

ภาคผนวก ง

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ใบรับรองการสอบเทียบเครื่องมือ



right solutions.  
right partner.

รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

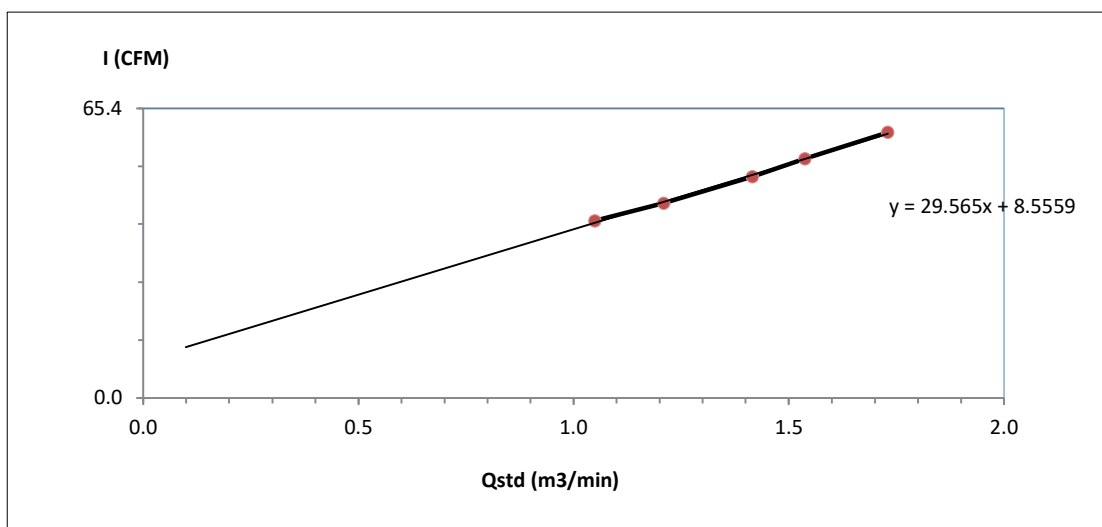
Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Total Suspended Particulate	High Volume	RYG_FS0176	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0180	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0178	-	-	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_FS0295	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0186	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0188	-	-	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_FS0531	19-Jan-23	19-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0530	19-Jan-23	19-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0141	5-Jan-23	5-Jul-24	18
Stack	Butyl Acrylate	Pitot Tube	RYG_FS0320	13-Jan-23	13-Jul-23	6
Stack	Butyl Acrylate	Flue gas Analyzer	RYG_FS0565	28-Dec-22	28-Dec-23	12
Stack	Butyl Acrylate	Field Rotameter	BKK_FS1004	1-Apr-23	1-Jul-23	3
Stack	Butyl Acrylate	GC-MSD	BKK_EN0119	18-Apr-23	18-Oct-24	18
Stack	Methyl Methacrylate	Pitot Tube	RYG_FS0320	13-Jan-23	13-Jul-23	6
Stack	Methyl Methacrylate	Flue gas Analyzer	RYG_FS0565	28-Dec-22	28-Dec-23	12
Stack	Methyl Methacrylate	Field Rotameter	BKK_FS1004	1-Apr-23	1-Jul-23	3
Stack	Methyl Methacrylate	GC-MSD	BKK_EN0119	18-Apr-23	18-Oct-24	18
Stack	Total Suspended Particulate	Console Control Unit	RYG_FS0315	13-Jan-23	13-Jul-23	6
Stack	Total Suspended Particulate	Flue gas Analyzer	RYG_FS0565	28-Dec-22	28-Dec-23	12
Stack	Total Suspended Particulate	Digital Balance	RYG_EN0003	1-Mar-23	1-Mar-24	12
Stack	Total VOC	Pitot Tube	RYG_FS0320	13-Jan-23	13-Jul-23	6
Stack	Total VOC	Flue gas Analyzer	RYG_FS0565	28-Dec-22	28-Dec-23	12
Stack	Total VOC	FID Analyzer	BKK_FS0758	4-Jan-23	4-Jul-23	6
Workplace	Total Dust	Field Rotameter	BKK_FS1043	3-Jan-23	3-Apr-23	3
Workplace	Total Dust	Field Rotameter	RYG_FS0197	1-Apr-23	1-Jul-23	3
Workplace	Total Dust	Digital Balance	RYG_EN0004	1-Mar-23	1-Mar-24	12
Workplace	Total VOC	TVOC Analyzer	BKK_FS0819	4-Feb-22	5-Aug-23	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	7-Sep-22	7-Sep-23	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0438	7-Sep-22	7-Sep-23	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0213	26-Jan-23	26-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0006	13-Jan-23	13-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0007	13-Jan-23	13-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	14-Feb-22	15-Aug-23	18
Rayong Lab	BOD	Incubator	RYG_EN0154	22-Apr-22	21-Oct-23	18
Rayong Lab	BOD	Burette	243007	21-Sep-18	21-Sep-23	60
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	27-Jul-22	26-Jul-23	12



## High Volume Air Sampler Calibration Worksheet

Project Site :	THAI MMA Co., Ltd.	Barometric Pressure (mm Hg) :	756
Calibrate Location :	บ้านบน	Temperature ( °C ) :	33
Calibrate Date :	22-Apr-23	High Volume ID :	RYG_FS0176
Calibration Sheet No.:	C-220423-RYG_FS0176	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0206	High Volume S/N :	4802
Calibrator Model :	TE-5028A	Calibrator Slope :	1.47433
Calibrator S/N :	1543	Calibrator Intercept :	-0.01503

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.4	1.0492	40	Slope : 29.5653 Intercept : 8.5559 Correlation Coefficient : 0.9990
2	3.2	1.2092	44	
3	4.4	1.4154	50	
4	5.2	1.5373	54	
5	6.6	1.7301	60	



Calibrated by



( Mr. Anuwet Tema )  
Field Scientist(1)

Approved by :



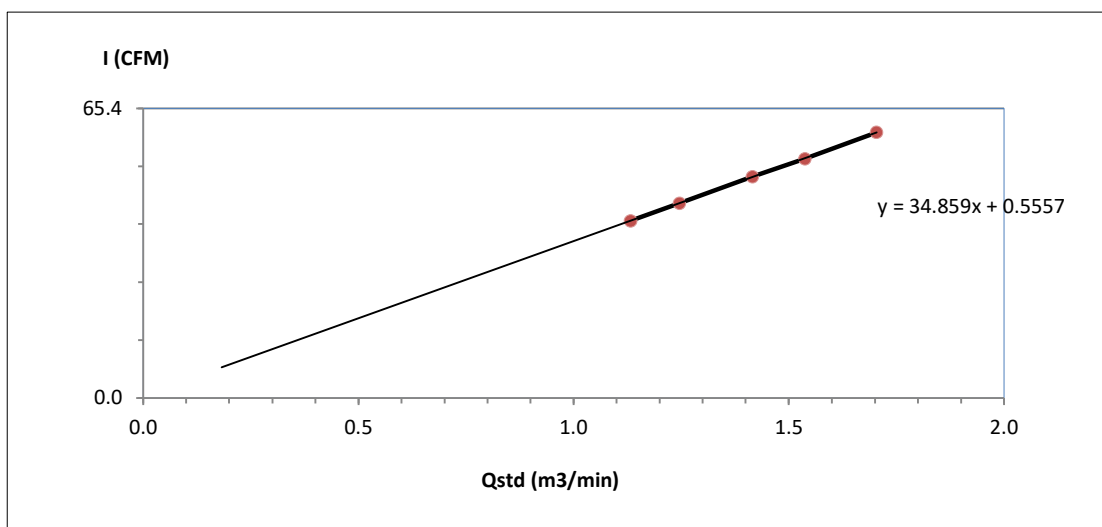
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)




## High Volume Air Sampler Calibration Worksheet

Project Site :	THAI MMA Co., Ltd.	Barometric Pressure (mm Hg) :	756
Calibrate Location :	บ้านนาบวช	Temperature ( °C ) :	33
Calibrate Date :	22-Apr-23	High Volume ID :	RYG_FS0180
Calibration Sheet No.:	C-220423-RYG_FS0180	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0206	High Volume S/N :	1328
Calibrator Model :	TE-5028A	Calibrator Slope :	1.47433
Calibrator S/N :	1543	Calibrator Intercept :	-0.01503


Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.8	1.1321	40	Slope : 34.8588 Intercept : 0.5557 Correlation Coefficient : 0.9999
2	3.4	1.2460	44	
3	4.4	1.4154	50	
4	5.2	1.5373	54	
5	6.4	1.7039	60	



Calibrated by

  
( Mr. Anuwet Tema )  
Field Scientist(1)

Approved by :

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

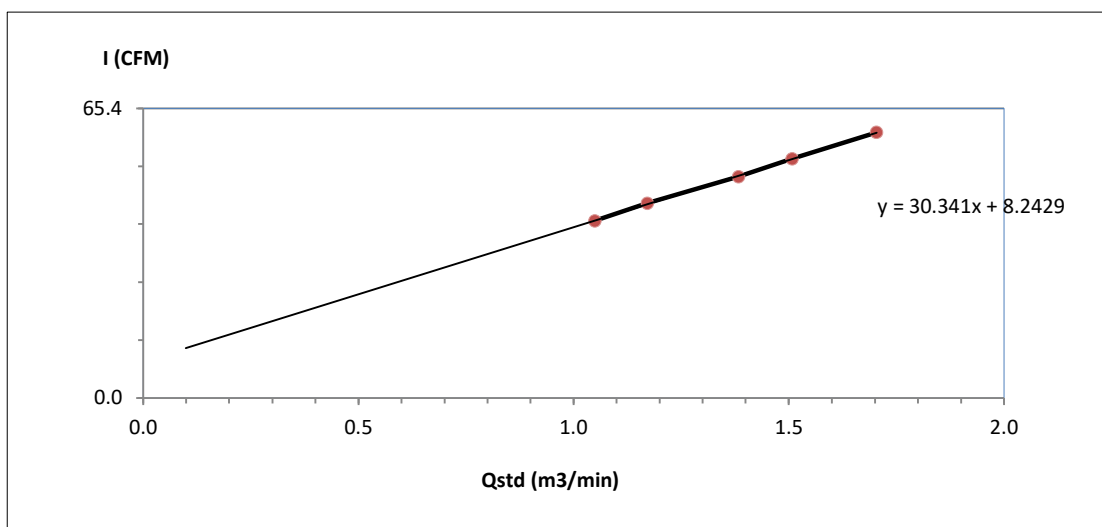





## High Volume Air Sampler Calibration Worksheet

Project Site :	THAI MMA Co., Ltd.	Barometric Pressure (mm Hg) :	756
Calibrate Location :	บ้านเนินพยอม	Temperature ( °C ) :	33
Calibrate Date :	22-Apr-23	High Volume ID :	RYG_FS0178
Calibration Sheet No.:	C-220423-RYG_FS0178	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0206	High Volume S/N :	4804
Calibrator Model :	TE-5028A	Calibrator Slope :	1.47433
Calibrator S/N :	1543	Calibrator Intercept :	-0.01503


Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.4	1.0492	40	Slope : 30.3409 Intercept : 8.2429 Correlation Coefficient : 0.9998
2	3.0	1.1713	44	
3	4.2	1.3832	50	
4	5.0	1.5078	54	
5	6.4	1.7039	60	



Calibrated by

  
( Mr. Anuwet Tema )  
Field Scientist(1)

Approved by :

  
(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. ChonchaiNEXT 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

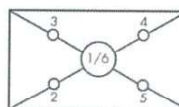
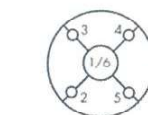
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

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 (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (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

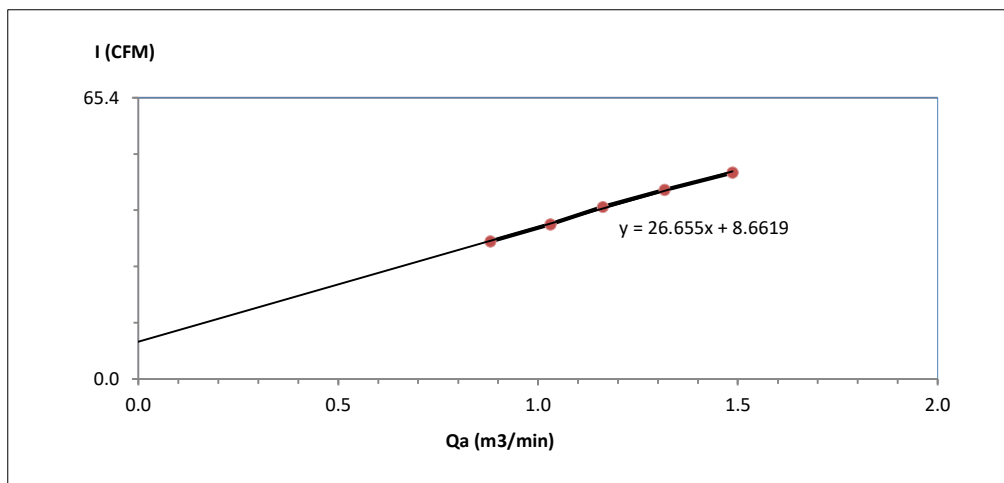
End of Report.





## High Volume Air Sampler Calibration Worksheet

Project Site :	THAI MMA Co., Ltd.	Barometric Pressure (mm Hg) :	756
Calibrate Location :	บ้านนา	Temperature ( °C ) :	33
Calibrate Date :	22-Apr-23	High Volume ID :	RYG_FS0295
Calibration Sheet No.:	C-220423-RYG_FS0295	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0206	High Volume S/N :	5502
Calibrator Model :	TE-5028A	Calibrator Slope :	0.92345
Calibrator S/N :	1543	Calibrator Intercept :	-0.0095

Test No.	Delta H <sub>2</sub> O (inch)	Qa (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	1.6	0.881	32	Slope : 26.6550 Intercept : 8.6619 Correlation Coefficient : 0.9990
2	2.2	1.031	36	
3	2.8	1.162	40	
4	3.6	1.317	44	
5	4.6	1.487	48	



Calibrated by   
 ( Mr. Anuwet Tema )  
 Field Scientist(1)

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

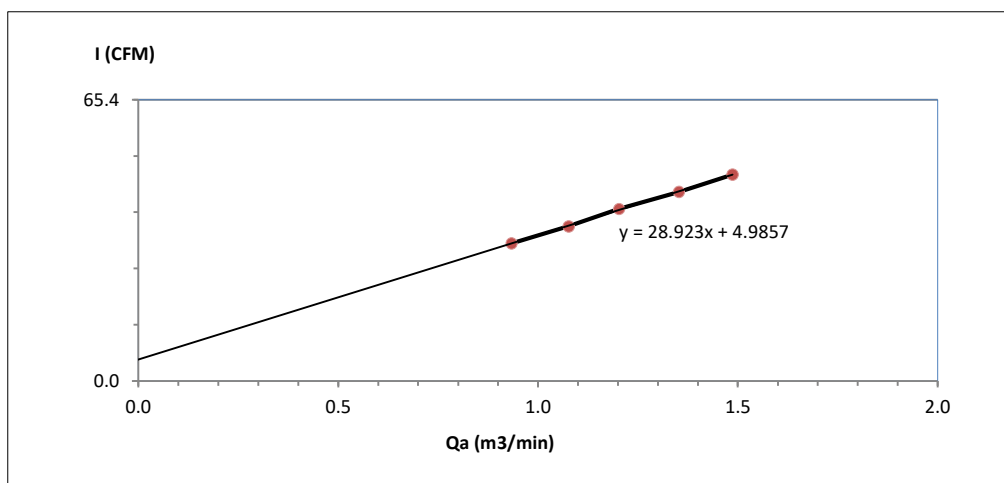




## High Volume Air Sampler Calibration Worksheet

Project Site :	THAI MMA Co., Ltd.	Barometric Pressure (mm Hg) :	756
Calibrate Location :	ระยอง	Temperature ( °C ) :	33
Calibrate Date :	22-Apr-23	High Volume ID :	RYG_FS0186
CalibrationSheet No.:	C-220423-RYG_FS0186	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0206	High Volume S/N :	4794
Calibrator Model :	TE-5028A	Calibrator Slope :	0.92345
Calibrator S/N :	1543	Calibrator Intercept :	-0.0095

Test No.	Delta H <sub>2</sub> O (inch)	Qa (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	1.8	0.934	32	Slope : 28.9228 Intercept : 4.9857 Correlation Coefficient : 0.9998
2	2.4	1.077	36	
3	3.0	1.203	40	
4	3.8	1.353	44	
5	4.6	1.487	48	



Calibrated by                       
( Mr. Anuwet Tema )  
Field Scientist(1)

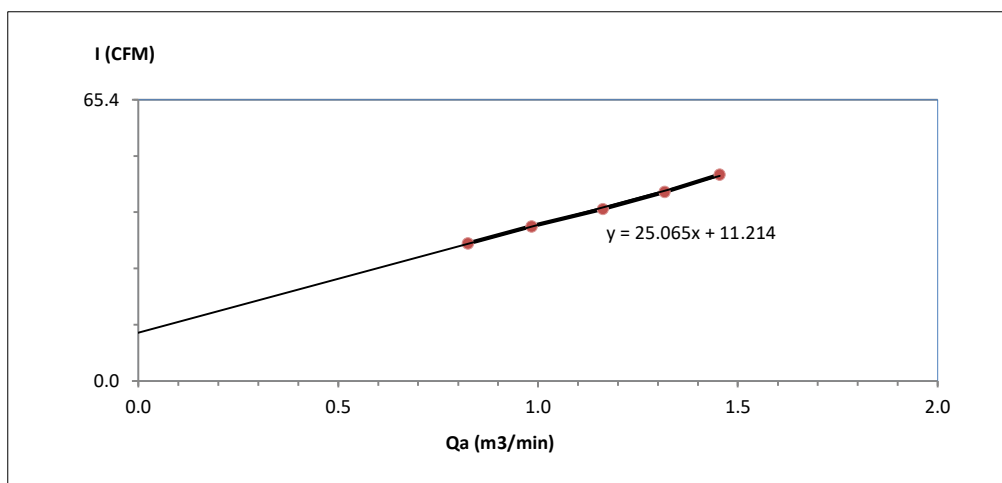
Approved by :                       
(Mr. Noppong Juntarupan)  
Enviro Field Coordinator Scientist (3)





## High Volume Air Sampler Calibration Worksheet

Project Site :	THAI MMA Co., Ltd.	Barometric Pressure (mm Hg) :	756
Calibrate Location :	บ้านเนินพยอม	Temperature ( °C ) :	33
Calibrate Date :	22-Apr-23	High Volume ID :	RYG_FS0188
CalibrationSheet No.:	C-220423-RYG_FS0188	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0206	High Volume S/N :	4796
Calibrator Model :	TE-5028A	Calibrator Slope :	0.92345
Calibrator S/N :	1543	Calibrator Intercept :	-0.0095

Test No.	Delta H <sub>2</sub> O (inch)	Qa (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	1.4	0.825	32	Slope : 25.0652 Intercept : 11.2144 Correlation Coefficient : 0.9991
2	2.0	0.984	36	
3	2.8	1.162	40	
4	3.6	1.317	44	
5	4.4	1.455	48	



Calibrated by   
( Mr. Anuwet Tema )  
Field Scientist(1)

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

Certificate Number

CL-013-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Wind Direction Sensor  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: 110-WS-25DL-D  
**SERIAL NUMBER** : Sensor: WSD-014  
Data logger: A5789  
**ID NUMBER** : RYG\_FS0531  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 16 Jan 2023  
**MEASUREMENT DATE** : 19 Jan 2023  
**ISSUE DATE** : 20 Jan 2023

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

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

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

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

**Measurement Condition** : The average values during measurement are (23.6)°C, (46.6) %RH and (1014.9) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss 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>

### Calibration procedure:

The wind direction sensor was calibrated against Standard Rotary Encoder model: AX4009TS-DM04-P3-S-U0 in an close test-section of Eiffel-type wind tunnel with 900 cm<sup>2</sup> cross test section area. The WI-CL-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

### Traceability:

This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: DA-0043-22

### Uncertainty of Measurement:

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

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 m/s	$D^{\circ}_{std}$ Degree (°)	$D^{\circ}_{uuc}$ Degree (°)	Error Degree (°)	$U (k=2)$ Degree (°)
4.99	0.000	0	0	0.58
	45.000	43	-2	0.74
	90.000	88	-2	0.74
	135.000	133	-2	0.74
	180.000	179	-1	0.74
	225.000	227	2	0.74
	270.000	272	2	0.74
	315.000	317	2	0.74

## Remark:

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

<sup>6</sup> Direction of standard

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

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





## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM**

: Cup anemometer

**MANUFACTURER**

: Novalynx

**MODEL/TYPE**

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

**SERIAL NUMBER**

: Sensor: WSD-014  
Data logger: A5789

**ID NUMBER**

: RYG\_FS0531

**CONDITION AS-RECEIVED**

: Used item

**CUSTOMER**

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

**Calibration procedure:**

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

**Traceability:**

This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0052-21 and MW-0066-22

**Uncertainty of Measurement:**

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

**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.

**CALIBRATION CONDITIONS**

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

**Preconditioning**

: 24 hours at ambient conditions.

**Measurement Condition**

: The average values during measurement are (23.7) °C, (44.5) %RH and (1018.3) hPa.

**TABULATION OF RESULTS:**

The table on next page give the measured values.

**Calibrated by:**

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jittrapor Lertsomphol



**Approved signatory:**

*28 ms*

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

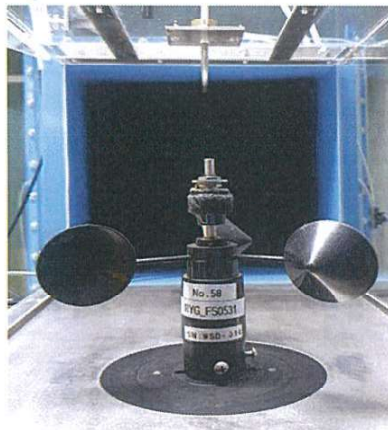
## Remark:

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

<sup>6</sup> Velocity of standard

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

## PHOTO OF CALIBRATION SET-UP



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

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



## CERTIFICATE OF CALIBRATION

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

Equipment Name: Data Logger with Temperature  
Sensor

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

### Customer

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

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

### Reference Used During Calibration

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

### Calibration Condition

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

### Calibration Procedure

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

### Traceability

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

### Calibrated by

- ☐ Mr. Sorawit Thachalad  
☒ Miss Jittraporn Lertsomphol



### Approved Signatory:

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

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

**Calibration Range:** 20-40 °C

**Function:**

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

Dimension : Diameter 12 mm. Length 80 mm.

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

UUC\*: Unit Under Calibration

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

\* End of Certificate \*



## CERTIFICATE OF CALIBRATION

Calibration No. : RH-06012023

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger  
Manufacturer : Novalynx  
Model/Type : 110-WS-25DL-D  
Serial Number : A5789  
ID No. : RYG\_FS0531  
Customer : ALS laboratory group (Thailand) Co., Ltd.  
: 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok  
10250 Thailand.

### Environmental Condition:

The measurement was carried out in an ambient temperature of  $(25 \pm 3)^{\circ}\text{C}$ , 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 : Jan 18, 2023

Issued Date : Jan 20, 2023

### Measurement Results:

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

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

The results of calibration are reported in table below.

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

### Performed by

- ☐ Mr. Sorawit Thachalad  
☒ Miss Jittraporn Lertsomphol



### Approved Signatory:

  
Mr. Parinya Booncharoen.  
Calibration Department Manager



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 Jittrapon 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 m/s	$D^{\circ}_{std}$ Degree (°)	$D^{\circ}_{uuc}$ Degree (°)	Error Degree (°)	$U (k=2)$ 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.

**Calibration procedure:**

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

**Traceability:**

This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0052-21 and MW-0066-22

**Uncertainty of Measurement:**

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

**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.

**CALIBRATION CONDITIONS**

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

**Preconditioning**

: 24 hours at ambient conditions.

**Measurement Condition**

: The average values during measurement are (23.7) °C, (50.2) %RH and (1017.1) hPa.

**TABULATION OF RESULTS:**

The table on next page give the measured values.

**Calibrated by:**

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn Lertsomphol



**Approved signatory:**

*(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> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$V_{uuc}$ <sup>7</sup> (m/s)	Error (m/s)	$U (k=2)$ (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 Jittraporn 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 Depth (mm)</u>	<u>Standard Reading (°C)</u>	<u>UUC Reading (°C)</u>	<u>Error (°C)</u>	<u>Uncertainty (°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 (%RH)	Standard (Reading) (%RH)	UUC (Reading) (%RH)	Error (%RH)	Uncertainty $\pm$ (%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: \_\_\_\_\_

*25ms*  
Mr. Parinya Booncharoen.  
Calibration Department Manager

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Cup anemometer  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02F  
 Data logger: WS-25DL  
**SERIAL NUMBER** : Sensor: -  
 Data logger: A4481  
**ID NUMBER** : BKK\_FS0141  
**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** : 28 Dec 2022  
**MEASUREMENT DATE** : 05 Jan 2023  
**ISSUE DATE** : 09 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 (23.9) °C, (47.3) %RH and (1015.0) 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.

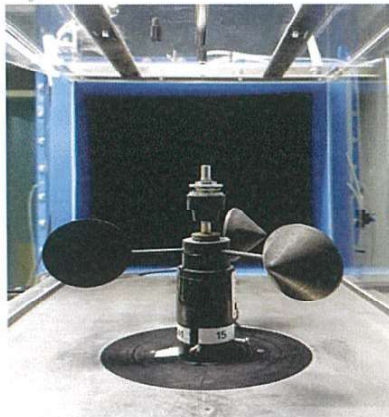
$v_{std}^6$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$v_{uuc}^7$ (m/s)	Error (m/s)	$U (k=2)$ (m/s)
0.989	23.82	23.85	0.7	-0.3	0.16
2.031	23.90	23.85	1.7	-0.3	0.16
3.051	24.00	23.85	2.9	-0.2	0.20
4.132	23.84	23.85	3.9	-0.2	0.20
5.00	23.88	23.85	4.9	-0.1	0.24
5.98	23.94	23.85	5.8	-0.2	0.18
7.06	23.82	23.85	6.9	-0.2	0.19
8.17	23.90	23.85	8.0	-0.1	0.22
9.08	23.72	23.85	9.0	-0.1	0.21
10.09	23.86	23.85	9.9	-0.2	0.20
11.14	23.60	23.85	11.0	-0.1	0.26
12.14	23.74	23.85	12.1	-0.1	0.28
13.21	23.68	23.85	13.0	-0.2	0.21
14.28	23.70	23.85	14.1	-0.2	0.27
15.26	23.64	23.85	15.0	-0.3	0.26
16.30	23.60	23.85	16.1	-0.2	0.28

**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 Number
CL-001-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Wind Direction Sensor  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02F  
 Data logger: WS-25DL  
**SERIAL NUMBER** : Sensor: -  
 Data logger: A4481  
**ID NUMBER** : BKK\_FS0141  
**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** : 28 Dec 2022  
**MEASUREMENT DATE** : 06 Jan 2023  
**ISSUE DATE** : 09 Jan 2023

**ENVIRONMENTAL CONDITIONS:**

Ambient condition in the laboratory are as follow:

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

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

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

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

**Measurement Condition** : The average values during measurement are (23.5)°C, (48.8) %RH and (1015.8) 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 m/s	$D_{std}^6$ Degree (°)	$D_{uuc}^7$ Degree (°)	Error Degree (°)	$U (k=2)$ Degree (°)
5.02	0.000	0	0	0.58
	45.000	41	-4	0.74
	90.000	87	-3	0.68
	135.000	134	-1	0.74
	180.001	181	1	0.74
	225.000	228	3	0.74
	270.001	273	3	0.74
	315.000	318	3	0.68

## Remark:

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

<sup>6</sup> Direction of standard

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



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





## Pitot Tube Calibration Data

Pitot Tube Identification Number : RYG\_FS0320

Calibration Date : 13 Jan 23

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

Standard Pitot ID : BKK\_FS0441

Calibration Sheet No. : C-130123-RYG\_FS0320

Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Type s pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Cp (s) Leg A	Cp (s) 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 660001

Date of issue : 03-Jan-23

Instrument description : Flue gas Analyzer  
Instrument model : Testo 340  
Instrument serial no. : 63119028  
ID no. or control no. : RYG\_FS0565  
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-230001  
Receiving date. : 26-Dec-22  
Parameter of calibration : Gas Calibration(Oxygen 2.498,10.04,21.02 %vol, Carbon Monoxide 80.14,309.9,1003 ppm,  
Nitric Oxide 30.08,150.9,320.6 ppm, Sulphur Dioxide 50.04,100.8,601.1 ppm)

REVIEW BY Narakorn P.  
APPROVED BY [Signature]  
NEXT CAL. DATE 28/12/23

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 : 28-Dec-22

[Signature]

Mr. Sedtawut Nueathong

Calibration Technician

[Signature]

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
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 : 23.2 °C Humidity : 56.4 %RH Pressure : 1014.8 mbar

### Calibration conditions

Gas Temperature : 23 °C Flow rate : 600 ml/min Gas pressure : 1018.6 mbar

### Calibration Results Before Adjustment (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty ( ± )
O <sub>2</sub> (%Vol)	2.498	2.47	-0.028	0.20
O <sub>2</sub> (%Vol)	10.04	9.93	-0.11	0.40
O <sub>2</sub> (%Vol)	21.02	21.09	0.07	0.80
CO (ppm)	80.14	83	2.86	3.0
CO (ppm)	309.9	319	9.1	6.0
CO (ppm)	1003	1038	35	12
NO (ppm)	30.08	28	-2.08	8.0
NO (ppm)	150.9	139	-11.9	8.0
NO (ppm)	320.6	299	-21.6	12
SO <sub>2</sub> (ppm)	50.04	46	-4.04	6.0
SO <sub>2</sub> (ppm)	100.8	98	-2.8	6.0
SO <sub>2</sub> (ppm)	601.1	593	-8.1	13

Calibration Results After Adjustment (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty ( ± )
O2 (%Vol)	2.498	2.47	-0.028	0.20
O2 (%Vol)	10.04	9.93	-0.11	0.40
O2 (%Vol)	21.02	21.09	0.07	0.80
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	309.9	311	1.1	6.0
CO (ppm)	1003	1004	1	12
NO (ppm)	30.08	30	-0.08	8.0
NO (ppm)	150.9	154	3.1	8.0
NO (ppm)	320.6	322	1.4	12
SO2 (ppm)	50.04	49	-1.04	6.0
SO2 (ppm)	100.8	101	0.2	6.0
SO2 (ppm)	601.1	603	1.9	13

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

### End of Report



## ROTA METER CALIBRATION RESULT APRIL 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS0577	03 Apr 23	$Y = 1.0246x - 1.1844$	0.9982
BKK_FS0579	03 Apr 23	$Y = 1.0313x - 0.8177$	0.9999
BKK_FS0583	03 Apr 23	$Y = 1.0023x - 0.0969$	0.9995
BKK_FS0584	03 Apr 23	$Y = 1.0025x + 2.25$	0.9999
BKK_FS0585	03 Apr 23	$Y = 0.9881x + 5.4452$	0.9993
BKK_FS0586	03 Apr 23	$Y = 0.9915x + 4.7452$	1.0000
BKK_FS0588	03 Apr 23	$Y = 1.0067x + 0.6738$	0.9998
BKK_FS0589	03 Apr 23	$Y = 0.9823x + 0.3286$	0.9936
BKK_FS0590	03 Apr 23	$Y = 0.9961x + 2.8786$	0.9999
BKK_FS0591	03 Apr 23	$Y = 0.9985x + 4.579$	1.0000
BKK_FS0592	03 Apr 23	$Y = 0.9975x + 3.6419$	1.0000
BKK_FS0593	03 Apr 23	$Y = 0.9966x + 16.005$	1.0000
BKK_FS0595	03 Apr 23	$Y = 0.9957x + 5.1368$	0.9999
BKK_FS0596	03 Apr 23	$Y = 1.017x - 14.044$	0.9967
BKK_FS0597	03 Apr 23	$Y = 1.0063x - 10.787$	1.0000
BKK_FS1004	01 Apr 23	$Y = 0.9943x + 7.1533$	0.9996
BKK_FS1005	01 Apr 23	$Y = 1.0035x + 3.1167$	0.9998
BKK_FS1006	01 Apr 23	$Y = 1.0273x - 0.4922$	0.9998
BKK_FS1007	03 Apr 23	$Y = 1.0452x - 1.5374$	0.9998
BKK_FS1009	03 Apr 23	$Y = 1.0351x - 1.3224$	0.9999
BKK_FS1010	03 Apr 23	$Y = 1.0108x - 0.0888$	1.0000
BKK_FS1011	03 Apr 23	$Y = 1.2946x - 6.6325$	0.9861
BKK_FS1012	03 Apr 23	$Y = 1.0976x - 27.969$	0.9996
BKK_FS1013	03 Apr 23	$Y = 1.0821x - 200.52$	0.9998
BKK_FS1017	03 Apr 23	$Y = 1.0333x + 7.0584$	0.9694
BKK_FS1018	03 Apr 23	$Y = 0.9551x - 18.832$	0.9997
BKK_FS1019	03 Apr 23	$Y = 1.0649x - 156.67$	0.9976
BKK_FS1020	03 Apr 23	$Y = 0.9911x + 0.0364$	0.9994
BKK_FS1021	03 Apr 23	$Y = 0.979x + 8.2333$	0.9992
BKK_FS1022	03 Apr 23	$Y = 0.9988x - 2.4905$	0.9997
BKK_FS1023	03 Apr 23	$Y = 1.0245x - 1.3878$	0.9996
BKK_FS1024	03 Apr 23	$Y = 0.7414x + 47.3$	0.9923
BKK_FS1025	03 Apr 23	$Y = 0.9997x + 5.4438$	1.0000
BKK_FS1026	03 Apr 23	$Y = 1.0172x - 0.9531$	1.0000
BKK_FS1027	03 Apr 23	$Y = 0.7331x + 49.317$	0.9921
BKK_FS1028	03 Apr 23	$Y = 0.9995x + 0.2124$	1.0000
BKK_FS1039	01 Apr 23	$Y = 1.025x - 3.795$	0.9994
BKK_FS1040	01 Apr 23	$Y = 1.0035x - 2.4295$	0.9998



## ROTA METER CALIBRATION RESULT APRIL 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS1041	01 Apr 23	$Y = 1.0329x - 0.6769$	0.9999
BKK_FS1042	01 Apr 23	$Y = 1.0144x + 1.94$	0.9997
BKK_FS1043	01 Apr 23	$Y = 1.0038x - 1.539$	0.9999
BKK_FS1044	01 Apr 23	$Y = 1.0273x - 1.6922$	0.9998
BKK_FS1164	03 Apr 23	$Y = 0.9913x + 0.8537$	0.9997
BKK_FS1165	03 Apr 23	$Y = 1.0005x + 2.0857$	1.0000
BKK_FS1166	03 Apr 23	$Y = 1.0842x - 169.6$	0.9987
BKK_FS1200	03 Apr 23	$Y = 0.9452x + 5.2959$	0.9981
BKK_FS1201	03 Apr 23	$Y = 1.0045x - 1.8786$	1.0000
BKK_FS1202	03 Apr 23	$Y = 0.9768x + 26.572$	0.9973
RYG_FS0197	01 Apr 23	$Y = 1.0042x + 15.442$	0.9999
RYG_FS0198	01 Apr 23	$Y = 1.0081x - 13.26$	0.9999
RYG_FS0199	01 Apr 23	$Y = 1.0255x - 1.2364$	0.9999

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, Phattanakan 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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Reason for Signature:	Executed protocol and published this original version of document

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User Name: supasak.nimsongtham  
 Hostname: 5CG1115HKC

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

## ALS GM2 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 18, 2023 2:14:23 PM	Audit	SessionCreated	Session	None
April 18, 2023 2:14:23 PM	Start	Configuration	Session	None
April 18, 2023 2:14:23 PM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
April 18, 2023 2:15:04 PM	Audit	EqpLoaded	Session	EQP details for primary technique [Gc] - File path: [ProtocolPacks/Gc/Configurations/02.51/Gc.02.51.eqp], EQP File Name: [Gc.02.51.eqp], EQP Name: [AgilentRecommended], Protocol Revision : [Gc.02.51] EQP details for hyphenated technique [GcMs] - File path: [ProtocolPacks/GcMs/Configurations/02.51/GcMs.02.51.eqp], EQP File Name: [GcMs.02.51.eqp], EQP Name: [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 MMI: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
April 18, 2023 2:17:33 PM	End	Execution	Inlet Pressure Accuracy - Front MMI: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count : 1
April 18, 2023 2:17:36 PM	Start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
April 18, 2023 2:18:00 PM	Audit	Data	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
April 18, 2023 2:18:01 PM	End	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count : 1
April 18, 2023 2:18:03 PM	Start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
April 18, 2023 2:18:20 PM	Audit	Data	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
April 18, 2023 2:18:22 PM	End	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count : 1
April 18, 2023 2:18:44 PM	Start	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - 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 - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
April 18, 2023 2:19:33 PM	End	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - 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 TAD SQ: - Source: EI - Inert	None
April 18, 2023 2:19:46 PM	End	Execution	Log Amp - 5975C inert XL with TAD SQ: - Source: EI - Inert	Run Count : 1
April 18, 2023 2:19:49 PM	Start	Execution	RFPA - 5975C inert XL with TAD SQ: - Source: EI - Inert	None
April 18, 2023 2:32:54 PM	End	Execution	RFPA - 5975C inert XL with TAD SQ: - Source: EI - Inert	Run Count : 1
April 18, 2023 2:32:57 PM	Start	Execution	Tune EI - 5975C inert XL with TAD SQ: - Source: - EI - Inert Filament 1 (Qualitative - No setpoints associated)	None
April 18, 2023 2:34:05 PM	End	Execution	Tune EI - 5975C inert XL with TAD SQ: - Source: - EI - Inert Filament 1 (Qualitative - No setpoints associated)	Run Count : 1
April 18, 2023 2:34:07 PM	Start	Execution	Tune EI - 5975C inert XL with TAD SQ: - Source: - EI - Inert Filament 2 (Qualitative - No setpoints associated)	None
April 18, 2023 2:34:20 PM	End	Execution	Tune EI - 5975C inert XL with TAD SQ: - Source: - EI - Inert Filament 2 (Qualitative - 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 2:34:23 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: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM-2 OQ2023\IPMRP\IP_MRP002. D\DATA.MS
April 18, 2023 2:36:20 PM	Audit	Data	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM-2 OQ2023\IPMRP\IP_MRP003. D\DATA.MS
April 18, 2023 2:36:20 PM	Audit	Data	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM-2 OQ2023\IPMRP\IP_MRP004. D\DATA.MS
April 18, 2023 2:36:20 PM	Audit	Data	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM-2 OQ2023\IPMRP\IP_MRP005. D\DATA.MS
April 18, 2023 2:36:20 PM	Audit	Data	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM-2 OQ2023\IPMRP\IP_MRP006. D\DATA.MS
April 18, 2023 2:36:21 PM	Audit	Data	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM-2 OQ2023\IPMRP\IP_MRP007. D\DATA.MS
April 18, 2023 2:36:42 PM	End	Execution	Injection Precision - Injection Tower, Front MMI, SQ: - 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: - 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 Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM-2 OQ2023\IPMRP\IP_MRP002. D\DATA.MS
April 18, 2023 2:37:04 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM-2 OQ2023\IPMRP\IP_MRP003. D\DATA.MS
April 18, 2023 2:37:04 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM-2 OQ2023\IPMRP\IP_MRP004. D\DATA.MS
April 18, 2023 2:37:04 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM-2 OQ2023\IPMRP\IP_MRP005. D\DATA.MS
April 18, 2023 2:37:06 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM-2 OQ2023\IPMRP\IP_MRP006. D\DATA.MS
April 18, 2023 2:37:06 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM-2 OQ2023\IPMRP\IP_MRP007. D\DATA.MS
April 18, 2023 2:37:17 PM	End	Execution	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Run Count : 1
April 18, 2023 2:37:23 PM	Start	Execution	Signal to Noise EI - Injection Tower, Front MMI, SQ: - Source: EI - Inert using 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 Tower, Front MMI, SQ: - Source: EI - Inert using 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 Tower, Front MMI, SQ: - Source: EI - Inert using Filament 2 - L: >= 320	Data files Path : E:\GM-2 OQ2023\SNF2_003.D\DATA. MS
April 18, 2023 2:57:58 PM	Start	Execution	Signal to Noise EI - Injection Tower, Front MMI, SQ: - Source: EI - Inert using Filament 2 - L: >= 320	None
April 18, 2023 2:58:05 PM	End	Execution	Signal to Noise EI - Injection Tower, Front MMI, SQ: - Source: EI - Inert using 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 : Certificate



CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 13-Jan-23  
Next Cal. Date : 13-Jul-23

Barometric Pressure (mmHg) : 760  
Relative Humidity (%) : 55.0  
Temperature (C°) : 30.0

Console Control Meter Data

Calibration No. : C-130123-RYG\_FS0315  
Dry Gas Meter ID : RYG\_FS0315  
Serial No. : 1706091  
Model No. : XC-572-V

Reference Dry Gas Meter Data

Reference Dry Gas Meter ID : BKK\_FS1122  
Serial No. : A2003240  
Correction Factor (Y) : 1.0160  
Next Calibration Date : 05/27/23

$\Delta H$ (mm.H <sub>2</sub> O)	$\Theta$ Minutes	Reference Dry Gas Meter Calibration			Console Control ; Drygas Meter							Dry Gas Meter Correction Factor (Y)	Orifice Calibration Factor $\Delta H @$
		Vr (Liters)			Tr (°C)	Vm (Liters)			Ti (°C)	To (°C)	Avg.Tm (°C)		
		Final	Initial	Total		Final	Initial	Total					
15	12.16	150.00	0.00	150.00	35.0	1659065.4	1658920.0	145.40	34.0	34.0	1.0432	46.1318	
25	9.33	150.00	0.00	150.00	35.0	1659215.2	1659070.0	145.20	35.0	35.0	1.0471	45.1163	
50	6.61	150.00	0.00	150.00	35.0	1659525.2	1659380.0	145.20	36.0	36.0	1.0479	45.1435	
80	5.20	150.00	0.00	150.00	35.0	1660005.0	1659860.0	145.00	36.0	36.0	1.0463	44.7012	
120	4.21	150.00	0.00	150.00	37.0	1660164.0	1660020.0	144.00	37.0	37.0	1.0462	44.3799	
Avg.											1.0461	45.0945	

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 Phaisanphisut

( Mr. Saksit Phaisanphisut )

Field Scientist(4)

Approved by:

Nattapon Jengwareewong

( Mr.Nattapol Jengwareewong )

Field Specialist(1)



## DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date : 13/01/23	Ambient Temperature (°C) 30
Calibration sheet No. : C-130123-RYG_FS0316	Relative Humidity (%) : 55
Digital Temperature ID : RYG_FS0316	Reference Temperature ID : BKK_FS0609
Console Serial No. : 1706091	Serial No. : 7688004
Model : XC-572-V	Model : FLUKE 714
	Last Calibrate : 1/25/22

Location	Reference Temperature °C	Digital Temperature °C	Error °C	Remark
Stack	0	1	1	
	25	26	1	
	50	51	1	
	100	101	1	
	150	151	1	
	200	201	1	
	250	251	1	
	300	301	1	
	500	501	1	
	1000	1001	1	
	1200	1201	1	
Probe	100	101	1	
	120	121	1	
	140	141	1	
Filter	100	101	1	
	120	121	1	
	140	141	1	
Exit	0	1	1	
	10	11	1	
	20	21	1	
Meter	0	1	1	
	25	26	1	
	50	51	1	
AUX	0	1	1	
	25	26	1	
	50	51	1	

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 Jan 23	Nozzle Set ID. : RYG_FS0319
Calibration Sheet No. : C-130123-RYG_FS0319	Vernier Caliper ID.: BKK_FS1123

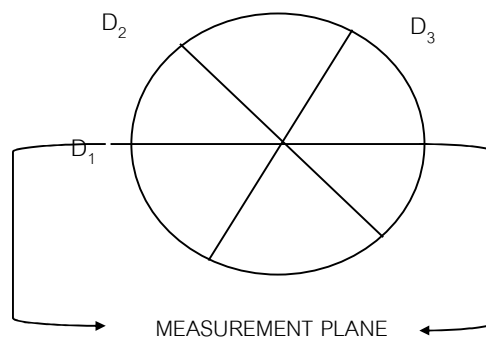
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo	$(D_1 + D_2 + D_3) / 3$
	$D_1$	$D_2$	$D_3$	$\Delta D$	$D_{avg}$
1	0.300	0.300	0.300	0.000	0.300
2	0.470	0.465	0.465	0.005	0.467
3	0.600	0.600	0.600	0.000	0.600
4	0.770	0.760	0.755	0.015	0.762
5	0.920	0.930	0.930	0.010	0.927
6	1.080	1.080	1.085	0.005	1.082
7	1.240	1.230	1.235	0.010	1.235
8	1.594	1.598	1.597	0.004	1.596

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)



## Pitot Tube Calibration Data

Pitot Tube Identification Number : RYG\_FS0320

Calibration Date : 13 Jan 23

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

Standard Pitot ID : BKK\_FS0441

Calibration Sheet No. : C-130123-RYG\_FS0320

Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Type s pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Cp (s) Leg A	Cp (s) 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 : RYG\_FS0321      Calibration Date : 13 Jan 23  
 Lab test duct Number : 258-1-13-01      Standard Pitot ID : BKK\_FS0441  
 Calibration Sheet No. : C-130123-RYG\_FS0321      Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Type s pitot tube ( $\Delta P$ , mm.H <sub>2</sub> O)	Cp (s) Leg A	Cp (s) 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)

**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	<i>Thawitall</i>
APPROVED BY	<i>D. [Signature]</i>
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)

S  
T  
A  
M  
P



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

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310

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

**SARTORIUS**

# Certificate of Calibration

Model Number : MSE224S-100-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**

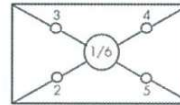
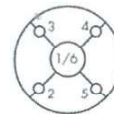
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

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 (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (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.



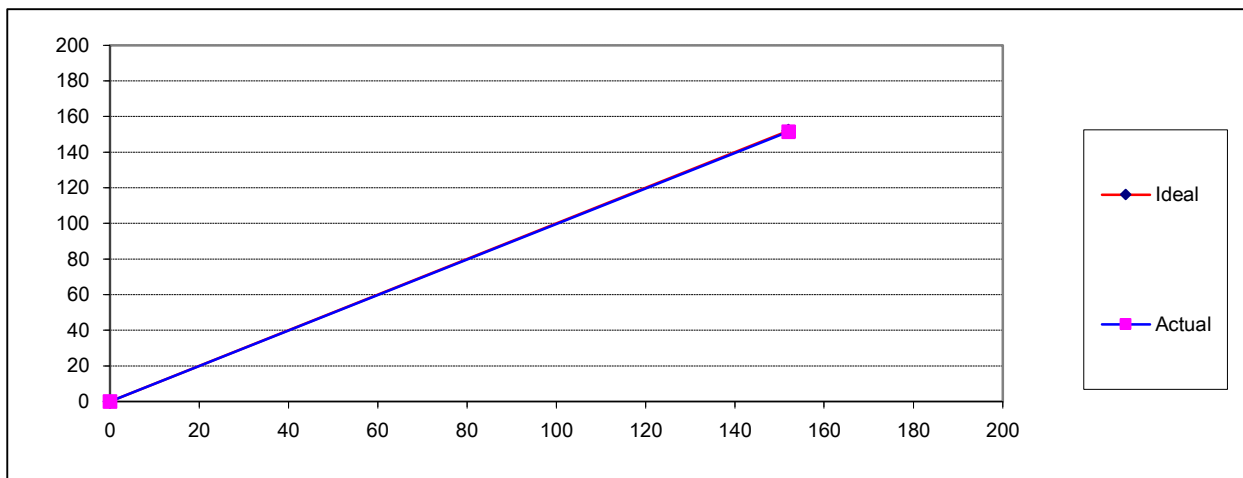


## CALIBRATION REPORT

Calibration Date	4-Jan-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	0.05	0.05	0.05
SPAN	152.00	151.50	-0.50	-0.33
AVERAGE (%)				-0.14



Calibrated By

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

Approved By

( Mr.Sarayuth Jittranont )  
Assistant General Manager



## ROTA METER CALIBRATION RESULT JANUARY 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS0577	03 Jan 23	$Y = 1.0259x - 0.6354$	0.9997
BKK_FS0579	05 Jan 23	$Y = 1.0005x + 0.2803$	1.0000
BKK_FS0583	05 Jan 23	$Y = 0.9976x + 1.2146$	1.0000
BKK_FS0584	03 Jan 23	$Y = 1.0104x - 0.3929$	1.0000
BKK_FS0586	05 Jan 23	$Y = 1.001x - 1.3619$	0.9999
BKK_FS0587	03 Jan 23	$Y = 1.0038x + 0.881$	1.0000
BKK_FS0588	05 Jan 23	$Y = 1.0015x - 0.6876$	0.9999
BKK_FS0590	05 Jan 23	$Y = 0.9958x + 1.7452$	1.0000
BKK_FS0591	03 Jan 23	$Y = 0.9677x + 64.54$	0.9951
BKK_FS0593	03 Jan 23	$Y = 0.9792x + 21.393$	0.9972
BKK_FS0594	03 Jan 23	$Y = 1.0455x - 43.344$	0.9976
BKK_FS0595	05 Jan 23	$Y = 0.9993x + 1.18$	1.0000
BKK_FS0597	05 Jan 23	$Y = 0.9788x + 22.286$	0.9971
BKK_FS1004	03 Jan 23	$Y = 0.9943x + 7.1619$	0.9996
BKK_FS1005	03 Jan 23	$Y = 1.0045x + 2.1167$	0.9998
BKK_FS1006	03 Jan 23	$Y = 1.0288x - 0.3852$	0.9999
BKK_FS1008	03 Jan 23	$Y = 1.0181x + 0.1282$	0.9998
BKK_FS1009	05 Jan 23	$Y = 1.0018x + 1.1293$	1.0000
BKK_FS1011	03 Jan 23	$Y = 1.0463x - 1.9344$	0.9985
BKK_FS1012	03 Jan 23	$Y = 1.0082x - 53.425$	0.9999
BKK_FS1013	03 Jan 23	$Y = 1.0058x - 9.701$	1.0000
BKK_FS1014	05 Jan 23	$Y = 0.9869x + 1.2643$	0.9995
BKK_FS1015	05 Jan 23	$Y = 1.004x - 0.7571$	0.9999
BKK_FS1016	05 Jan 23	$Y = 0.978x + 24.623$	0.9973
BKK_FS1017	17 Jan 23	$Y = 1.0022x + 0.4211$	1.0000
BKK_FS1018	17 Jan 23	$Y = 0.9893x + 5.8317$	1.0000
BKK_FS1019	17 Jan 23	$Y = 0.9859x - 11.574$	0.9986
BKK_FS1020	03 Jan 23	$Y = 1.0208x - 0.6221$	0.9998
BKK_FS1021	03 Jan 23	$Y = 0.992x - 44.599$	0.9997
BKK_FS1022	03 Jan 23	$Y = 1.0067x - 12.483$	0.9999
BKK_FS1023	03 Jan 23	$Y = 1.0013x + 0.5823$	0.9993
BKK_FS1024	03 Jan 23	$Y = 1.0036x - 50.787$	0.9999
BKK_FS1025	03 Jan 23	$Y = 0.974x + 27.034$	0.9969
BKK_FS1026	05 Jan 23	$Y = 0.9783x + 1.7075$	0.9991
BKK_FS1027	05 Jan 23	$Y = 1.145x - 90.325$	0.9797
BKK_FS1028	05 Jan 23	$Y = 0.9815x + 13.626$	0.9969
BKK_FS1029	03 Jan 23	$Y = 0.9706x + 3.6283$	0.9951
BKK_FS1030	03 Jan 23	$Y = 1.0197x - 52.982$	0.9999



## ROTA METER CALIBRATION RESULT JANUARY 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS1031	03 Jan 23	$Y = 0.9995x - 0.1581$	1.0000
BKK_FS1039	03 Jan 23	$Y = 1.0242x - 4.3007$	0.9986
BKK_FS1040	03 Jan 23	$Y = 1.0035x + 1.0705$	0.9998
BKK_FS1041	03 Jan 23	$Y = 0.9791x + 0.252$	1.0000
BKK_FS1042	03 Jan 23	$Y = 1.0186x - 3.7429$	0.9999
BKK_FS1043	03 Jan 23	$Y = 1.0038x + 2.961$	0.9999
BKK_FS1044	03 Jan 23	$Y = 1.0189x + 0.2969$	1.0000
BKK_FS1163	18 Jan 23	$Y = 1.0127x + 0.8332$	0.9996
BKK_FS1164	18 Jan 23	$Y = 1.2176x + 4.7376$	0.9952
BKK_FS1165	18 Jan 23	$Y = 1.0005x - 47.94$	1.0000
BKK_FS1166	18 Jan 23	$Y = 1.0346x - 35.841$	0.9996
BKK_FS1200	03 Jan 23	$Y = 1.0168x + 0.4034$	0.9997
BKK_FS1201	03 Jan 23	$Y = 0.7655x + 60.985$	0.9986
BKK_FS1202	03 Jan 23	$Y = 0.9593x + 87.615$	0.9958
RYG_FS0197	03 Jan 23	$Y = 1.0305x - 94.849$	0.9991
RYG_FS0198	03 Jan 23	$Y = 1.0103x - 19.254$	0.9999
RYG_FS0199	03 Jan 23	$Y = 0.9897x + 0.998$	0.9983

Review By :

(Mr. Wichan Choonharat)  
Enviro Field Services Manager

Approved By :

(Mr. Sarayuth Jittranont)  
Assistant General Manager

**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

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 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.

[Signature]

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 : 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

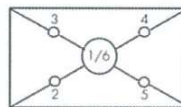
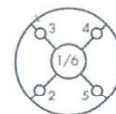
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

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 (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (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



**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 : 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

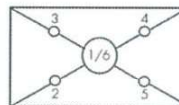
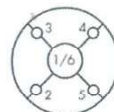
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

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

### Eccentricity (Off-center loading error)

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

Nominal value :	50	g
Tolerance	0.00015	g
Difference		
	1	-
	2	-
	3	-
	4	-
	5	-
	6	-



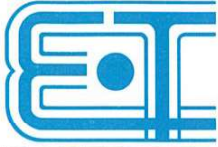
### Linearity

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

Tolerance 0.0001 g

Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(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 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

ที่ RA 013/22

## ใบรายงานผลการปรับเทียบ

ชื่อผู้ขอรับบริการ : บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด.

ที่อยู่ : 104 ซ.พัฒนาการ 40 ถ.พัฒนาการ แขวงสวนหลวง เขตสวนหลวง กรุงเทพมหานคร 10250.

ปรับเทียบที่ : บริษัท เอกเสคคิวทิฟ เทรตติ้ง จำกัด

ที่อยู่ : 48/194-5 ซอย ประดิษฐ์มนูธรรม 19 ถนนประดิษฐ์มนูธรรม แขวง/เขตลาดพร้าว กรุงเทพฯ 10230

รายละเอียดเครื่องมือที่ทำการปรับเทียบ :

สภาวะแวดล้อม :

เครื่องมือ : เครื่องตรวจวัดไอระเหยจากสารเคมี

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

ผลิตภัณฑ์ : RAE Systems

ความชื้นสัมพัทธ์ :  $(36 \pm 15) \%$

รุ่น : MiniRAE3000

ความดันบรรยากาศ : 760 มิลลิเมตรปรอท

หมายเลขเครื่อง : 592-906493

ID : BKK\_FS0819

REVIEW BY	<i>Malom P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL DATE	5/8/23

วันที่ปรับเทียบมาตรฐาน : 4 กุมภาพันธ์ 2565

วิธีการปรับเทียบมาตรฐาน : ปรับเทียบโดยใช้ Standard Reference Gas ผลิตภัณฑ์ GASCO  
- Isobutylene Standard Gas 100 ppm; Lot number: 304-402089381-1.

### 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)	54.1 ppm	100.0 ppm	0.0 ppm	Pass

Flow Rate of Pump : 490 cc/min.

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

ผู้ปรับเทียบ : *[Signature]*  
(นายสุรินทร์ สายเนตร)  
Service Engineer

ผู้ตรวจสอบ : *[Signature]*  
(นายสุทธิวิงศ์ คงทองสังข์)  
Service Engineer Manager

ผลการสอบเทียบ/ปรับเทียบ นี้ รับรองเฉพาะตัวอย่างและรายการที่ได้ระบุไว้เท่านั้น

การนำรายงานผล/ใบรับรองนี้ไปโฆษณาและการคัดลอกหรือการนำผลงานส่วนไปเผยแพร่ต่อสาธารณะต้องได้รับอนุญาตเป็นลายลักษณ์อักษรจากทางบริษัทฯ





# 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 013/22

## 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 :**

**Environmental Condition :**

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

Product : RAE Systems Relative Humidity :  $(36 \pm 15) \%$

Model Name : MiniRAE3000 Pressure : 760 mmHg

Serial Number : 592-906493

ID : BKK\_FS0819

**Date of Calibration** : February 4, 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: 304-402089381-1.

### 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)	54.1 ppm	100.0 ppm	0.0 ppm	Pass

**Flow Rate of Pump** : 490 cc/min.

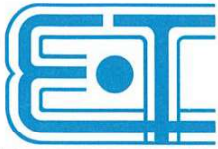
**Accuracy** :  $\pm 2 \%$  at calibration point

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 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

ที่ RA 013/22

## ใบรายงานการตรวจเช็คเครื่องตรวจวัดก๊าซ รุ่น MiniRAE3000

หมายเลขเครื่อง : 592-906493

วันที่ตรวจเช็ค : 4 กุมภาพันธ์ 2565

ลำดับที่	รายละเอียด การตรวจสอบ	RAW COUNT		สรุป	หมายเหตุ
		REF.	REAL		
1.	PID RAW COUNT				
	Ch.H	10000-62500	39643	■ YES □ NO	
	Ch.L	<62500	29542	■ YES □ NO	
2.	Lamp	>40	45	■ YES □ NO	

ลำดับที่	รายละเอียด การตรวจซ่อม	การแก้ไข	สรุป	หมายเหตุ
1.	Motor Pump	Check flow rate	■ YES □ NO	490 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	เปลี่ยนใหม่

ผู้ตรวจเช็ค : สุรินทร์ สายเนตร  
(นายสุรินทร์ สายเนตร)  
Service Engineer

ผลการสอบเทียบ/ปรับเทียบ นี้ รับรองเฉพาะตัวอย่างและรายการที่ได้รับอนุญาตไว้เท่านั้น

การนำรายงานผล/ใบรับรองนี้ไปโฆษณาและการคัดลอกหรือการนำผลบางส่วนไปเผยแพร่ต่อสาธารณะต้องได้รับอนุญาตเป็นลายลักษณ์อักษรจากทางบริษัทฯ



**GASCO AFFILIATES, LLC.**

320 Scarlet Blvd.  
Oldsmar, FL 34677  
(800) 910-0051  
fax: (866) 755-8920  
www.gascogas.com

## **CERTIFICATE OF ANALYSIS**

**Date:** May 14, 2021  
**Order Number:** 58376  
**Lot Number:** 304-402089381-1

**Customer:** R C Systems Co Inc  
**Use Before:** 05/14/2025

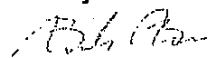
<u>Component</u>	<u>Requested Concentration</u>	<u>Analytical Result (+/- 2%)</u>
Isobutylene	100 PPM	101.2 PPM
Air	Balance	Balance

**Cylinder Size:** 3.70 Cu. Ft.  
**Contents:** 105 Liter

**Valve:** 5/8"-18 UNF  
**Pressure:** 1200 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:**

  
Brandon Brown

Honeywell Analytics – Singapore Office  
17 Changi Business Park Central 1  
Singapore 486073  
Cert Ref: 00317

**Honeywell**  
THE POWER OF CONNECTED

Gas Detection



# CERTIFICATE Of Attendance

It is hereby certified that

**Mr Suttiwong Kongthongsang**  
**(Executive Trading Limited)**

has attended the

**RAE Products & Maintenance Training Course**

Conducted by

**RAE Systems BY HONEYWELL**

on **31<sup>st</sup> July to 2<sup>nd</sup> August 2018**

A handwritten signature in blue ink, appearing to be "Desmond Tan".



Conducted by : Desmond Tan  
Service Engineer/Technical Trainer  
Date of Issue : 2<sup>nd</sup> August 2018  
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).