficient Data |                              |                                                            |                                                          |                 |                 |
|------------------------------------|------------------------------|------------------------------------------------------------|----------------------------------------------------------|-----------------|-----------------|
|                                    | Type s pitot<br>tube Leg A,B | Standard pitot tube<br>( $\Delta P$ , mm.H <sub>2</sub> O) | Type s pitot tube<br>( $\Delta P$ , mm.H <sub>2</sub> O) | Cp (s)<br>Leg A | Cp (s)<br>Leg B |
| Test 1                             | A                            | 12.00                                                      | 17.00                                                    | 0.840           | -               |
|                                    | B                            | 12.00                                                      | 17.00                                                    | -               | 0.840           |
| Test 2                             | A                            | 12.00                                                      | 17.00                                                    | 0.840           | -               |
|                                    | B                            | 12.00                                                      | 17.00                                                    | -               | 0.840           |
| Test 3                             | A                            | 12.00                                                      | 16.80                                                    | 0.845           | -               |
|                                    | B                            | 12.00                                                      | 16.80                                                    | -               | 0.845           |
| $\bar{C}_p$                        |                              |                                                            |                                                          | 0.842           | 0.842           |

$$Cp(S) = Cp_{(std)} \sqrt{\frac{\Delta P(std)}{\Delta P(s)}}$$

$$\left[ \bar{C}_{p(A)} - \bar{C}_{p(B)} \right] \text{ must } BE \leq 0.01$$

$$\text{Average deviation(A or B)} = \frac{\sum_i [Cp(s) - Cp(A \text{ or } B)]}{3} \text{ must } BE \leq 0.01$$

Calibrated by

Saksit Phaisanphisut

( Mr. Saksit Phaisanphisut )

Field Scientist (4)

Approved by

Nattapon Jiengwareewong

( Mr. Nattapon Jiengwareewong )

Specialist (1)



**Certificate No:** G 660018

**Date of issue :** 23-Jan-23

**Instrument description :** Flue gas Analyzer  
**Instrument model :** Testo 350 New  
**Instrument serial no. :** 62985049  
**ID no. or control no. :** RYG\_FS0564  
**Manufacturer :** Testo SE & Co. KGaA  
**Probe description :** -  
**Probe model :** -  
**Probe serial :** -  
**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-230152  
**Receiving date. :** 19-Jan-23  
**Parameter of calibration :** Gas Calibration(Oxygen 2.498,10.04,21.02 %vol, Carbon Monoxide 80.14,309.9,1003 ppm,  
 Nitrogen Dioxide 30.34,80.96,202.2 ppm, Nitric Oxide 30.08,150.9,320.6 ppm,  
 Sulphur Dioxide 50.04,100.8,601.1 ppm)

|                |                    |
|----------------|--------------------|
| REVIEW BY      | <i>Hirakorn P.</i> |
| APPROVED BY    | <i>[Signature]</i> |
| NEXT CAL. DATE | 20/1/24            |

**Condition of UUC. :** Used  
**Ambient condition :** All of the Measurement were carried out the stabilized laboratory  
 Temperature : 23 ± 5 °C  
 Humidity : 55 ± 15 %RH  
**Calibration place :** 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210  
**Calibration procedure no. :** WI-CL-28-C

*The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement 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 reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature and seal not valid.*

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

**Date of calibration :** 20-Jan-23



Mr. Sedtawut Nueathong  
Calibration Technician



Mrs. Nongluck Wongsettee  
Technical Manager

### 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 ) 309.9 ppm               | 2803/21         | Linde  | 22-Jun-23 |
| Carbon monoxide ( CO ) 1003 ppm                | 2583/22         | Linde  | 09-Aug-24 |
| Nitrogen Dioxide ( NO <sub>2</sub> ) 30.34 ppm | 2703/22         | Linde  | 22-Aug-24 |
| Nitrogen Dioxide ( NO <sub>2</sub> ) 80.96 ppm | 2041/22         | Linde  | 26-Jun-24 |
| Nitrogen Dioxide ( NO <sub>2</sub> ) 202.2 ppm | 3239/21         | Linde  | 20-Jul-23 |
| Nitric Oxide ( NO ) 30.08 ppm                  | CG-0089-22      | Nimt   | 13-Jun-24 |
| Nitric Oxide ( NO ) 150.9 ppm                  | 2857/21         | Linde  | 27-Jun-23 |
| Nitric Oxide ( NO ) 320.6 ppm                  | 2944/21         | Linde  | 02-Jul-23 |
| Sulphur Dioxide ( SO <sub>2</sub> ) 50.04 ppm  | 3205/21         | Linde  | 25-Jul-23 |
| Sulphur Dioxide ( SO <sub>2</sub> ) 100.8 ppm  | 3507/22         | Linde  | 09-Nov-24 |
| Sulphur Dioxide ( SO <sub>2</sub> ) 601.1 ppm  | 3204/21         | Linde  | 20-Jul-23 |

### Measured room conditions

Temperature : 22.8 °C Humidity : 58.5 %RH Pressure : 1013.5 mbar

### Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,200 ml/min Gas pressure : 1021.4 mbar

### Calibration Results Before Adjustment (Table 2)

| Parameter of Standard | Standard Values | Mean of UUC | Error  | Uncertainty ( ± ) |
|-----------------------|-----------------|-------------|--------|-------------------|
| O <sub>2</sub> (%Vol) | 2.498           | 2.45        | -0.048 | 0.20              |
| O <sub>2</sub> (%Vol) | 10.04           | 9.89        | -0.15  | 0.40              |
| O <sub>2</sub> (%Vol) | 21.02           | 21.16       | 0.14   | 0.80              |
| CO (ppm)              | 80.14           | 82          | 1.86   | 3.0               |
| CO (ppm)              | 309.9           | 313         | 13.1   | 6.0               |
| CO (ppm)              | 1003            | 1014        | 11     | 12                |
| NO <sub>2</sub> (ppm) | 30.34           | 21.9        | -8.44  | 8.0               |
| NO <sub>2</sub> (ppm) | 80.96           | 55.3        | -25.66 | 8.0               |
| NO <sub>2</sub> (ppm) | 202.2           | 154.8       | -47.4  | 12                |
| NO (ppm)              | 30.08           | 27          | -3.08  | 8.0               |
| NO (ppm)              | 150.9           | 145         | -5.9   | 8.0               |
| NO (ppm)              | 320.6           | 304         | -16.6  | 12                |
| SO <sub>2</sub> (ppm) | 50.04           | 50          | -0.04  | 6.0               |
| SO <sub>2</sub> (ppm) | 100.8           | 100         | -0.8   | 6.0               |
| SO <sub>2</sub> (ppm) | 601.1           | 598         | -3.1   | 13                |

Calibration Results After Adjustment (Table 3)

| Parameter of Standard | Standard Values | Mean of UUC | Error  | Uncertainty (±) |
|-----------------------|-----------------|-------------|--------|-----------------|
| O2 (%Vol)             | 2.498           | 2.45        | -0.048 | 0.20            |
| O2 (%Vol)             | 10.04           | 9.89        | -0.15  | 0.40            |
| O2 (%Vol)             | 21.02           | 21.16       | 0.14   | 0.80            |
| CO (ppm)              | 80.14           | 82          | 1.86   | 3.0             |
| CO (ppm)              | 309.9           | 313         | 3.1    | 6.0             |
| CO (ppm)              | 1003            | 1014        | 11     | 12              |
| NO2 (ppm)             | 30.34           | 31.2        | 0.86   | 8.0             |
| NO2 (ppm)             | 80.96           | 82.7        | 1.74   | 8.0             |
| NO2 (ppm)             | 202.2           | 205.6       | 3.4    | 12              |
| NO (ppm)              | 30.08           | 32          | 1.90   | 8.0             |
| NO (ppm)              | 150.9           | 153         | 2.1    | 8.0             |
| NO (ppm)              | 320.6           | 322         | 1.4    | 12              |
| SO2 (ppm)             | 50.04           | 50          | -0.04  | 6.0             |
| SO2 (ppm)             | 100.8           | 100         | -0.8   | 6.0             |
| SO2 (ppm)             | 601.1           | 598         | -3.1   | 13              |

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

**End of Report**



## ROTA METER CALIBRATION RESULT OCTOBER 2023

| Rotameter ID. | Calibration Date | Regression Result      | Coefficient (R <sup>2</sup> ) |
|---------------|------------------|------------------------|-------------------------------|
| BKK_FS0577    | 02 Oct 23        | $Y = 1.2862x - 1.2952$ | 0.9963                        |
| BKK_FS0579    | 02 Oct 23        | $Y = 1.2546x + 0.0065$ | 0.9946                        |
| BKK_FS0583    | 03 Oct 23        | $Y = 1.0773x - 2.4138$ | 0.9989                        |
| BKK_FS0584    | 02 Oct 23        | $Y = 0.9787x + 12.569$ | 0.9999                        |
| BKK_FS0585    | 18 Oct 23        | $Y = 1.0322x + 3.7767$ | 0.9998                        |
| BKK_FS0586    | 02 Oct 23        | $Y = 0.9777x + 15.405$ | 0.9997                        |
| BKK_FS0587    | 18 Oct 23        | $Y = 1.0175x + 14.717$ | 0.9997                        |
| BKK_FS0589    | 03 Oct 23        | $Y = 1.0148x + 2.4143$ | 1.0000                        |
| BKK_FS0590    | 03 Oct 23        | $Y = 1.0088x + 0.8429$ | 1.0000                        |
| BKK_FS0591    | 02 Oct 23        | $Y = 1.0733x - 88.805$ | 0.9989                        |
| BKK_FS0592    | 18 Oct 23        | $Y = 1.0037x + 10.388$ | 1.0000                        |
| BKK_FS0593    | 02 Oct 23        | $Y = 1.0538x - 60.63$  | 0.9996                        |
| BKK_FS0594    | 18 Oct 23        | $Y = 1.0052x + 5.3238$ | 0.9999                        |
| BKK_FS0596    | 03 Oct 23        | $Y = 1.0449x - 48.241$ | 0.9996                        |
| BKK_FS0597    | 03 Oct 23        | $Y = 1.0697x - 83.62$  | 0.9994                        |
| BKK_FS1004    | 02 Oct 23        | $Y = 0.9855x + 14.75$  | 0.9992                        |
| BKK_FS1005    | 02 Oct 23        | $Y = 1.02x + 1.7167$   | 0.9996                        |
| BKK_FS1006    | 02 Oct 23        | $Y = 1.1762x - 3.5619$ | 0.9999                        |
| BKK_FS1007    | 18 Oct 23        | $Y = 1.1405x + 2.6044$ | 0.9993                        |
| BKK_FS1008    | 18 Oct 23        | $Y = 1.1267x + 4.8333$ | 0.9991                        |
| BKK_FS1010    | 03 Oct 23        | $Y = 1.0027x + 2.5832$ | 0.9986                        |
| BKK_FS1011    | 02 Oct 23        | $Y = 1.3811x - 6.2068$ | 0.9998                        |
| BKK_FS1012    | 02 Oct 23        | $Y = 1.0017x + 0.9$    | 1.0000                        |
| BKK_FS1013    | 02 Oct 23        | $Y = 1.0593x - 46.02$  | 0.9994                        |
| BKK_FS1014    | 03 Oct 23        | $Y = 1.0961x - 1.6895$ | 0.9983                        |
| BKK_FS1015    | 03 Oct 23        | $Y = 0.9979x + 6.2595$ | 0.9993                        |
| BKK_FS1016    | 03 Oct 23        | $Y = 1.0683x - 82.491$ | 0.9995                        |
| BKK_FS1017    | 06 Oct 23        | $Y = 0.9981x - 2.2235$ | 0.9998                        |
| BKK_FS1018    | 06 Oct 23        | $Y = 0.9817x - 20.653$ | 0.9999                        |
| BKK_FS1019    | 06 Oct 23        | $Y = 1.0152x - 64.485$ | 0.9998                        |
| BKK_FS1020    | 02 Oct 23        | $Y = 1.2691x - 2.4721$ | 0.9983                        |
| BKK_FS1021    | 02 Oct 23        | $Y = 1.0036x + 2.3286$ | 0.9999                        |
| BKK_FS1022    | 02 Oct 23        | $Y = 1.0633x - 73.266$ | 0.9990                        |
| BKK_FS1023    | 03 Oct 23        | $Y = 1.0879x - 1.0694$ | 0.9984                        |
| BKK_FS1024    | 02 Oct 23        | $Y = 1.0035x + 1.4857$ | 1.0000                        |
| BKK_FS1025    | 03 Oct 23        | $Y = 1.0556x - 58.597$ | 0.9999                        |
| BKK_FS1026    | 02 Oct 23        | $Y = 1.2894x - 1.497$  | 0.9970                        |
| BKK_FS1027    | 02 Oct 23        | $Y = 1.0032x + 1.5167$ | 1.0000                        |
| BKK_FS1028    | 02 Oct 23        | $Y = 1.0433x - 30.012$ | 0.9994                        |





## ROTA METER CALIBRATION RESULT OCTOBER 2023

| Rotameter ID. | Calibration Date | Regression Result      | Coefficient (R <sup>2</sup> ) |
|---------------|------------------|------------------------|-------------------------------|
| BKK_FS1029    | 02 Oct 23        | $Y = 1.3494x - 3.5078$ | 0.9981                        |
| BKK_FS1030    | 02 Oct 23        | $Y = 1.0015x + 1.2214$ | 1.0000                        |
| BKK_FS1031    | 02 Oct 23        | $Y = 1.0516x - 56.996$ | 0.9994                        |
| BKK_FS1039    | 02 Oct 23        | $Y = 0.9991x + 14.527$ | 0.9994                        |
| BKK_FS1040    | 02 Oct 23        | $Y = 1.0049x - 2.4324$ | 1.0000                        |
| BKK_FS1041    | 02 Oct 23        | $Y = 1.1682x - 2.1293$ | 1.0000                        |
| BKK_FS1042    | 02 Oct 23        | $Y = 1.0051x + 6.2533$ | 0.9989                        |
| BKK_FS1043    | 02 Oct 23        | $Y = 1.0022x + 3.96$   | 1.0000                        |
| BKK_FS1044    | 02 Oct 23        | $Y = 1.0796x + 2.9806$ | 0.9993                        |
| BKK_FS1164    | 02 Oct 23        | $Y = 1.2714x + 0.234$  | 0.9945                        |
| BKK_FS1165    | 02 Oct 23        | $Y = 1.0029x + 3.3571$ | 0.9994                        |
| BKK_FS1166    | 02 Oct 23        | $Y = 1.061x - 56.83$   | 1.0000                        |
| BKK_FS1200    | 02 Oct 23        | $Y = 1.2803x - 1.4599$ | 0.9962                        |
| BKK_FS1201    | 02 Oct 23        | $Y = 1.0374x - 6.1952$ | 1.0000                        |
| BKK_FS1202    | 02 Oct 23        | $Y = 1.0486x - 44.05$  | 0.9997                        |
| PHK_FS0027    | 09 Oct 23        | $Y = 1.1052x + 1.0293$ | 1.0000                        |
| PHK_FS0028    | 09 Oct 23        | $Y = 1.0377x - 1.9833$ | 1.0000                        |
| PHK_FS0029    | 09 Oct 23        | $Y = 1.0021x + 7.5248$ | 1.0000                        |
| RYG_FS0197    | 02 Oct 23        | $Y = 1.0036x + 9.0133$ | 1.0000                        |
| RYG_FS0198    | 02 Oct 23        | $Y = 0.9991x + 17.568$ | 1.0000                        |
| RYG_FS0199    | 02 Oct 23        | $Y = 1.0814x - 1.2993$ | 0.9997                        |
| RYG_FS0654    | 02 Oct 23        | $Y = 1.1168x - 2.1207$ | 1.0000                        |
| RYG_FS0655    | 02 Oct 23        | $Y = 1.0086x + 6.2733$ | 0.9991                        |
| RYG_FS0656    | 02 Oct 23        | $Y = 1.0009x + 8.48$   | 1.0000                        |
| RYG_FS0657    | 02 Oct 23        | $Y = 1.0435x + 2.6459$ | 0.9999                        |
| RYG_FS0658    | 02 Oct 23        | $Y = 0.9788x + 10.283$ | 0.9992                        |
| RYG_FS0659    | 02 Oct 23        | $Y = 1.0074x - 6.621$  | 1.0000                        |
| SGK_FS0135    | 18 Oct 23        | $Y = 0.9831x + 14.843$ | 0.9994                        |
| SGK_FS0138    | 06 Oct 23        | $Y = 1.0831x - 0.8401$ | 0.9998                        |
| SGK_FS0139    | 06 Oct 23        | $Y = 0.9826x + 8.6567$ | 1.0000                        |
| SGK_FS0140    | 06 Oct 23        | $Y = 1.0011x + 7.8095$ | 1.0000                        |
| SGK_FS0141    | 06 Oct 23        | $Y = 1.125x - 1.2259$  | 0.9998                        |
| SGK_FS0142    | 06 Oct 23        | $Y = 0.9956x + 10.257$ | 0.9997                        |
| SGK_FS0143    | 06 Oct 23        | $Y = 1.004x + 3.3105$  | 1.0000                        |

Review By :

(Mr. Wichan Choonharat)

Enviro Field Services Manager

Approved By :

(Mr. Sarayuth Jittrantont)

Assistant General Manager

# Certificate of System Qualification

GC-OQ + GCMS-OQ

|                |            |
|----------------|------------|
| REVIEW BY      | Suchada T. |
| APPROVED BY    | Tamara M.  |
| NEXT CAL. DATE | 18 Oct 24  |

System ID: GM-2  
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.  
Organization Location: 104 Phatthanakan 40, Phatthanakan Rd., Kheiwang 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:

&lt;=

5.00

&lt;=

5.00

Pass

Pass

**Overall Mass Ratio Precision Test Status**

Pass

Date:

April 18, 2023 3:15:25 PM

System ID:

GM-2

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

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.nilmsongtham  
 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 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 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 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 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 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 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 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 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 verification state but the user 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 : 13-Jul-23  
Next Cal. Date : 13-Jan-24

Barometric Pressure (mmHg) : 752  
Relative Humidity (%) : 56.6  
Temperature (C°) : 31.0

## Console Control Meter Data

Calibration No. : C-130723-BKK\_FS518  
Dry Gas Meter ID : BKK\_FS0518  
Serial No. : 1504025  
Model No. : XC-572-V

Reference Dry Gas Meter ID : BKK\_FS0629  
Serial No. : 1607009  
Correction Factor (Y) : 1.0000  
Next Calibration Date : 9 Dec 23

## Reference Dry Gas Meter Data

| $\Delta H$<br>(mm.H <sub>2</sub> O) | $\Theta$<br>Minutes | Reference Dry Gas Meter Calibration |         |        | Console Control ; Drygas Meter |             |          |        |            |            |                | Dry Gas Meter<br>Correction<br>Factor<br>(Y) | Orifice<br>Calibration<br>Factor<br>$\Delta H @$ |
|-------------------------------------|---------------------|-------------------------------------|---------|--------|--------------------------------|-------------|----------|--------|------------|------------|----------------|----------------------------------------------|--------------------------------------------------|
|                                     |                     | Vr (Liters)                         |         |        | Tr<br>(°C)                     | Vm (Liters) |          |        | Ti<br>(°C) | To<br>(°C) | Avg.Tm<br>(°C) |                                              |                                                  |
|                                     |                     | Final                               | Initial | Total  |                                | Final       | Initial  | Total  |            |            |                |                                              |                                                  |
|                                     |                     |                                     |         |        |                                |             |          |        |            |            |                |                                              |                                                  |
| 15                                  | 12.10               | 150.22                              | 0.00    | 150.22 | 30.0                           | 426310.0    | 426158.0 | 152.00 | 31.0       | 31.0       | 31.0           | 0.9901                                       | 44.9858                                          |
| 25                                  | 9.32                | 150.20                              | 0.00    | 150.20 | 30.0                           | 426470.0    | 426317.0 | 153.00 | 31.0       | 31.0       | 31.0           | 0.9825                                       | 44.4940                                          |
| 50                                  | 6.51                | 150.23                              | 0.00    | 150.23 | 31.0                           | 426632.0    | 426480.0 | 152.00 | 32.0       | 32.0       | 32.0           | 0.9868                                       | 43.5435                                          |
| 100                                 | 4.59                | 150.40                              | 0.00    | 150.40 | 31.0                           | 426798.0    | 426646.0 | 152.00 | 32.0       | 32.0       | 32.0           | 0.9831                                       | 43.1951                                          |
| 150                                 | 3.75                | 150.20                              | 0.00    | 150.20 | 32.0                           | 426973.0    | 426820.0 | 153.00 | 32.0       | 32.0       | 32.0           | 0.9675                                       | 43.6487                                          |
| Avg.                                |                     |                                     |         |        |                                |             |          |        |            |            | 0.9820         | 43.9734                                      |                                                  |

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 , mmH2O ; tolerance for individual values  $\pm 5,08$  from average .

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

Calibrated by:

Saksit Phaisanphisit

( Mr. Saksit Phaisanphisit )

Field Scientist(4)

Approved by:

Nattapon Jengwareewong

( Mr.Nattapol Jengwareewong )

Field Specialist(1)



## Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK\_FS0522

Calibration Date : 13 Jul 23

Lab test duct Number : 258-1-13-01

Standard Pitot ID : BKK\_FS0441

Calibration Sheet No. : C-130723-BKK\_FS0522

Cp Standard : 0.99

| Type S Pitot Tube Coefficient Data |                              |                                                            |                                                          |                 |                 |
|------------------------------------|------------------------------|------------------------------------------------------------|----------------------------------------------------------|-----------------|-----------------|
|                                    | Type s pitot<br>tube Leg A,B | Standard pitot tube<br>( $\Delta P$ , mm.H <sub>2</sub> O) | Type s pitot tube<br>( $\Delta P$ , mm.H <sub>2</sub> O) | Cp (s)<br>Leg A | Cp (s)<br>Leg B |
| Test 1                             | A                            | 12.00                                                      | 17.00                                                    | 0.840           | -               |
|                                    | B                            | 12.00                                                      | 17.00                                                    | -               | 0.840           |
| Test 2                             | A                            | 12.00                                                      | 17.00                                                    | 0.840           | -               |
|                                    | B                            | 12.00                                                      | 17.00                                                    | -               | 0.840           |
| Test 3                             | A                            | 12.00                                                      | 16.80                                                    | 0.845           | -               |
|                                    | B                            | 12.00                                                      | 16.80                                                    | -               | 0.845           |
| $\bar{C}_p$                        |                              |                                                            |                                                          | 0.842           | 0.842           |

$$Cp(S) = Cp_{(std)} \sqrt{\frac{\Delta P(std)}{\Delta P(s)}}$$

$$\left| \bar{C}_{p(A)} - \bar{C}_{p(B)} \right| \text{ must } BE \leq 0.01$$

$$\text{Average deviation(A or B)} = \frac{\sum_i [Cp(s) - Cp(A \text{ or } B)]}{3} \text{ must } BE \leq 0.01$$

Calibrated by

Saksit Phaisanphisut

( Mr. Saksit Phaisanphisut )

Field Scientist (4)

Approved by

Nattapon Jiengwareewong

( Mr. Nattapon Jiengwareewong )

Specialist (1)



## Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK\_FS0523

Calibration Date : 13 Jul 23

Lab test duct Number : 258-1-13-01

Standard Pitot ID : BKK\_FS0441

Calibration Sheet No. : C-130723-BKK\_FS0523

Cp Standard : 0.99

| Type S Pitot Tube Coefficient Data |                              |                                                            |                                                          |                 |                 |
|------------------------------------|------------------------------|------------------------------------------------------------|----------------------------------------------------------|-----------------|-----------------|
|                                    | Type s pitot<br>tube Leg A,B | Standard pitot tube<br>( $\Delta P$ , mm.H <sub>2</sub> O) | Type s pitot tube<br>( $\Delta P$ , mm.H <sub>2</sub> O) | Cp (s)<br>Leg A | Cp (s)<br>Leg B |
| Test 1                             | A                            | 12.00                                                      | 17.00                                                    | 0.840           | -               |
|                                    | B                            | 12.00                                                      | 17.00                                                    | -               | 0.840           |
| Test 2                             | A                            | 12.00                                                      | 17.00                                                    | 0.840           | -               |
|                                    | B                            | 12.00                                                      | 17.00                                                    | -               | 0.840           |
| Test 3                             | A                            | 12.00                                                      | 16.80                                                    | 0.845           | -               |
|                                    | B                            | 12.00                                                      | 16.80                                                    | -               | 0.845           |
| $\bar{C}_p$                        |                              |                                                            |                                                          | 0.842           | 0.842           |

$$Cp(S) = Cp_{(std)} \sqrt{\frac{\Delta P(std)}{\Delta P(s)}}$$

$$\left| \bar{C}_{p(A)} - \bar{C}_{p(B)} \right| \text{ must } BE \leq 0.01$$

$$\text{Average deviation(A or B)} = \frac{\sum_i [Cp(s) - Cp(A \text{ or } B)]}{3} \text{ must } BE \leq 0.01$$

Calibrated by

Saksit Phaisanphisut

( Mr. Saksit Phaisanphisut )

Field Scientist (4)

Approved by

Nattapon Jiengwareewong

( Mr. Nattapon Jiengwareewong )

Specialist (1)





## DIGITAL TEMPERATURE CALIBRATION DATA SHEET

|                          |                     |                          |                  |
|--------------------------|---------------------|--------------------------|------------------|
| Calibration Date :       | 13 Jul 23           | Ambient Temperature (°C) | 29               |
| Calibration sheet No. :  | C-130723-BKK_FS0519 | Relative Humidity (%) :  | 60               |
| Digital Temperature ID : | BKK_FS0519          | Reference Temperature ID | BKK_FS1144       |
| Serial No. :             | 1504025             | Serial No. :             | 201090006013     |
| Model :                  | XC-572-V            | Model :                  | Digicon-CC-VT-MS |
|                          |                     | Next Calibrate :         | 14 Aug 24        |

| Location | Reference Temperature<br>°C | Digital Temperature<br>°C | Error<br>°C | MPE | Pass / Fail |
|----------|-----------------------------|---------------------------|-------------|-----|-------------|
| Stack    | 0                           | 0                         | 0           | ±3  | Pass        |
|          | 25                          | 25                        | 0           | ±3  | Pass        |
|          | 50                          | 50                        | 0           | ±3  | Pass        |
|          | 100                         | 100                       | 0           | ±3  | Pass        |
|          | 150                         | 150                       | 0           | ±3  | Pass        |
|          | 200                         | 200                       | 0           | ±3  | Pass        |
|          | 250                         | 250                       | 0           | ±3  | Pass        |
|          | 300                         | 300                       | 0           | ±3  | Pass        |
| Probe    | 500                         | 500                       | 0           | ±3  | Pass        |
|          | 100                         | 100                       | 0           | ±3  | Pass        |
|          | 120                         | 120                       | 0           | ±3  | Pass        |
| Oven     | 140                         | 140                       | 0           | ±3  | Pass        |
|          | 100                         | 100                       | 0           | ±3  | Pass        |
|          | 120                         | 120                       | 0           | ±3  | Pass        |
| Filter   | 140                         | 140                       | 0           | ±3  | Pass        |
|          | 100                         | 100                       | 0           | ±3  | Pass        |
|          | 120                         | 120                       | 0           | ±3  | Pass        |
| Exit     | 140                         | 140                       | 0           | ±3  | Pass        |
|          | 0                           | 0                         | 0           | ±3  | Pass        |
|          | 10                          | 10                        | 0           | ±3  | Pass        |
| Meter    | 20                          | 20                        | 0           | ±3  | Pass        |
|          | 0                           | 0                         | 0           | ±3  | Pass        |
|          | 25                          | 25                        | 0           | ±3  | Pass        |
| AUX      | 50                          | 50                        | 0           | ±3  | Pass        |
|          | 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

Field Scientist (4)

Approved by :

*Nattapol Jiengwareewong*

Mr. Nattapol Jiengwareewong

Specialist (1)



PROBE NOZZLE DIAMETER  
CALIBRATION DATA SHEET

|                                             |                                 |
|---------------------------------------------|---------------------------------|
| Calibration Date : 13 Jul 23                | Nozzle Set ID. : BKK_FS0524     |
| Calibration Sheet No. : C-130723-BKK_FS0524 | Vernier Caliper ID.: BKK_FS1123 |

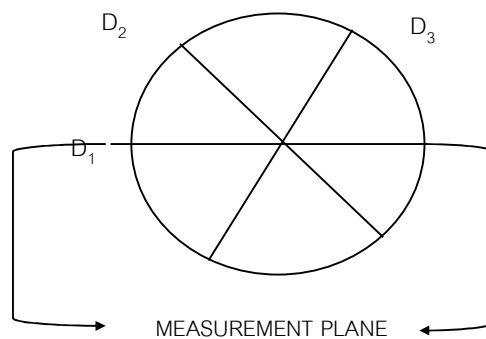
| Nozzle ID # | Nozzle Diameter (cm.) |       |       | Hi - Lo    | $(D_1 + D_2 + D_3) / 3$ |
|-------------|-----------------------|-------|-------|------------|-------------------------|
|             | $D_1$                 | $D_2$ | $D_3$ | $\Delta D$ | $D_{avg}$               |
| 1           | 0.318                 | 0.318 | 0.318 | 0.000      | 0.318                   |
| 2           | 0.472                 | 0.474 | 0.475 | 0.003      | 0.474                   |
| 3           | 0.632                 | 0.635 | 0.634 | 0.003      | 0.634                   |
| 4           | 0.792                 | 0.792 | 0.792 | 0.000      | 0.792                   |
| 5           | 0.952                 | 0.952 | 0.952 | 0.000      | 0.952                   |
| 6           | 1.091                 | 1.110 | 1.092 | 0.019      | 1.098                   |
| 7           | 1.256                 | 1.262 | 1.262 | 0.006      | 1.260                   |
| 8           | 1.601                 | 1.598 | 1.600 | 0.003      | 1.600                   |

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 )

Field Scientist (4)

Approved by : Nattapon Jiengwareewong

( Mr.Nattapol Jiengwareewong )

Field Specialist (1)

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

129 Rama 9 Road, 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      | Thaisall       |
| APPROVED BY    | D. [Signature] |
| NEXT CAL. DATE | 01/03/24       |

Model Number : MSE224S-100-DU

Certificate No. : 23BCI0115

Description : Analytical Balance

Issued Date : Friday, March 03, 2023

Serial Number : 0031709552

Reference No. : 204833

ID No. : RYG\_EN0003

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.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 : 220 g Readability : 0.0001 g

**Ambients Conditions:**

Temperature : 23.0 °C ± 5.0 °C

Humidity : 56.0 % 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 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 | 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.

Mr.chonchai Inthana(Technical Manager)

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**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-DUCertificate No. : 23BCI0115Description : Analytical BalanceIssued Date : Friday, March 03, 2023Serial Number : 0031709552Reference No. : 204833ID No. : RYG\_EN0003Manufacturer : SartoriusPage No. : 2 of 2

## Calibration Results : Without Adjustment

### Repeatability

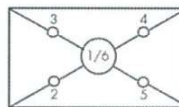
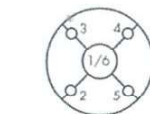
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

|                             |         |          |
|-----------------------------|---------|----------|
| Nominal Value : (Low Load)  | 20.0000 | 200.0000 |
| 20 g                        | 20.0001 | 200.0000 |
| Tolerance                   | 20.0000 | 200.0001 |
| 0.0001 g                    | 20.0000 | 200.0000 |
|                             | 20.0000 | 200.0001 |
| Nominal Value : (High Load) | 20.0001 | 200.0001 |
| 200 g                       | 20.0000 | 200.0001 |
| Tolerance                   | 20.0000 | 200.0000 |
| 0.0001 g                    | 20.0000 | 200.0001 |
|                             | 20.0000 | 200.0001 |
| Standard Deviation          | 0.00004 | 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 | 0.0001 |
| 3 | 0.0000 |
| 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            |
| 0.05                 | 0.0500                         | 0.0500                 | 0.0000           | 0.00013            |
| 0.1                  | 0.1000                         | 0.1000                 | 0.0000           | 0.00013            |
| 0.5                  | 0.5000                         | 0.5000                 | 0.0000           | 0.00014            |
| 1                    | 1.0000                         | 1.0000                 | 0.0000           | 0.00014            |
| 5                    | 5.0000                         | 5.0000                 | 0.0000           | 0.00014            |
| 10                   | 10.0000                        | 10.0000                | 0.0000           | 0.00014            |
| 20                   | 20.0000                        | 20.0000                | 0.0000           | 0.00024            |
| 50                   | 50.0000                        | 50.0000                | 0.0000           | 0.00015            |
| 100                  | 100.0000                       | 100.0000               | 0.0000           | 0.00019            |
| 200                  | 200.0000                       | 200.0001               | 0.0001           | 0.00032            |

End of Report.



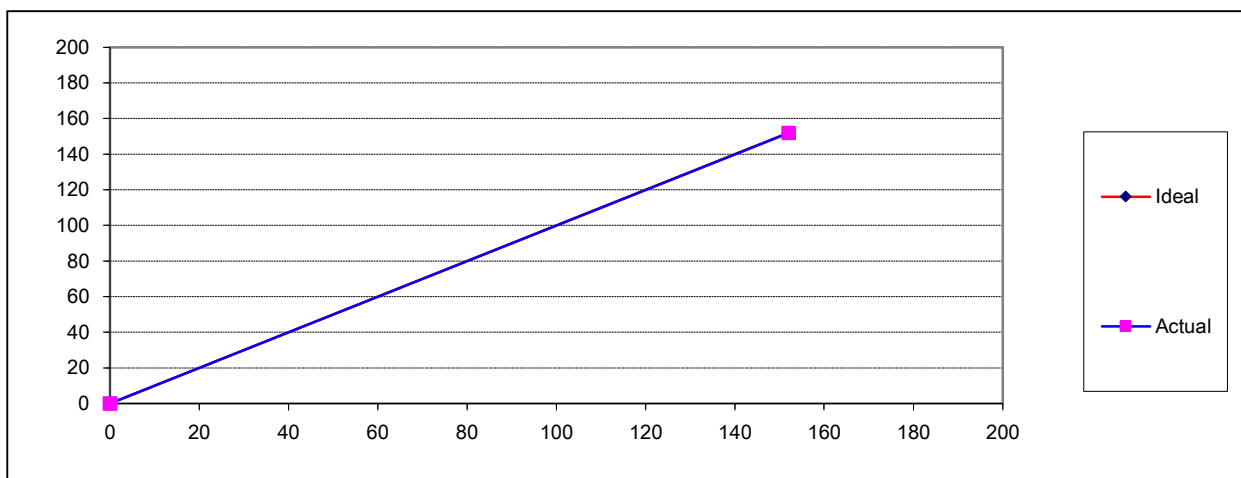


## CALIBRATION REPORT

|                    |              |              |                |
|--------------------|--------------|--------------|----------------|
| Calibration Date   | 1-Jul-23     | 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                | 0.02   | 0.02  | 0.02   |
| SPAN        | 152.00              | 151.85 | -0.15 | -0.10  |
| AVERAGE (%) |                     |        |       | -0.04  |



Calibrated By

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

Approved By

( Mr.Sarayuth Jittranont )  
Assistant General Manager



## ROTA METER CALIBRATION RESULT JULY 2023

| Rotameter ID. | Calibration Date | Regression Result      | Coefficient (R <sup>2</sup> ) |
|---------------|------------------|------------------------|-------------------------------|
| BKK_FS0577    | 03 Jul 23        | $Y = 1.2484x - 0.6741$ | 0.9931                        |
| BKK_FS0579    | 03 Jul 23        | $Y = 1.0997x - 0.4918$ | 1.0000                        |
| BKK_FS0583    | 01 Jul 23        | $Y = 1.0068x + 1.6459$ | 0.9998                        |
| BKK_FS0584    | 01 Jul 23        | $Y = 0.9804x + 9.469$  | 0.9999                        |
| BKK_FS0585    | 07 Jul 23        | $Y = 1.0248x + 0.8333$ | 0.9996                        |
| BKK_FS0586    | 01 Jul 23        | $Y = 0.9907x + 11.074$ | 1.0000                        |
| BKK_FS0587    | 07 Jul 23        | $Y = 0.986x + 17.77$   | 0.9993                        |
| BKK_FS0588    | 01 Jul 23        | $Y = 0.9751x + 9.8452$ | 0.9999                        |
| BKK_FS0589    | 03 Jul 23        | $Y = 1.0174x + 0.0381$ | 1.0000                        |
| BKK_FS0590    | 01 Jul 23        | $Y = 1.0127x - 3.4333$ | 1.0000                        |
| BKK_FS0591    | 03 Jul 23        | $Y = 1.0452x - 51.824$ | 0.9998                        |
| BKK_FS0592    | 07 Jul 23        | $Y = 1.0003x + 14.344$ | 1.0000                        |
| BKK_FS0593    | 01 Jul 23        | $Y = 1.0386x - 41.415$ | 0.9997                        |
| BKK_FS0594    | 07 Jul 23        | $Y = 1.0025x + 6.32$   | 0.9999                        |
| BKK_FS0595    | 01 Jul 23        | $Y = 1.0871x - 114.97$ | 0.9985                        |
| BKK_FS0596    | 03 Jul 23        | $Y = 1.038x - 51.974$  | 0.9993                        |
| BKK_FS0597    | 01 Jul 23        | $Y = 1.0059x - 9.9086$ | 1.0000                        |
| BKK_FS1004    | 01 Jul 23        | $Y = 1.0186x + 6.731$  | 0.9998                        |
| BKK_FS1005    | 01 Jul 23        | $Y = 0.9922x + 13.993$ | 0.9970                        |
| BKK_FS1006    | 01 Jul 23        | $Y = 1.1747x - 3.1235$ | 0.9991                        |
| BKK_FS1007    | 07 Jul 23        | $Y = 1.0737x + 0.8677$ | 0.9997                        |
| BKK_FS1008    | 07 Jul 23        | $Y = 1.0446x + 1.2156$ | 0.9999                        |
| BKK_FS1009    | 01 Jul 23        | $Y = 1.1044x - 0.8245$ | 1.0000                        |
| BKK_FS1010    | 03 Jul 23        | $Y = 1.2271x - 2.0139$ | 1.0000                        |
| BKK_FS1011    | 03 Jul 23        | $Y = 1.261x - 1.7003$  | 1.0000                        |
| BKK_FS1012    | 03 Jul 23        | $Y = 0.9978x - 3.7238$ | 0.9990                        |
| BKK_FS1013    | 03 Jul 23        | $Y = 1.0245x - 28.65$  | 0.9999                        |
| BKK_FS1014    | 01 Jul 23        | $Y = 1.3135x - 7.0966$ | 0.9961                        |
| BKK_FS1015    | 01 Jul 23        | $Y = 0.9802x + 3.8214$ | 0.9999                        |
| BKK_FS1016    | 01 Jul 23        | $Y = 1.0726x - 85.581$ | 0.9995                        |
| BKK_FS1020    | 01 Jul 23        | $Y = 1.1161x - 1.1986$ | 1.0000                        |
| BKK_FS1021    | 01 Jul 23        | $Y = 0.9566x + 16.524$ | 0.9987                        |
| BKK_FS1022    | 01 Jul 23        | $Y = 1.0712x - 89.51$  | 0.9990                        |
| BKK_FS1023    | 01 Jul 23        | $Y = 1.3791x - 8.8721$ | 0.9944                        |
| BKK_FS1024    | 01 Jul 23        | $Y = 0.9449x + 11.421$ | 0.9993                        |
| BKK_FS1025    | 01 Jul 23        | $Y = 1.0477x - 41.116$ | 1.0000                        |
| BKK_FS1026    | 01 Jul 23        | $Y = 1.3389x - 4.918$  | 1.0000                        |
| BKK_FS1027    | 01 Jul 23        | $Y = 0.9852x + 1.5238$ | 1.0000                        |
| BKK_FS1028    | 01 Jul 23        | $Y = 1.0281x - 19.897$ | 0.9996                        |



## ROTA METER CALIBRATION RESULT JULY 2023

| Rotameter ID. | Calibration Date | Regression Result      | Coefficient (R <sup>2</sup> ) |
|---------------|------------------|------------------------|-------------------------------|
| BKK_FS1029    | 01 Jul 23        | $Y = 1.3382x - 8.9776$ | 0.9941                        |
| BKK_FS1030    | 01 Jul 23        | $Y = 0.9818x + 2.3476$ | 0.9995                        |
| BKK_FS1031    | 01 Jul 23        | $Y = 1.0526x - 64.415$ | 0.9997                        |
| BKK_FS1039    | 01 Jul 23        | $Y = 0.998x + 14.823$  | 0.9997                        |
| BKK_FS1040    | 01 Jul 23        | $Y = 1.0041x - 2.7552$ | 0.9999                        |
| BKK_FS1041    | 01 Jul 23        | $Y = 1.116x - 1.0078$  | 0.9999                        |
| BKK_FS1042    | 01 Jul 23        | $Y = 1.0209x + 3.56$   | 0.9980                        |
| BKK_FS1043    | 01 Jul 23        | $Y = 1.0039x - 5.0143$ | 0.9999                        |
| BKK_FS1044    | 01 Jul 23        | $Y = 1.0807x + 0.9837$ | 0.9998                        |
| BKK_FS1164    | 03 Jul 23        | $Y = 1.0589x + 4.6061$ | 0.9996                        |
| BKK_FS1165    | 03 Jul 23        | $Y = 0.9809x + 7.5262$ | 0.9981                        |
| BKK_FS1166    | 03 Jul 23        | $Y = 1.0567x - 50.446$ | 0.9999                        |
| BKK_FS1200    | 03 Jul 23        | $Y = 1.3634x - 1.3816$ | 0.9991                        |
| BKK_FS1201    | 03 Jul 23        | $Y = 1.0388x - 7.0524$ | 0.9999                        |
| BKK_FS1202    | 03 Jul 23        | $Y = 1.0518x - 59.531$ | 0.9998                        |
| RYG_FS0197    | 01 Jul 23        | $Y = 1.0087x - 3.2838$ | 0.9999                        |
| RYG_FS0198    | 01 Jul 23        | $Y = 0.9877x + 36.487$ | 0.9999                        |
| RYG_FS0199    | 01 Jul 23        | $Y = 1.0299x - 0.367$  | 0.9992                        |
| PHK_FS0027    | 13 Jul 23        | $Y = 1.1219x - 2.2432$ | 0.9984                        |
| PHK_FS0028    | 13 Jul 23        | $Y = 1.0341x - 6.7967$ | 0.9999                        |
| PHK_FS0029    | 13 Jul 23        | $Y = 0.9977x + 8.7829$ | 0.9999                        |
| SGK_FS0135    | 14 Jul 23        | $Y = 0.9877x + 11.513$ | 0.9974                        |
| SGK_FS0138    | 13 Jul 23        | $Y = 1.0571x - 1.1565$ | 0.9991                        |
| SGK_FS0139    | 13 Jul 23        | $Y = 0.9801x + 8.6267$ | 0.9997                        |
| SGK_FS0140    | 13 Jul 23        | $Y = 0.9978x + 11.644$ | 1.0000                        |
| SGK_FS0141    | 13 Jul 23        | $Y = 1.1349x - 2.2867$ | 0.9990                        |
| SGK_FS0142    | 13 Jul 23        | $Y = 0.9915x + 11.403$ | 0.9994                        |
| SGK_FS0143    | 13 Jul 23        | $Y = 1.0054x - 4.0648$ | 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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NSC-TISI-TIS 17025

CALIBRATION 0426

**SARTORIUS**

REVIEW BY

Thavitall

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.

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Sartorius (Thailand) Co., Ltd.

Mr.chonchai Inthana(Technical Manager)

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**SARTORIUS**

# Certificate of Calibration

Model Number : MSE125P-100-DUCertificate No. : 23BCI0114Description : Semi-micro BalanceIssued Date : Friday, March 03, 2023Serial Number : 0033108993Reference No. : 204833ID No. : RYG\_EN0004Manufacturer : SartoriusPage No. : 2 of 3

## Calibration Results : Without Adjustment

### Repeatability

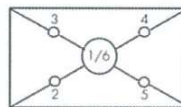
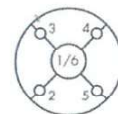
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

|                             |          |          |
|-----------------------------|----------|----------|
| 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 | Conventional Mass Value | Displayed Value | Deviation | Uncertainty |
|---------------|-------------------------|-----------------|-----------|-------------|
| (g)           | (g)                     | (g)             | (g)       | (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   | 0.000240    |
| 40            | 40.00003                | 40.00002        | -0.00001  | 0.000087    |
| 50            | 50.00002                | 50.00001        | -0.00001  | 0.000081    |



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**SARTORIUS**

# Certificate of Calibration

Model Number : MSE125P-100-DUCertificate No. : 23BCI0114Description : Semi-micro BalanceIssued Date : Friday, March 03, 2023Serial Number : 0033108993Reference No. : 204833ID No. : RYG\_EN0004Manufacturer : SartoriusPage 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

Nominal Value : (High Load) 100.0000  
100 g 100.00001

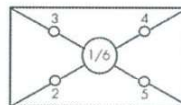
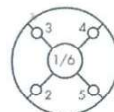
Tolerance 100.0000  
0.000015 g 100.0000

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.



# บริษัท เอกเสคคิวทิฟ เทรดดิง 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

## ใบรายงานผลการปรับเทียบ

|                |                 |               |
|----------------|-----------------|---------------|
| REVIEW BY      | <u>Narakorn</u> | ที่ RA 169/22 |
| APPROVED BY    | <u>rich chm</u> |               |
| NEXT CAL. DATE | <u>26/4/24</u>  |               |

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

### รายละเอียดเครื่องมือที่ทำการปรับเทียบ :

เครื่องมือ : เครื่องตรวจวัดไอระเหยจากสารเคมี  
ผลิตภัณฑ์ : RAE Systems  
รุ่น : MiniRAE3000  
หมายเลขเครื่อง : 592-911239  
ID : BKK\_FS0821

### สภาวะแวดล้อม :

อุณหภูมิ :  $(25 \pm 3) ^\circ\text{C}$   
ความชื้นสัมพัทธ์ :  $(29 \pm 15) \%$   
ความดันบรรยากาศ : 760 มิลลิเมตรปรอท

วันที่ปรับเทียบมาตรฐาน : 26 ตุลาคม 2565  
วิธีการปรับเทียบมาตรฐาน : ปรับเทียบโดยใช้ Standard Reference Gas ผลิตภัณฑ์ GASCO  
- Isobutylene Standard Gas 100 ppm; Lot number: 304-402257108-1

### 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)   | 75.5 ppm    | 100.0 ppm  | 0.0 ppm       | Pass   |

Flow Rate of Pump : 470 cc/min.

Accuracy :  $\pm 2 \%$  at calibration point

ผู้ปรับเทียบ : สุรินทร์ สายเนตร  
(นายสุรินทร์ สายเนตร)  
Service Engineer

ผู้ตรวจสอบ : สุทธีวงศ์ คงทองสังข์  
(นายสุทธีวงศ์ คงทองสังข์)  
Service Engineer Manager

ผลการสอบเทียบ/ปรับเทียบ นี้ รับรองเฉพาะตัวอย่างและรายการที่ได้รับไว้เท่านั้น

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 169/22

## 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 : 592-911239

ID : BKK\_FS0821

**Environmental Condition :**

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

Relative Humidity :  $(29 \pm 15) \%$

Pressure : 760 mmHg

**Date of Calibration** : October 26, 2022

**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: 304-402257108-1

### 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)   | 75.5 ppm    | 100.0 ppm  | 0.0 ppm       | Pass   |

**Flow Rate of Pump** : 470 cc/min.

**Accuracy** :  $\pm 2 \%$  at calibration point

Calibrated By : Surinthorn S.  
(Mr. Surinthorn Sainate)  
Service Engineer

Approved By : Suttiwong Kongtongsang  
(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 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 169/22

ใบรายงานการตรวจเช็คเครื่องตรวจวัดก๊าซ รุ่น MiniRAE3000

หมายเลขเครื่อง : 592-911239

วันที่ตรวจเช็ค : 26 ตุลาคม 2565

| ลำดับที่ | รายละเอียด<br>การตรวจสอบ | RAW COUNT   |       | สรุป       | หมายเหตุ |
|----------|--------------------------|-------------|-------|------------|----------|
|          |                          | REF.        | REAL  |            |          |
| 1.       | PID RAW COUNT            |             |       |            |          |
|          | Ch.H                     | 10000-62500 | 42798 | ■ YES □ NO |          |
|          | Ch.L                     | <62500      | 52085 | ■ YES □ NO |          |
| 2.       | Lamp                     | >40         | 50    | ■ YES □ NO |          |

| ลำดับที่ | รายละเอียด<br>การตรวจซ่อม | การแก้ไข        | สรุป       | หมายเหตุ    |
|----------|---------------------------|-----------------|------------|-------------|
| 1.       | Motor Pump                | Check flow rate | ■ YES □ NO | 470 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

การนำรายงานผล/ใบรับรองนี้ไปโฆษณาและการคัดลอกหรือการนำผลบางส่วนไปเผยแพร่ต่อสาธารณะต้องได้รับอนุญาตเป็นลายลักษณ์อักษรจากทางบริษัทฯ



## CERTIFICATE OF ANALYSIS

**Date:** November 8, 2021  
**PO Number:** 0000020821  
**Lot Number:** 304-402257108-1

**Customer:** CalGaz Internl LLC

**Use Before:** 11/08/2025

| <u>Component</u> | <u>Requested Concentration</u> | <u>Analytical Result (+/- 2%)</u> |
|------------------|--------------------------------|-----------------------------------|
| Isobutylene      | 100 PPM                        | 100.5 PPM                         |
| Air              | Balance                        | Balance                           |

**Cylinder Size:** 3.6 Cu. Ft.  
**Contents:** 103 Liter

**Valve:** 5/8" -18UNF  
**Pressure:** 1000 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:**

  
Glen Velez





Honeywell Analytics – Singapore Office  
17 Changi Business Park Central 1  
Singapore 486073  
Cert Ref : 00698

# 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@sithiporn.com http://www.sithiporn.com

Cert. No. : ACC23005

Pages : 1 of 3

## Calibration Certificate

**Equipment :** SOUND CALIBRATOR  
**Manufacturer :** RION  
**Model :** NC-75  
**Serial No.:** 35002736  
**ID No.:** RYG\_FS0496

**Condition As Found :** GOOD

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

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

**Received Date :** 06 JANUARY 2023  
**Calibration Date :** 17 JANUARY 2023  
**Date of Issue :** 19 JANUARY 2023



**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

( *T. Petchurai* )  
( 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. : ACC23005

Job No. : VC66AC0024

Pages : 2 of 3

Calibration Procedure : CP-AC-03

**Calibration Method :**

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

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

**Condition of this result of calibration :**

## 1. Reference Standard Instruments :

| <u>Instrument</u>       | <u>Model</u> | <u>Serial No.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|-------------------------|--------------|-------------------|------------------|-----------------|
| Waveform Generator      | 33511B       | MY52302742        | EF-0008-22       | 04-Feb-23       |
| Digital Multimeter      | 33461A       | MY53220104        | EEL.BP. 04/0265  | 09-Feb-23       |
| Digital Multimeter      | 33461A       | MY53220076        | EEL.BP. 03/0265  | 09-Feb-23       |
| Digital Multimeter      | 33461A       | MY60024273        | EEL.BP. 05/0265  | 09-Feb-23       |
| Programmable Attenuator | MAT-1070     | 62100114          | EF-0009-22       | 07-Feb-23       |
| Condenser Microphone    | 4180         | 2977900           | AA-1013-22       | 24-Feb-23       |
| Measuring Amplifier     | NA-42KAI     | 34560495          | AA-3005-22       | 22-Feb-23       |
| Audio Analyzer          | AVR-3360A    | V744B6069         | EF-0010-22       | 07-Feb-23       |

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

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

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).



## Continuation of Calibration Certificate

Cert. No. : ACC23005

Job No. : VC66AC0024

Pages : 3 of 3

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

| Specified sound<br>pressure level<br>(dB) | Measured<br>value<br>(dB) | Deviated<br>value<br>(dB) | Uncertainty<br>(dB) | Tolerance<br>limit<br>(dB) |
|-------------------------------------------|---------------------------|---------------------------|---------------------|----------------------------|
| 94                                        | 93.98                     | -0.02                     | 0.14                | 0.40                       |

**2. Frequency**

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

**3. Total distortion**

| Measured value (%) | Uncertainty (%) | Tolerance limit (%) |
|--------------------|-----------------|---------------------|
| 0.35               | 0.10            | 3.0                 |

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor  $k = 2$  or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

# SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : 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

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. : ACL23320

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 ) |
|--------------------------|
| 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

Cert. No. : ACL23320

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                  | -0.1                                                           | -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

Cert. No. : ACL23320

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                           | 63.9                        | -0.1                        | ± 1.1                          |
| 59.0                           | 59.0                        | 0.0                         | ± 1.1                          |
| 54.0                           | 53.9                        | -0.1                        | ± 1.1                          |
| 49.0                           | 48.9                        | -0.1                        | ± 1.1                          |
| 44.0                           | 43.9                        | -0.1                        | ± 1.1                          |
| 39.0                           | 38.9                        | -0.1                        | ± 1.1                          |
| 34.0                           | 34.0                        | 0.0                         | ± 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                           | 24.9                        | -0.1                        | ± 1.1                          |