

ภาคผนวก ง

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ใบรับรองการสอบเทียบเครื่องมือ



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0668	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0397	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0184	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	RYG_EN0001	20-Feb-25	20-Feb-26	12
Ambient	Total Suspended Particulate	High Volume	RYG_FS0176	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0174	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0181	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RYG_EN0001	20-Feb-25	20-Feb-26	12
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0647	15-Jan-25	14-Jul-26	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0609	18-Jul-24	18-Jan-26	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0610	26-Jun-24	26-Dec-25	18
Stack	Total Suspended Particulate	Console Control Unit	RYG_FS0315	6-Feb-25	6-Aug-25	6
Stack	Total Suspended Particulate	Pitot Tube	RYG_FS0321	6-Feb-25	9-Aug-25	6
Stack	Total Suspended Particulate	Flue gas Analyzer	RYG_FS0563	22-Jan-25	22-Jan-26	12
Stack	Total Suspended Particulate	Digital Balance	RYG_EN0003	20-Feb-25	20-Feb-26	12
Stack	Butyl Acrylate	Console Control Unit	RYG_FS0315	6-Feb-25	6-Aug-25	6
Stack	Butyl Acrylate	Pitot Tube	RYG_FS0321	6-Feb-25	9-Aug-25	6
Stack	Butyl Acrylate	Flue gas Analyzer	RYG_FS0464	24-Mar-25	23-Mar-26	12
Stack	Butyl Acrylate	Field Rotameter	RYG_FS0658	9-Jan-25	9-Apr-25	3
Stack	Butyl Acrylate	GC-MSD	BKK_EN0410	10-May-24	10-Nov-25	18
Stack	Methyl Methacrylate	Console Control Unit	RYG_FS0315	6-Feb-25	6-Aug-25	6
Stack	Methyl Methacrylate	Pitot Tube	RYG_FS0321	6-Feb-25	9-Aug-25	6
Stack	Methyl Methacrylate	Flue gas Analyzer	RYG_FS0464	24-Mar-25	23-Mar-26	12
Stack	Methyl Methacrylate	Field Rotameter	RYG_FS0658	9-Jan-25	9-Apr-25	3
Stack	Methyl Methacrylate	GC-MSD	BKK_EN0410	10-May-24	10-Nov-25	18
Stack	Total VOCs as Propane	Console Control Unit	RYG_FS0315	6-Feb-25	6-Aug-25	6
Stack	Total VOCs as Propane	Pitot Tube	RYG_FS0320	6-Feb-25	9-Aug-25	6
Stack	Total VOCs as Propane	Flue gas Analyzer	RYG_FS0464	24-Mar-25	23-Mar-26	12
Stack	Total VOCs as Propane	FID Analyzer	BKK_FS0758	3-Jan-25	3-Jul-25	6
Noise	Leq 24 hrs	Sound Calibrator	RYG_FS0496	19-Mar-25	19-Mar-26	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0020	21-Jan-25	21-Jan-26	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0019	21-Jan-25	21-Jan-26	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0213	16-Jan-25	16-Jan-26	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0388	19-Mar-25	19-Mar-26	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0389	27-Jan-25	26-Jan-26	12
Workplace	Total VOC	DRYCAL FLOWMETER	RYG_FS0208	13-Feb-24	13-Aug-25	18
Workplace	Total VOC	DRYCAL FLOWMETER	BKK_FS0614	21-May-24	21-May-25	12
Workplace	Total VOC	DRYCAL FLOWMETER	RYG_FS0208	27-Jan-25	26-Jan-26	12
Workplace	Total VOC	DRYCAL FLOWMETER	BKK_FS0614	9-Sep-24	9-Sep-25	12
Workplace	Total VOC	Air Sampling Pump	RYG_FS0126	6-Jan-25	6-Apr-25	3
Workplace	Total VOC	Air Sampling Pump	RYG_FS0130	7-Jan-25	7-Apr-25	3
Workplace	Total VOC	Air Sampling Pump	RYG_FS0135	7-Jan-25	7-Apr-25	3
Workplace	Total VOC	Air Sampling Pump	RYG_FS0136	7-Jan-25	7-Apr-25	3
Workplace	Total VOC	Air Sampling Pump	RYG_FS0101	7-Apr-25	7-Jul-25	3
Workplace	Total VOC	Air Sampling Pump	RYG_FS0108	6-Apr-25	6-Jul-25	3
Workplace	Total VOC	Air Sampling Pump	RYG_FS0111	7-Apr-25	7-Jul-25	3
Workplace	Total VOC	Air Sampling Pump	RYG_FS0114	6-Apr-25	6-Jul-25	3
Workplace	Total VOC	TVOC Analyzer	BKK_FS0820	9-Sep-24	9-Mar-26	18





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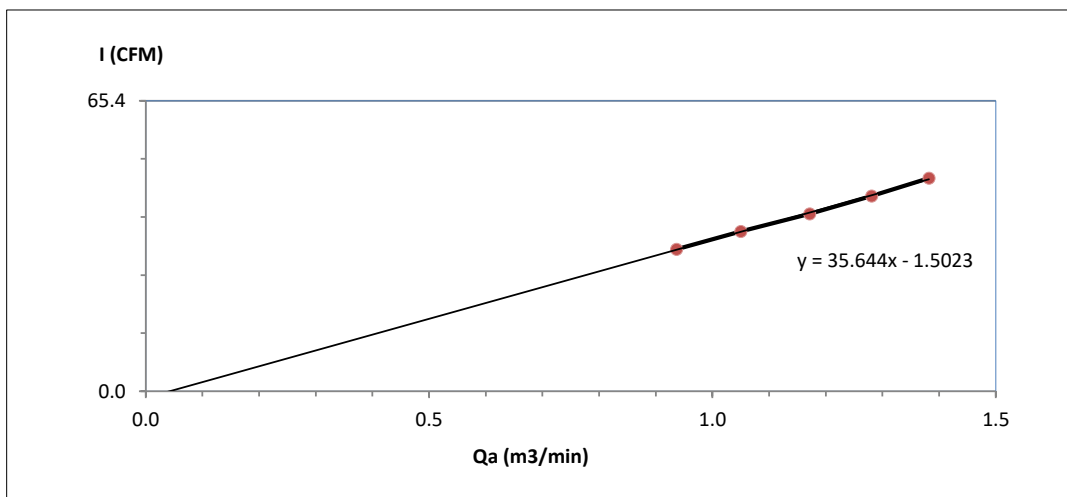
Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Workplace	Total Dust	DRYCAL FLOWMETER	RYG_FS0208	13-Feb-24	13-Aug-25	18
Workplace	Total Dust	DRYCAL FLOWMETER	BKK_FS0614	21-May-24	21-May-25	12
Workplace	Total Dust	DRYCAL FLOWMETER	RYG_FS0208	27-Jan-25	26-Jan-26	12
Workplace	Total Dust	DRYCAL FLOWMETER	BKK_FS0614	9-Sep-24	9-Sep-25	12
Workplace	Total Dust	Air Sampling Pump	RYG_FS0139	6-Jan-25	6-Apr-25	3
Workplace	Total Dust	Air Sampling Pump	RYG_FS0124	6-Apr-25	6-Jul-25	3
Workplace	Total Dust	Digital Balance	RYG_EN0004	22-Feb-24	22-Feb-25	12
Workplace	Total Dust	Digital Balance	RYG_EN0004	20-Feb-25	20-Feb-26	12
Rayong Lab	BOD	DO meter with Sensor	RYG_EN0032	20-Jan-25	20-Jul-26	18
Rayong Lab	BOD	Incubator	RYG_EN0154	1-Nov-24	1-May-26	18
Rayong Lab	BOD	Burette	RYG_EN0216	24-Sep-24	24-Sep-25	12
Rayong Lab	COD	Spectrophotometer	RYG_EN0037	18-Mar-25	18-Sep-26	18
Rayong Lab	Oil & Grease	Electronic Balance	RYG_EN0002	20-Feb-25	20-Feb-26	12
Rayong Lab	Oil & Grease	Hot Air Oven	RYG_EN0213	19-Mar-25	19-Mar-26	12
Rayong Lab	Oil & Grease	Water Bath	RYG_EN0061	21-Mar-24	21-Sep-25	18
Rayong Lab	pH at 25 °C	pH meter	RYG_EN0183	19-Jan-24	19-Jul-25	18
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG_EN0002	20-Feb-25	20-Feb-26	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RYG_EN0010	21-Mar-24	21-Sep-25	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RYG_EN0002	20-Feb-25	20-Feb-26	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RYG_EN0010	21-Mar-24	21-Sep-25	18
Rayong Lab	Temperature	pH meter	RYG_FS0596	1-Jul-24	1-Jul-25	12




## High Volume Air Sampler Calibration Worksheet

Project Site :	Thai MMA Co.,Ltd	Barometric Pressure (mm Hg) :	756.2
Calibrate Location :	นนทบุรี	Temperature ( °C ) :	30.8
Calibrate Date :	24-Mar-25	High Volume ID :	RYG_FS0668
CalibrationSheet No.:	C-240325-RYG_FS0668	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0205	High Volume S/N :	6267
Calibrator Model :	TE-5028A	Calibrator Slope :	0.95561
Calibrator S/N :	1166	Calibrator Intercept :	-0.02266

Test No.	Delta H <sub>2</sub> O (inch)	Qa (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	1.9	0.937	32	Slope : 35.6443 Intercept : -1.5023 Correlation Coefficient : 0.9995
2	2.4	1.050	36	
3	3.0	1.171	40	
4	3.6	1.281	44	
5	4.2	1.382	48	



Calibrated by   
( Mr.Santi Chaichana )  
RYG-Field Services Scientist(2)

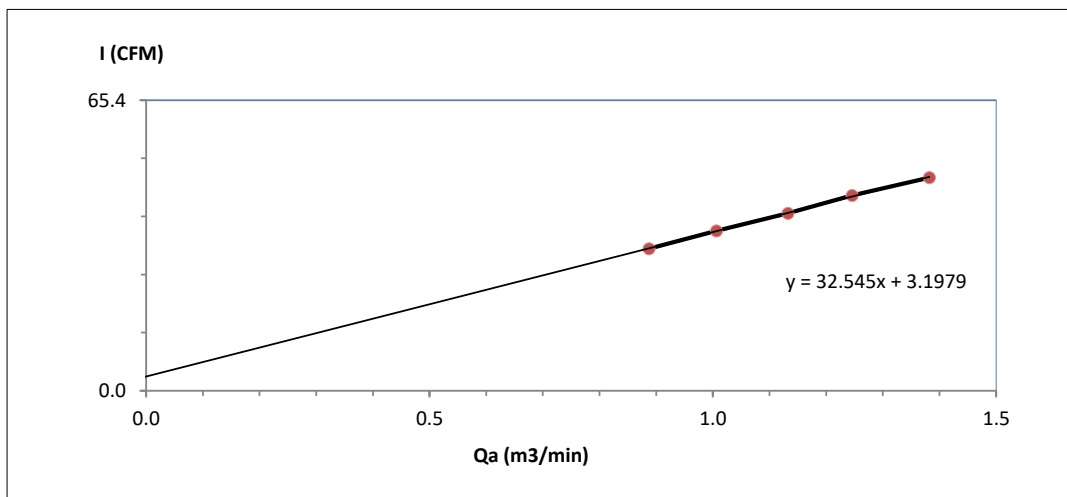
Approved by :   
(Mr.Supot Salamteh)  
RYG-Field Services Section Head




### High Volume Air Sampler Calibration Worksheet

Project Site :	Thai MMA Co.,Ltd	Barometric Pressure (mm Hg) :	756.2
Calibrate Location :	ยวณณณณณณ	Temperature ( °C ) :	30.8
Calibrate Date :	24-Mar-25	High Volume ID :	RYG_FS0397
CalibrationSheet No.:	C-240325-RYG_FS0397	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0205	High Volume S/N :	5687
Calibrator Model :	TE-5028A	Calibrator Slope :	0.95561
Calibrator S/N :	1166	Calibrator Intercept :	-0.02266

Test No.	Delta H <sub>2</sub> O (inch)	Qa (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	1.7	0.887	32	Slope : 32.5446 Intercept : 3.1979 Correlation Coefficient : 0.9997
2	2.2	1.006	36	
3	2.8	1.133	40	
4	3.4	1.246	44	
5	4.2	1.382	48	



Calibrated by   
( Mr.Santi Chaichana )  
RYG-Field Services Scientist(2)

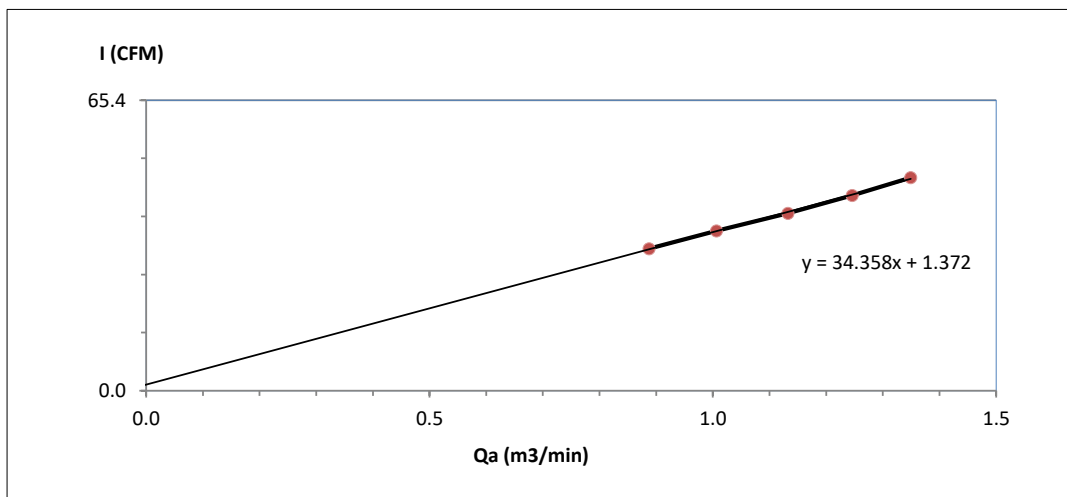
Approved by :   
(Mr.Supot Salamteh)  
RYG-Field Services Section Head




### High Volume Air Sampler Calibration Worksheet

Project Site :	Thai MMA Co.,Ltd	Barometric Pressure (mm Hg) :	756.2
Calibrate Location :	บ้านเนินพยอม	Temperature ( °C ) :	30.8
Calibrate Date :	24-Mar-25	High Volume ID :	RYG_FS0184
CalibrationSheet No.:	C-240325-RYG_FS0184	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0205	High Volume S/N :	4792
Calibrator Model :	TE-5028A	Calibrator Slope :	0.95561
Calibrator S/N :	1166	Calibrator Intercept :	-0.02266

Test No.	Delta H <sub>2</sub> O (inch)	Qa (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	1.7	0.887	32	Slope : 34.3582 Intercept : 1.3720 Correlation Coefficient : 0.9994
2	2.2	1.006	36	
3	2.8	1.133	40	
4	3.4	1.246	44	
5	4.0	1.349	48	



Calibrated by   
( Mr.Santi Chaichana )  
RYG-Field Services Scientist(2)

Approved by :   
(Mr.Supot Salamteh)  
RYG-Field Services Section Head

Accredited by

NSC-TISI-TIS 17025

Calibration 0426



NSC-TISI-TIS 17025

CALIBRATION 0426

## Calibration certificate

Calibration Certificate No. 25BKL0001

Object	Electronic non-automatic weighing instrument	This calibration certificate documents the traceability to national standards.
Manufacturer	Sartorius	Uncertainties of measurements are taken into account when only statements of compliance are made.
Type	LA130S-F	This certificate was prepared by Sartorius Corporation in accordance to the current ISO/IEC 17025:2017 standard and Sartorius Work Instruction (Method) SOP WI 08.
Serial   QM Ident. no.	25409664   RYG_EN0001	This certificate relate and apply this equipment only.
Customer	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)	
	616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.	
Order no.	2230	
Number of pages	4	
Date of calibration	20 Feb 2025	

REVIEW BY .....

Thanitak.

APPROVED BY.....

D. Khunon.

NEXT CAL DATE.....

20/02/26

This calibration certificate may not be reproduced other than in full except with the permission of NSC-TISI-TIS-17025 and the issuing laboratory. Calibration certificates without signature are not valid.

The user is obliged to have the object recalibrated at appropriate intervals.

Date 06 Mar 2025 Approval of the Calibration Certificate



Mr. Chonchai Inthana

Person in charge

Kachen Lalee

Calibration object

Single range instrument

Model	LA130S-F
Serial Number	25409664
QM Ident. no   Inventory no.	RYG_EN0001   ---

Maximum capacity (Max. load)	150.0000 g
Measured range	150.0000 g
Scale interval	0.0001 g

Place of calibration

Address	According to page 1
Department   Cost center	Laboratory Department.   ---
Building   Floor	---   1st Floor.
Room	Balance Room.
Maximum temperature variation at place of calibration	5 K

Calibration procedure

EURAMET cg-18, V4.0 - Guidelines on the Calibration of Non-Automatic Weighing Instruments

Test equipment

Test equipment type	Test equipment ID	Valid until
Thermometer	MHB-382SD s/nB011342 Traceable to SI unit through DKSH	21 Aug 2025
Test weight set OIML R111 E2	Certificate No.M2308197S ,E2(Traceable to SI unit through TCS)	23 Aug 2025

Adjustment Status

The measuring device was internally adjusted before the calibration.

Environmental and measuring conditions

Date of calibration	20 Feb 2025
Temperature at place of calibration   Temp. diff. <i>T</i> <sub>weights</sub> - <i>T</i> <sub>place</sub>	24.5 °C   1.0 K
Measuring conditions	The installation site is suitable. The device was levelled. Balance was loaded up to Max before test.
Comments	Humidity 58.0 %RH.

Measurement results | Measurement uncertainties

Repeatability

Test load (nominal): 10 g   100 g		
	10 g	100 g
1	10.0000 g	100.0000 g
2	9.9999 g	100.0000 g
3	10.0000 g	99.9999 g
4	10.0000 g	100.0000 g
5	10.0000 g	99.9999 g
6	9.9999 g	99.9999 g
7	10.0000 g	100.0000 g
8	10.0000 g	100.0000 g
9	10.0000 g	100.0000 g
10	10.0000 g	100.0000 g
	<i>s</i> = 0.00004 g	<i>s</i> = 0.00005 g

Eccentricity

Test load (nominal): 50 g	
Center	50.0000 g
Front left	50.0001 g
Back left	50.0000 g
Back right	49.9999 g
Front right	50.0001 g
Maximum deviation from centric loading indication $ \Delta_{ecc} _{max} = 0.0001\text{ g}$	

Error of indication

Testload	Indication	Error	Expansion factor	Uncertainty	Uncertainty relative
<i>L</i>	<i>I</i>	<i>E</i>	<i>k</i>	<i>U(E)</i>	<i>U<sub>rel</sub>(E)</i>
0.0100 g	0.0100 g	0.0000 g	2.00	0.00012 g	1.2 %
0.0500 g	0.0500 g	0.0000 g	2.00	0.00013 g	0.25 %
0.1000 g	0.1000 g	0.0000 g	2.00	0.00013 g	0.13 %
0.5000 g	0.5000 g	0.0000 g	2.00	0.00013 g	0.026 %
1.0000 g	1.0000 g	0.0000 g	2.00	0.00013 g	0.013 %
2.0000 g	2.0000 g	0.0000 g	2.00	0.00013 g	0.0065 %
5.0000 g	5.0000 g	0.0000 g	2.00	0.00013 g	0.0026 %
10.0000 g	10.0000 g	0.0000 g	2.00	0.00013 g	0.0013 %
20.0000 g	20.0000 g	0.0000 g	2.00	0.00014 g	0.00069 %
100.0000 g	100.0000 g	0.0000 g	2.00	0.00021 g	0.00021 %
150.0000 g	149.9999 g	-0.0001 g	2.00	0.00028 g	0.00019 %
Maximum error of indication		$ E _{max} = 0.0001\text{ g}$			

*U<sub>rel</sub>(E)* is the quotient of *U(E)* and test load *L*. The uncertainty of measurement *U(E)* is valid only if error *E* is considered. You will find reference notes on the uncertainty of measurement in use under: Appendix to the calibration certificate | Interpretation of measurement results.  
Reference note: The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the documented Expansion factor, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

End of calibration certificate

# Uncertainty of measurement in use

Device adjusted before measurement	Yes
Temperature deviation considered	1.5 K (isoCAL active)
Temperature coefficient considered	$1 \cdot 10^{-6}/\text{K}$

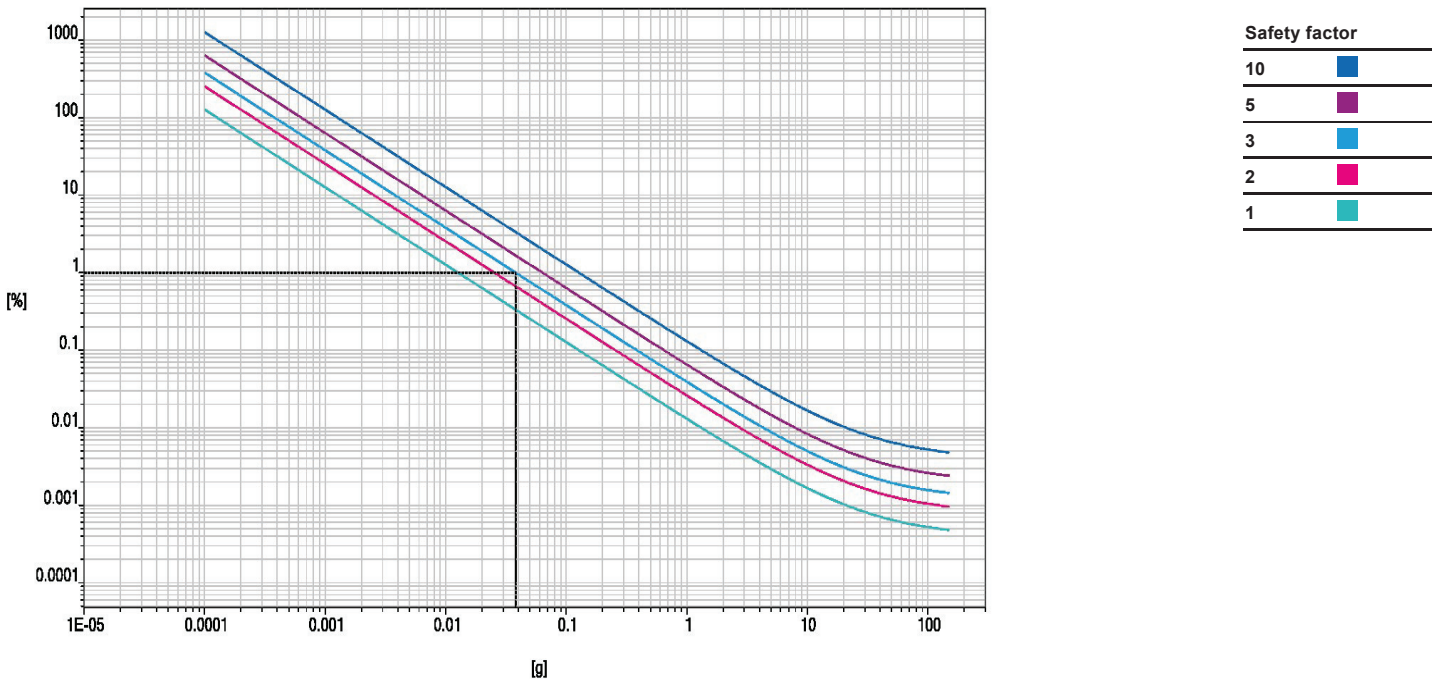
Uncertainty of the weighing result  $U_{gl}(W)$

$U_{gl}(W) = 0.00013 \text{ g} + 3.96 \cdot 10^{-6} \cdot R$

Reference note: The current uncertainty of measurement is calculated by entering of the reading  $R$  into this formula. In relation to this, there is no need for a correction of the indication error. The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied with an Expansion factor of 2, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

Indication in % from max load	Net indication $R$	Uncertainty $U_{gl}(W)$	Uncertainty relative $U_{gl}(W)_{rel}$
1 %	1.5000 g	0.00014 g	0.0091 %
25 %	37.5000 g	0.00028 g	0.00074 %
50 %	75.0000 g	0.00043 g	0.00057 %
75 %	112.5000 g	0.00058 g	0.00051 %
100 %	150.0000 g	0.00072 g	0.00048 %

Graphic realization of the relative uncertainty of measurement | process accuracy



Displayed example

Process accuracy	1.00 %
Safety factor	3
Minimum sample weight	0.0380 g

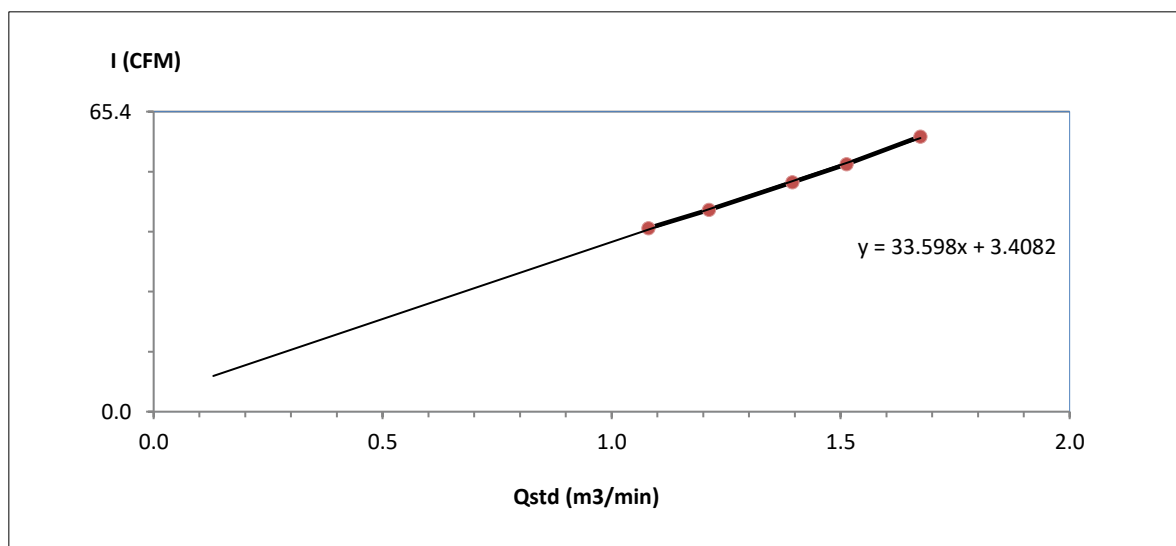





## High Volume Air Sampler Calibration Worksheet

Project Site :	Thai MMA Co., Ltd.	Barometric Pressure (mm Hg) :	756.2
Calibrate Location :	บ้านบน	Temperature ( °C ) :	30.8
Calibrate Date :	24-Mar-25	High Volume ID :	RYG_FS0176
CalibrationSheet No.:	C-240325-RYG_FS0176	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0205	High Volume S/N :	4802
Calibrator Model :	TE-5028A	Calibrator Slope :	1.52567
Calibrator S/N :	1166	Calibrator Intercept :	-0.03613

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.6	1.0802	40	Slope : 33.5985 Intercept : 3.4082 Correlation Coefficient : 0.9993
2	3.3	1.2124	44	
3	4.4	1.3944	50	
4	5.2	1.5127	54	
5	6.4	1.6743	60	



Calibrated by

  
( Mr.Santi Chaichana )  
RYG-Field Services Scientist(2)

Approved by :

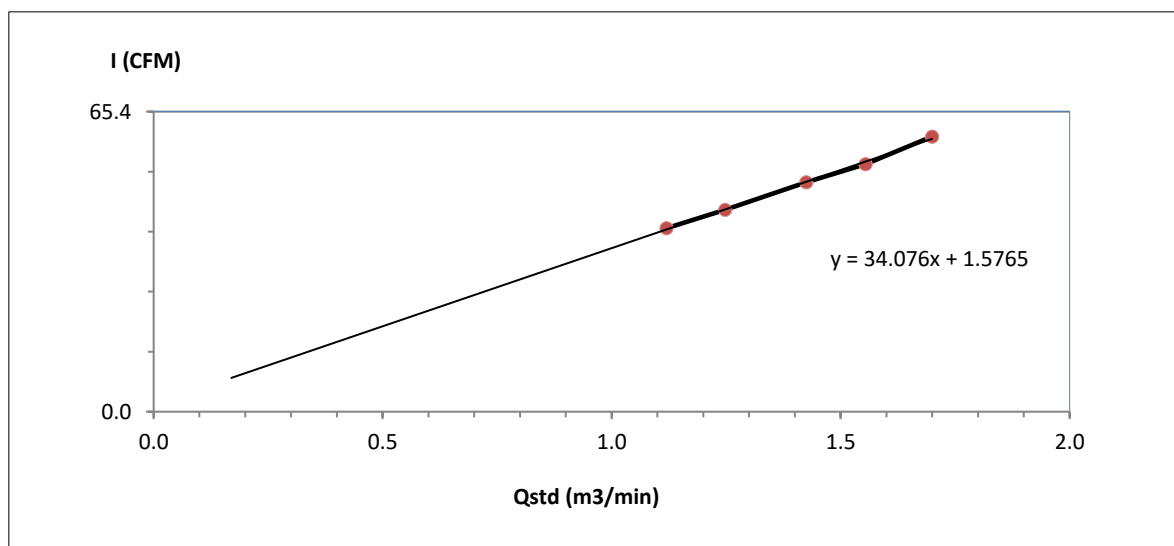
  
(Mr.Supot Salamteh)  
RYG-Field Services Section Head




## High Volume Air Sampler Calibration Worksheet

Project Site :	Thai MMA Co., Ltd.	Barometric Pressure (mm Hg) :	756.2
Calibrate Location :	บ้านมณเฑียร	Temperature ( °C ) :	30.8
Calibrate Date :	24-Mar-25	High Volume ID :	RYG_FS0174
CalibrationSheet No.:	C-240325-RYG_FS0174	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0205	High Volume S/N :	4800
Calibrator Model :	TE-5028A	Calibrator Slope :	1.52567
Calibrator S/N :	1166	Calibrator Intercept :	-0.03613

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	1.1197	40	Slope : 34.0759 Intercept : 1.5765 Correlation Coefficient : 0.9987
2	3.5	1.2476	44	
3	4.6	1.4249	50	
4	5.5	1.5547	54	
5	6.6	1.6997	60	



Calibrated by

  
( Mr.Santi Chaichana )  
RYG-Field Services Scientist(2)

Approved by :

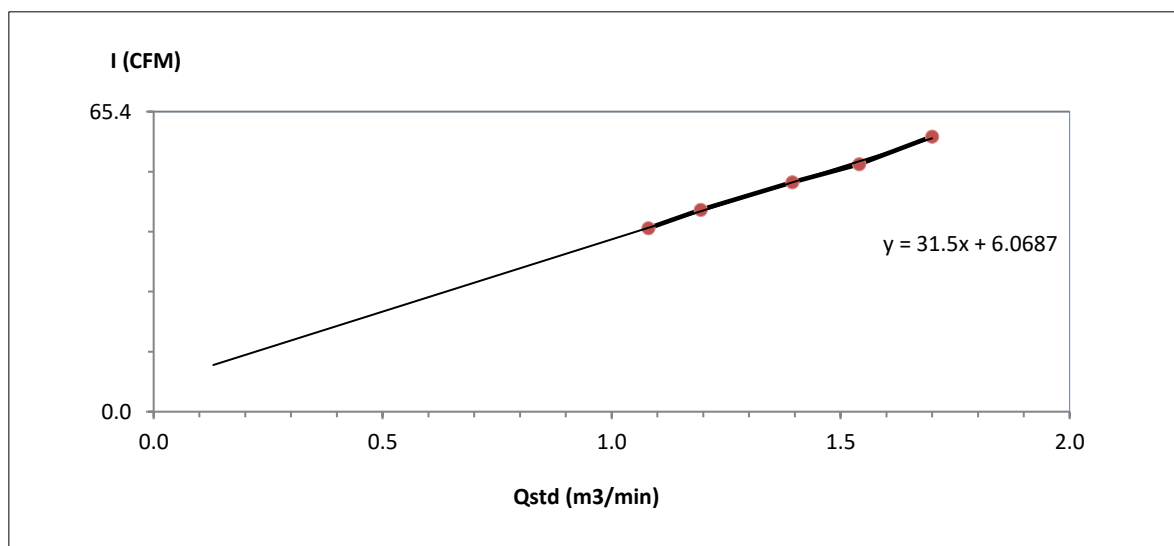
  
(Mr.Supot Salamteh)  
RYG-Field Services Section Head




## High Volume Air Sampler Calibration Worksheet

Project Site :	Thai MMA Co., Ltd.	Barometric Pressure (mm Hg) :	756.2
Calibrate Location :	บ้านเนินพยอม	Temperature ( °C ) :	30.8
Calibrate Date :	24-Mar-25	High Volume ID :	RYG_FS0181
CalibrationSheet No.:	C-240325-RYG_FS0181	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0205	High Volume S/N :	5334
Calibrator Model :	TE-5028A	Calibrator Slope :	1.52567
Calibrator S/N :	1166	Calibrator Intercept :	-0.03613

Test No.	Delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I : Chart (CFM)	Linear Regression
1	2.6	1.0802	40	Slope : 31.5003 Intercept : 6.0687 Correlation Coefficient : 0.9988
2	3.2	1.1945	44	
3	4.4	1.3944	50	
4	5.4	1.5409	54	
5	6.6	1.6997	60	



Calibrated by

  
( Mr.Santi Chaichana )  
RYG-Field Services Scientist(2)

Approved by :

  
(Mr.Supot Salamteh)  
RYG-Field Services Section Head



JIRANATEE ASSOCIATES CO.,LTD.

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

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

Air speed measurement laboratory  
Calibration services department.



Certificate Number

CWS-004-68

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Cup anemometer  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02FA  
Data logger: 110-WS-25DL-D  
**SERIAL NUMBER** : Sensor: WSD-A5977  
Data logger: A5977  
**ID NUMBER** : RYG\_FS0647  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 10 Jan 2025  
**MEASUREMENT DATE** : 15 Jan 2025  
**ISSUE DATE** : 20 Jan 2025

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

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

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

**Preconditioning** : 24 hours at ambient conditions.  
**Measurement Condition** : The average values during measurement are (24.1) °C, (54.2) %RH and (1016.4) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jittraporn Lertsomphol



Approved signatory: .....

Mr. Parinya Booncharoen  
Calibration Department Manager

### Remark:

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

REVIEW BY ....

APPROVED BY ....

NEXT CAL DATE. 14/ 07/ 26

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 which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section, UUC was mounted on a round vertical tube of the lower plate at center of 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)
0.990	24.10	24.05	0.9	-0.1	0.45
2.203	24.20	24.05	2.1	-0.1	0.31
3.010	24.10	24.05	2.9	-0.1	0.55
4.200	24.10	24.05	4.1	-0.1	0.31
4.95	24.20	24.05	5.0	0.1	0.68
5.97	24.10	24.05	5.9	-0.1	0.36
7.03	24.20	24.05	6.9	-0.1	0.43
7.96	24.10	24.05	7.9	-0.1	0.61
9.01	24.10	24.05	9.0	-0.1	0.54
9.95	24.10	24.05	9.9	-0.1	0.66
11.06	24.00	24.05	10.9	-0.2	0.71
11.99	24.28	24.05	11.8	-0.2	0.63
13.03	24.04	24.05	13.0	0.0	0.89
13.95	24.30	24.05	14.0	0.0	0.83
15.02	24.12	24.05	14.9	-0.1	0.69
15.95	24.26	24.05	15.9	0.0	0.71

## 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.







JIRANATEE ASSOCIATES CO.,LTD.

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

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

Wind direction measurement laboratory  
Calibration services department.



Certificate Number

CWD-004-68

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Wind Direction Sensor  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02FA  
Data logger: 110-WS-25DL-D  
**SERIAL NUMBER** : Sensor: WSD-A5977  
Data logger: A5977  
**ID NUMBER** : RYG\_FS0647  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 10 Jan 2025  
**MEASUREMENT DATE** : 15 Jan 2025  
**ISSUE DATE** : 20 Jan 2025

### 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>  
Wind direction frontal area<sup>2</sup> 129 cm<sup>2</sup>  
Diameter of mounting pipe<sup>3</sup> - mm  
Blockage ratio of test object<sup>4</sup> 0.143 [-]

**Preconditioning** : 24 hours at ambient conditions.  
**Measurement Condition** : The average values during measurement are (24.4)°C, (59.7) %RH and (1011.0) 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	$D^{\circ}_{std}$ Degree (°)	$D^{\circ}_{uuc}$ Degree (°)	Error Degree (°)	$U (k=2)$ Degree (°)
4.99	0.000	0	0	0.80
	45.000	41	-4	0.80
	90.000	87	-3	0.80
	135.000	131	-4	0.80
	180.000	177	-3	0.80
	225.000	225	0	0.80
	270.000	274	4	0.80
	315.000	319	4	0.80

## Remark:

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

<sup>6</sup> Direction of standard

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

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





JIRANATEE ASSOCIATES CO.,LTD.

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

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

Temperature measurement laboratory  
Calibration services department.



NSC – TISI – TIS 17025  
CALIBRATION 0367

## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-028-68

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Data Logger with Temperature sensor  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : 110-WS-25DL-D  
**SERIAL NUMBER** : A5977  
**ID NUMBER** : RYG\_FS0647  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khwaeng Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.

**RECEIVED DATE** : 10 Jan 2025  
**MEASUREMENT DATE** : 15 Jan 2025  
**ISSUE DATE** : 20 Jan 2025

### 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

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

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibration procedure:

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

### Traceability:

The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0047-24, Certificate number: ER-0113-24

### Reference Used During Calibration:

1. Standard Temperature Probe  
Model: STS-100 A500, Serial No.: 667682-09,  
Due date: 26 Mar 2025
2. Digital Temperature Indicator  
Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 21 Oct 2025

### Uncertainty of Measurement:

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

### Calibrated by:

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



Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager





JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number CDT-028-68

Page 2 of 2 Pages

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

**Calibration Range:** 20 °C to 40 °C

**Function:**

Table 1: This equipment was connected with temperature sensor Model: HMP60 S/N: V1920212.  
Dimension: Diameter 12 mm. Length 80 mm.

<u>Immersion Depth</u> (mm)	<u>Standard Reading</u> (°C)	<u>UUC Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
80	20.077	19.8	-0.3	0.099
80	25.066	24.8	-0.3	0.099
80	30.053	29.8	-0.3	0.099
80	35.034	34.7	-0.3	0.099
80	40.019	39.7	-0.3	0.099

**UUC\*:** Unit Under Calibration

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





JIRANATEE ASSOCIATES CO.,LTD.

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

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



Relative humidity and Air Temperature measurement laboratory  
Calibration services department.

## CERTIFICATE OF CALIBRATION

Certificate No. : CRT-002-68

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Relative humidity with data logger  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Data Logger: 110-WS-25DL-D  
Sensor: HMP60  
**SERIAL NUMBER** : Data Logger: A5977  
Sensor: V1920212  
**ID NUMBER** : RYG\_FS0647  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 10 Jan 2025  
**MEASUREMENT DATE** : 15 Jan 2025  
**ISSUE DATE** : 20 Jan 2025

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

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

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibration procedure:

The Relative humidity and Air Temperature calibration was done by In-House calibration method as WI-CL-009 and WI-CL-010 according to comparison method with Standard Chilled Mirror hygrometer with Temperature sensor and standard Humidity generator chamber.

### Traceability:

The measurements are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT). Certificate number: TH-0146-24 and Jiranatee Associates Co., Ltd. Certificate number: CDT-026-68.

### Uncertainty of Measurement:

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

Calibrated by:

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



Approved signatory: .....

Mr. Parinya Booncharoen  
Calibration Department Manager



JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number: CRT-002-68

Page 2 of 2 Pages

**Measurement Results:**

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

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

**Table 1:** The results of calibration of relative humidity at 30 °C are reported in table below.

**Calibration Range:** 20%RH to 80%RH

<u>Air Temperature</u> (°C)	<u>Standard Reading</u> (%RH)	<u>UUC Reading</u> (%RH)	<u>Error</u> (%RH)	<u>Uncertainty</u> ±(%RH)
29.72	19.84	18.6	-1.3	0.78
29.73	51.26	49.0	-2.3	1.3
29.74	82.85	79.7	-3.2	2.1

UUC\*: Unit Under Calibration

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





JIRANATEE ASSOCIATES CO.,LTD.

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

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

Pressure measurement laboratory  
Calibration services department.



## CERTIFICATE OF CALIBRATION

Certificate No. : CPR-002-68

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Digital barometer  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: 110-WS-25BP  
Data logger: 110-WS-25DL-D  
**SERIAL NUMBER** : Sensor: BP-A5977  
Data logger: A5977  
**ID NUMBER** : RYG\_FS0647  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd,  
Khwaeng Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.

**RECEIVED DATE** : 10 Jan 2025  
**MEASUREMENT DATE** : 15 Jan 2025  
**ISSUE DATE** : 20 Jan 2025

### Calibration procedure:

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

### Traceability:

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

### Reference Used During Calibration:

1. Absolute Pressure Transducer  
Model: GPG2500, Serial No.: 4100126P

### Uncertainty of Measurement:

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

### CONDITION OF THIS RESULT OF CALIBRATION:

- Calibration effort for calibration sequence C
- The UUC\* was installed in vertical orientation above reference standard instrument and center of UUC\* was used as the reference level.
- Calibration conditions:
- Condition : ☒ Normal ☐ Abnormal  
Pressure transmitting medium : Air  
 $\rho_{F1}$  (20°C, 1 bar) : 1.19 kg/m<sup>3</sup>  
 $H_{amb}$  : (62.4±2.6) %  
 $t_{amb}$  : (23.5±0.1) °C  
 $p_{amb}$  : (1011.0±1.6) mbar
- The certificate is valid only to the item calibrated on date and place of calibration

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn Lertsomphol



### Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager





JIRANATEE ASSOCIATES CO.,LTD.

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

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

Pressure measurement laboratory  
Calibration services department.



## CERTIFICATE OF CALIBRATION

Certificate No. : CPR-002-68

Page 2 of 2 Pages

MEASUREMENT RESULTS : ☐ Without adjustment ☒ With adjustment

CALIBRATION IN THE RANGE OF : 950 mbar to 1050 mbar

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.02	951.4	1.4	0.37
970.08	971.3	1.2	0.38
990.07	990.8	0.8	0.38
1010.07	1010.4	0.3	0.38
1030.02	1029.9	-0.1	0.37
1050.08	1049.5	-0.6	0.37

Note: UUC\* Unit Under Calibration

: To convert the result in report unit to Pa should be multiply by 100

\*End of certificate\*





JIRANATEE ASSOCIATES CO., LTD.

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

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

Air speed measurement laboratory  
Calibration services department.



NSC – TISI – TIS 17025  
CALIBRATION 0367

Certificate Number

CWS-026-67

## 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-A5910  
Data logger: A5910  
**ID NUMBER** : RYG\_FS0609  
**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** : 08 Jul 2024  
**MEASUREMENT DATE** : 18 Jul 2024  
**ISSUE DATE** : 18 Jul 2024

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

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

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

**Preconditioning** : 24 hours at ambient conditions.  
**Measurement Condition** : The average values during measurement are (23.8) °C, (44.9) %RH and (1003.3) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jittraporn Lertsomphol



### 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-0007-24 and MW-0055-23

### Uncertainty of Measurement:

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

REVIEW BY *Margaloni P*

APPROVED BY *Wichit Ch*

NEXT CAL. DATE 18/1/26

Approved signatory: *Mr. Parinya Booncharoen*

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>

THIS CERTIFICATE OF CALIBRATION MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY



**MEASUREMENT RESULTS <sup>5</sup>**

The Cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section, UUC was mounted on a round vertical tube of the lower plate at center of 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.

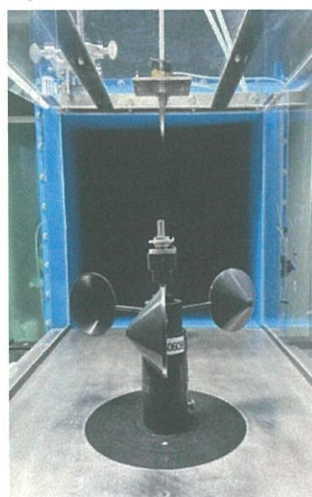
$v_{std}^6$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$v_{uuc}^7$ (m/s)	Error (m/s)	$U (k=2)$ (m/s)
0.997	23.70	23.80	0.9	-0.1	0.31
2.021	23.90	23.80	1.8	-0.2	0.31
2.990	23.70	23.80	2.9	-0.1	0.31
4.094	23.70	23.80	3.8	-0.3	0.31
4.97	23.72	23.80	5.0	0.0	0.31
5.97	23.60	23.80	6.0	0.0	0.31
7.04	23.80	23.80	7.0	0.0	0.31
7.98	23.62	23.80	8.0	0.0	0.31
9.00	23.72	23.80	9.1	0.1	0.31
9.98	23.50	23.80	10.1	0.1	0.31
10.97	23.70	23.80	11.1	0.1	0.31
12.04	23.50	23.80	12.1	0.1	0.31
12.96	23.80	23.80	13.1	0.1	0.33
14.10	23.50	23.80	14.2	0.1	0.31
15.04	23.70	23.80	15.2	0.2	0.31
15.97	23.60	23.80	16.2	0.2	0.31

**Remark:**

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

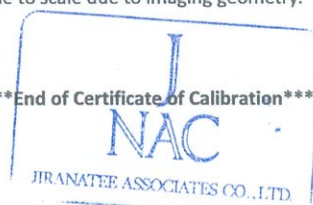
<sup>6</sup> Velocity of standard

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

**PHOTO OF CALIBRATION SET-UP**

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

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



Certificate Number

CWD-026-67

## 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-A5910  
Data logger: A5910  
**ID NUMBER** : RYG\_FS0609  
**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** : 08 Jul 2024  
**MEASUREMENT DATE** : 18 Jul 2024  
**ISSUE DATE** : 18 Jul 2024

**ENVIRONMENTAL CONDITIONS:**

Ambient condition in the laboratory are as follow:

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

**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>
	Wind 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 (22.2)°C, (47.5) %RH and (1001.7) hPa.

**TABULATION OF RESULTS:**

The table on next page give the measured values.

**Calibrated by:**

☒ Mr. Sorawit Thachalad  
☐ Miss Jittraporn Lertsomphol



Approved signatory: .....

Mr. Parinya Booncharoen  
Calibration Department Manager

**Remark:**

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



MEASUREMENT RESULTS <sup>5</sup>

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

Air speed m/s	$D^{\text{std}}$ Degree (°)	$D^{\text{unc}}$ Degree (°)	Error Degree (°)	$U (k=2)$ Degree (°)
5.04	0.000	0	0	0.80
	45.000	44	-1	0.80
	90.000	87	-3	0.80
	135.000	131	-4	0.80
	180.000	176	-4	0.80
	225.000	222	-3	0.80
	270.000	272	2	0.80
	315.000	320	5	0.80

## Remark:

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

<sup>6</sup> Direction of standard

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

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





JIRANATEE ASSOCIATES CO.,LTD.

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

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

Temperature measurement laboratory  
Calibration services department.



## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-121-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Data Logger with Temperature sensor  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : 110-WS-25DL-D  
**SERIAL NUMBER** : A5910  
**ID NUMBER** : RYG\_FS0609  
**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** : 08 Jul 2024  
**MEASUREMENT DATE** : 18 Jul 2024  
**ISSUE DATE** : 18 Jul 2024

### 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

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

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibration procedure:

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

### Traceability:

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

### Reference Used During Calibration:

1. Standard Temperature Probe  
Model: STS-100 A500, Serial No.: 667682-09,  
Due date: 26 Mar 2025
2. Digital Temperature Indicator  
Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 14 Sep 2024

### Uncertainty of Measurement:

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

### Calibrated by:

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



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

Mr. Parinya Booncharoen  
Calibration Department Manager



JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number CDT-121-67

Page 2 of 2 Pages

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

**Calibration Range:** 20 °C to 40 °C

**Function:**

Table 3: This equipment was connected with temperature sensor Model: HMP60 S/N: U3641223.  
Dimension: Diameter 12 mm. Length 80 mm.

<u>Immersion Depth</u> (mm)	<u>Standard Reading</u> (°C)	<u>UUC Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
80	20.047	19.6	-0.4	0.099
80	25.043	24.6	-0.4	0.099
80	30.034	29.7	-0.3	0.099
80	35.028	34.7	-0.3	0.099
80	40.018	39.5	-0.5	0.099

UUC\*: Unit Under Calibration

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







JIRANATEE ASSOCIATES CO.,LTD.

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

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

Relative humidity and Air Temperature measurement laboratory  
Calibration services department.

## CERTIFICATE OF CALIBRATION

Certificate No. : CRT-023-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Relative humidity with data logger  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Data Logger: 110-WS-25DL-D  
Sensor: HMP60  
**SERIAL NUMBER** : Data Logger: A5910  
Sensor: U3641223  
**ID NUMBER** : RYG\_FS0609  
**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** : 08 Jul 2024  
**MEASUREMENT DATE** : 18 Jul 2024  
**ISSUE DATE** : 18 Jul 2024

### 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

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

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibration procedure:

The Relative humidity and Air Temperature calibration was done by In-House calibration method as WI-CL-009 and WI-CL-010 according to comparison method with Standard Chilled Mirror hygrometer with Temperature sensor and standard Humidity generator chamber.

### Traceability:

The measurements are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT). Certificate number: TH-0079-23 and through Jiranatee Associates Co., Ltd. Certificate number: CDT-001-67.

### Uncertainty of Measurement:

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

Calibrated by:

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



Approved signatory: .....

Mr. Parinya Booncharoen  
Calibration Department Manager



JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number: CRT-023-67

Page 2 of 2 Pages

**Measurement Results:**

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

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

**Table 1:** The results of calibration of relative humidity at 30 °C are reported in table below.

**Calibration Range:** 20%RH to 80%RH

<u>Air Temperature</u> (°C)	<u>Standard Reading</u> (%RH)	<u>UUC Reading</u> (%RH)	<u>Error</u> (%RH)	<u>Uncertainty</u> ± (%RH)
29.79	19.50	17.7	-1.8	0.83
29.83	50.52	47.9	-2.7	1.3
29.80	81.80	78.0	-3.8	2.3

UUC\*: Unit Under Calibration

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





Certificate Number

CWS-016-67

## 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-A5911  
Data logger: A5911  
**ID NUMBER** : RYG\_FS0610  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 10 Jun 2024  
**MEASUREMENT DATE** : 26 Jun 2024  
**ISSUE DATE** : 26 Jun 2024

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

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

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

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

**Measurement Condition** : The average values during measurement are (24.6) °C, (41.4) %RH and (1002.0) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jittraporn Lertsomphol



### 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-0007-24 and MW-0055-23

### Uncertainty of Measurement:

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

REVIEW BY

Marakorn P

APPROVED BY

26/12/25

NEXT CAL DATE

Approved signatory:

Mr. Parinya Booncharoen

Calibration Department Manager

### Remark:

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

**MEASUREMENT RESULTS<sup>5</sup>**

The Cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section, UUC was mounted on a round vertical tube of the lower plate at center of 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.

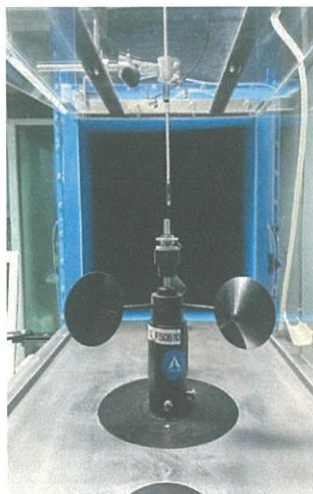
$V_{std}^6$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$V_{UUC}^7$ (m/s)	Error (m/s)	$U (k=2)$ (m/s)
0.993	24.50	24.60	0.8	-0.2	0.31
2.014	24.70	24.60	1.7	-0.3	0.31
2.985	24.68	24.60	2.8	-0.2	0.31
4.131	24.64	24.60	3.8	-0.3	0.31
4.97	24.50	24.60	4.9	-0.1	0.31
5.98	24.46	24.60	6.0	0.0	0.31
7.04	24.50	24.60	7.1	0.0	0.31
7.96	24.32	24.60	8.1	0.1	0.31
9.02	24.70	24.60	9.1	0.1	0.31
9.98	24.30	24.60	10.2	0.2	0.31
11.02	24.70	24.60	11.3	0.3	0.31
11.99	24.30	24.60	12.3	0.3	0.31
13.03	24.70	24.60	13.3	0.3	0.31
14.05	24.30	24.60	14.4	0.4	0.31
15.05	24.70	24.60	15.4	0.4	0.31
15.99	24.46	24.60	16.4	0.4	0.31

**Remark:**

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

<sup>6</sup> Velocity of standard

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

**PHOTO OF CALIBRATION SET-UP**

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





Certificate Number

CWD-016-67

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Wind Direction Sensor  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: WS-02F  
Data logger: 110-WS-2SDL-D  
**SERIAL NUMBER** : Sensor: WSD-AS911  
Data logger: AS911  
**ID NUMBER** : RYG\_FS0610  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 10 Jun 2024  
**MEASUREMENT DATE** : 26 Jun 2024  
**ISSUE DATE** : 26 Jun 2024

**ENVIRONMENTAL CONDITIONS:**

Ambient condition in the laboratory are as follow:

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

**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>
	Wind direction frontal area <sup>2</sup>	129	cm <sup>2</sup>
	Diameter of mounting pipe <sup>3</sup>	-	mm
	Blockage ratio of test object <sup>4</sup>	0.143	[-]

**Preconditioning** : 24 hours at ambient conditions.  
**Measurement Condition** : The average values during measurement are (24.0)°C, (53.0) %RH and (1005.2) hPa.

**TABULATION OF RESULTS:**

The table on next page give the measured values.

**Calibrated by:**

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jittraporn Lertsomphol



Approved signatory: .....

Mr. Parinya Booncharoen  
Calibration Department Manager

**Remark:**

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



MEASUREMENT RESULTS<sup>5</sup>

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

Air speed m/s	$D^{std}$ Degree (°)	$D^{uuc}$ Degree (°)	Error Degree (°)	$U (k=2)$ Degree (°)
5.00	0.000	0	0	0.80
	45.000	45	0	0.80
	90.000	89	-1	0.80
	135.000	132	-3	0.80
	180.000	177	-3	0.80
	225.000	223	-2	0.80
	270.000	270	0	0.80
	315.000	318	3	0.80

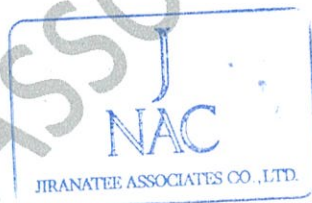
## Remark:

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

<sup>6</sup> Direction of standard

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

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





JIRANATEE ASSOCIATES CO.,LTD.

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

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

Pressure measurement laboratory  
Calibration services department.



## CERTIFICATE OF CALIBRATION

Certificate No. : CPR-006-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Digital barometer  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Sensor: 110-WS-25BP  
Data logger: 110-WS-25DL-D  
**SERIAL NUMBER** : Sensor: BP-A5911  
Data logger: A5911  
**ID NUMBER** : RYG\_FS0610  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd,  
Khwaeng Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.  
**RECEIVED DATE** : 10 Jun 2024  
**MEASUREMENT DATE** : 26 Jun 2024  
**ISSUE DATE** : 26 Jun 2024

### Calibration procedure:

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

### Traceability:

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

### Uncertainty of Measurement:

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

### CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

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

1. Calibration effort for calibration sequence B

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

3. Calibration conditions:

4. Condition : ☒ Normal ☐ Abnormal

Pressure transmitting medium : Air

$\rho_{F1}$  (20°C, 1 bar) : 1.19 kg/m<sup>3</sup>

$H_{amb}$  : (55±15) %

$t_{amb}$  : (23±3) °C

$p_{amb}$  : (1010±10) mbar

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

### Calibrated by:

☒ Mr. Sorawit Thachalad  
☐ Miss Jittraporn Lertsomphol



### Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager



JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd.  
63/14-15, 67/35-36  
Petchkasem 7,7/1, Rd.Watthapra, Bangkokyai,  
Bangkok10600(Thailand)  
Tel: +6608680812  
Mobile: +66863999453  
E-mail: jnac-calibration@jiranatee.com  
Web site: www.jiranatee.com

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



Pressure measurement laboratory  
Calibration services department.

## CERTIFICATE OF CALIBRATION

Certificate No. : CPR-006-67

Page 2 of 2 Pages

MEASUREMENT RESULTS : ☐ Without adjustment ☒ With adjustment

CALIBRATION IN THE RANGE OF : 950 mbar to 1050 mbar

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

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.15	951.6	1.5	0.37
970.11	971.0	0.9	0.37
990.06	990.7	0.7	0.37
1010.08	1010.4	0.3	0.37
1030.07	1030.1	0.0	0.37
1050.07	1049.8	-0.3	0.37

Note: UUC\* Unit Under Calibration

: To convert the result in report unit to Pa should be multiply by 100

\*End of certificate\*







JIRANATEE ASSOCIATES CO.,LTD.

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

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

Temperature measurement laboratory  
Calibration services department.



## CERTIFICATE OF CALIBRATION

Certificate No. : CDT-103-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Data Logger with Temperature sensor  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : 110-WS-25DL-D  
**SERIAL NUMBER** : A5911  
**ID NUMBER** : RYG\_FS0610  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd.,  
Khwaeng Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand.

**RECEIVED DATE** : 10 Jun 2024  
**MEASUREMENT DATE** : 26 Jun 2024  
**ISSUE DATE** : 26 Jun 2024

### 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

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

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibration procedure:

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

### Traceability:

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

### Reference Used During Calibration:

1. Standard Temperature Probe  
Model: STS-100 A500, Serial No.: 667682-09,  
Due date: 26 Mar 2025  
2. Digital Temperature Indicator  
Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 14 Sep 2024

### Uncertainty of Measurement:

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

### Calibrated by:

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



Approved signatory: .....

Mr. Parinya Booncharoen  
Calibration Department Manager



JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number CDT-103-67

Page 2 of 2 Pages

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

**Calibration Range:** 20 °C to 40 °C

**Function:**

Table 3: This equipment was connected with temperature sensor Model: HMP60 S/N: U3911245.  
Dimension: Diameter 12 mm. Length 80 mm.

<u>Immersion Depth</u> (mm)	<u>Standard Reading</u> (°C)	<u>UUC Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (°C)
80	20.054	19.8	-0.2	0.16
80	25.051	24.8	-0.2	0.16
80	30.046	29.9	-0.1	0.099
80	35.034	34.8	-0.2	0.099
80	40.043	39.8	-0.2	0.099

**UUC\*:** Unit Under Calibration

**Remark:** The reported uncertainty of measurement is 0.16, based on standard uncertainty multiplied by a coverage factor k=2.21 providing a level of confidence of approximately 95%.

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





JIRANATEE ASSOCIATES CO.,LTD.

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

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

Relative humidity and Air Temperature measurement laboratory  
Calibration services department.

## CERTIFICATE OF CALIBRATION

Certificate No. : CRT-015-67

Page 1 of 2 Pages

**MEASUREMENT ITEM** : Relative humidity with data logger  
**MANUFACTURER** : Novalynx  
**MODEL/TYPE** : Data Logger: 110-WS-25DL-D  
Sensor: HMP60  
**SERIAL NUMBER** : Data Logger: A5911  
Sensor: U3911245  
**ID NUMBER** : RYG\_FS0610  
**CONDITION AS-RECEIVED** : Used item  
**CUSTOMER** : ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**RECEIVED DATE** : 10 Jun 2024  
**MEASUREMENT DATE** : 26 Jun 2024  
**ISSUE DATE** : 26 Jun 2024

### Calibration procedure:

The Relative humidity and Air Temperature calibration was done by In-House calibration method as WI-CL-009 and WI-CL-010 according to comparison method with Standard Chilled Mirror hygrometer with Temperature sensor and standard Humidity generator chamber.

### Traceability:

The measurements are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT). Certificate number: TH-0079-23 and through Jiranatee Associates Co., Ltd. Certificate number: CDT-001-67.

### 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'

### 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

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

### TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

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



Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager





JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number: CRT-015-67

Page 2 of 2 Pages

**Measurement Results:**

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

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

**Table 1:** The results of calibration of relative humidity at 30 °C are reported in table below.

**Calibration Range:** 20%RH to 80%RH

<u>Air Temperature</u> (°C)	<u>Standard Reading</u> (%RH)	<u>UUC Reading</u> (%RH)	<u>Error</u> (%RH)	<u>Uncertainty</u> ± (%RH)
29.80	19.61	17.6	-2.0	0.83
29.80	50.48	47.4	-3.0	1.3
29.81	81.62	77.5	-4.1	2.3

UUC\*: Unit Under Calibration

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





## CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 6-Feb-25  
Next Cal. Date : 6-Aug-25

Barometric Pressure (mmHg) : 752  
Relative Humidity (%) : 45.5  
Temperature (C°) : 31.5

### Console Control Meter Data

Calibration No. : C-060225-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) : 1.0000  
Next Calibration Date : 25 Feb 26

$\Delta H$  (mm.H <sub>2</sub> O)	$\Theta$  Minutes	Reference Dry Gas Meter Calibration				Console Control ; Drygas Meter						Dry Gas Meter	Orifice
		Vr (Liters)			Tr  (°C)	Vm (Liters)			Ti  (°C)	To  (°C)	Avg.Tm  (°C)	Correction	Calibration
		Final	Initial	Total		Final	Initial	Total				Factor  (Y)	Factor  $\Delta H@$
15	12.07	150.18	0.00	150.18	29.0	1164.4	1013.0	151.40	30.0	30.0	30.0	0.9938	44.6386
25	9.32	150.04	0.00	150.04	29.0	1380.6	1230.0	150.60	30.0	30.0	30.0	0.9971	44.4413
50	6.55	150.10	0.00	150.10	29.0	1550.8	1400.0	150.80	30.0	30.0	30.0	0.9938	43.8652
80	5.10	150.33	0.00	150.33	29.0	1720.8	1570.0	150.80	30.0	30.0	30.0	0.9924	42.4197
120	4.17	150.38	0.00	150.38	29.0	1900.9	1750.0	150.90	30.0	30.0	30.0	0.9883	42.5111
Avg.												0.9931	43.5752

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

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

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

Calibrated by:

*Saksit Phaisanphisut*

( Mr. Saksit Phaisanphisut )

RYG Field Service Scientist(4)

Approved by:

*Nattapol Jiengwareewong*

( Mr.Nattapol Jiengwareewong )

RYG Field Service Specialist(1)





## DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	2 Jun 25	Ambient Temperature (°C)	31.5
Calibration sheet No. :	C-060225-RYG_FS0315	Relative Humidity (%) :	45.5
Digital Temperature ID :	RYG_FS0315	Reference Temperature ID	RYG_FS0681
Serial No. :	1706091	Serial No. :	201090014918
Model :	XC-572-V	Model :	Digicon-CC-VT-MS
		Next Calibrate :	13 May 25

Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	100	101	1	±3	Pass
	150	151	1	±3	Pass
	200	200	0	±3	Pass
	250	250	0	±3	Pass
	300	301	1	±3	Pass
	500	501	1	±3	Pass
Probe	100	102	2	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Oven	100	101	1	±3	Pass
	120	120	0	±3	Pass
	140	141	1	±3	Pass
Filter	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	140	0	±3	Pass
Exit	0	0	0	±3	Pass
	10	10	0	±3	Pass
	20	20	0	±3	Pass
Meter	0	-1	-1	±3	Pass
	25	24	-1	±3	Pass
	50	49	-1	±3	Pass
AUX	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความผิดพลาดสูงสุดของการวัดที่ยอมรับได้

Calibrated by :

*Saksit Phaisanphisut*

( Mr. Saksit Phaisanphisut )

RYG Field Service Scientist (4)

Approved by :

*Nattapon Jiengwareewong*

( Mr.Nattapol Jiengwareewong )

RYG Field Service Specialist (1)



## PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date : 6 Feb 25	Nozzle Set ID. : RYG_FS0319
Calibration Sheet No. : C-060225-RYG_FS0319	Vernier Caliper ID.: BKK_FS1123

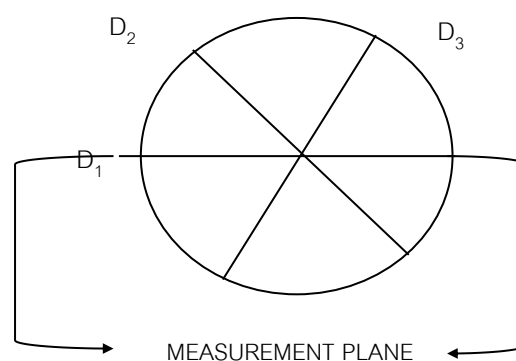
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo	$(D_1 + D_2 + D_3) / 3$
	$D_1$	$D_2$	$D_3$	$\Delta D$	$D_{avg}$
1	0.298	0.300	0.305	0.007	0.301
2	0.465	0.475	0.465	0.010	0.468
3	0.605	0.605	0.605	0.000	0.605
4	0.540	0.540	0.540	0.000	0.540
5	0.770	0.760	0.765	0.010	0.765
6	0.930	0.928	0.930	0.002	0.929
7	1.082	1.080	1.085	0.005	1.082
8	1.240	1.230	1.235	0.010	1.235
9	1.594	1.558	1.551	0.043	1.568

Where :

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

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

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



Calibrated by : Saksit Phaisanphisut

( Mr. Saksit Phaisanphisut )

RYG Field Service Scientist (4)

Approved by : Nattapon Jengwareewong

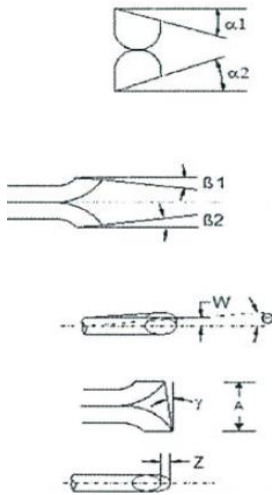
( Mr.Nattapol Jengwareewong )

RYG Field Service Specialist (1)



## Type S Pitot Tube Calibration

<b>Date Calibration</b>	6-Feb-25	<b>Due Date</b>	9-Aug-25
<b>Pitot ID</b>	RYG_FS0321	<b>Inclinometer ID</b>	BKK_FS1131
<b>Pitot SN</b>	-	<b>Vernier ID</b>	RYG_FS0539



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

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

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

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

**Certificate No:** G 680048

**Date of issue :** 27-Jan-25

**Instrument description :** Flue Gas Analyzer  
**Instrument model :** Testo 350 New  
**Instrument serial no. :** 62985047/1121  
**Control unit serial no. :** 03580098/1121  
**ID no. or control no. :** RYG\_FS0563  
**Manufacturer :** Testo SE & Co. KGaA  
**Probe description :** -  
**Probe model :** -  
**Probe serial no. :** -  
**Customer name :** ALS LABORATORY GROUP (THAILAND) CO.,LTD.  
**Customer address :** 104 Phatthanakan 40, Phatthanakan Road, Khwaeng Phatthanakan, Khet Suan Luang, Bangkok, 10250 Thailand  
**Total pages of certificate :** 2 Pages  
**Receiving no. :** L-250179  
**Receiving date. :** 22-Jan-25  
**Parameter of calibration :** Gas Calibration(Oxygen 2.50,9.984,21.02 %vol, Carbon Monoxide 80.45,302,1007 ppm)  
Nitrogen Dioxide 30.68,81.8,201.9 ppm, Nitric Oxide 30.0,151.5,322.5 ppm,  
Sulphur Dioxide 50.36,100.7,600.8 ppm)  
**Condition of UUC. :** Used  
**Ambient condition :** All of the Measurment ware caried out the stabilized labotary  
Temperature : 23 ±5 °C  
Humidity : 55 ± 15 %RH  
**Calibration place :** 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210  
**Calibration procedure no :** This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no. WI-CL-28-C

REVIEW BY .....

APPROVED BY .....

NEXT CAL DATE..... 22/ 01/ 2026

*The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurent Multiplied by coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.  
This certificate is applied only to item under test Environmental condition.  
This Calibration Certificate may not be reporduced other than in full except with the permission of the issuing laboratory.  
Calibration certificates without signature and seal not valid and The results relate only to the items tested/calibrated.  
This calibration certificate documents are tracebility to national standards, which realize measurement according to the International System of Units (SI).*

**Date of calibration :** 22-Jan-25

*Kwanchai K.*

Mr. Kwanchai Khamdoug

**Calibration Technician**

*Nongluck W.*

Mrs. Nongluck Wongsettee

**Technical Manager**



**Certificate No.:** G 680048

**Standard References (Table 1)**

Standard	Certificate No.	Vendor	Due date
Oxygen ( O <sub>2</sub> ) 2.50 % Vol	2412/23	Linde	27-Aug-27
Oxygen ( O <sub>2</sub> ) 9.984 % Vol	CG-0113-24	Nimt	01-Aug-29
Oxygen ( O <sub>2</sub> ) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide ( CO ) 80.45 ppm	CG-0132-24	Nimt	10-Sep-29
Carbon monoxide ( CO ) 302 ppm	1915/23	Linde	16-Jun-25
Carbon monoxide ( CO ) 1007 ppm	1870/24	Linde	17-Jun-26
Nitrogen Dioxide ( NO <sub>2</sub> ) 30.68 ppm	2832/24	Linde	08-Sep-26
Nitrogen Dioxide ( NO <sub>2</sub> ) 81.8 ppm	2330/24	Linde	01-Aug-26
Nitrogen Dioxide ( NO <sub>2</sub> ) 201.9 ppm	1975/23	Linde	17-Jul-25
Nitric Oxide ( NO ) 30.0 ppm	CG-0065-24	Nimt	06-May-26
Nitric Oxide ( NO ) 151.5 ppm	0161/23	Linde	22-Jan-25
Nitric Oxide ( NO ) 322.5 ppm	1974/23	Linde	17-Jul-25
Sulphur Dioxide ( SO <sub>2</sub> ) 50.36 ppm	2004/23	Linde	17-Jul-25
Sulphur Dioxide ( SO <sub>2</sub> ) 100.7 ppm	2662/24	Linde	25-Aug-26
Sulphur Dioxide ( SO <sub>2</sub> ) 600.8 ppm	2003/23	Linde	17-Jul-25

**Measured room conditions**

Temperature : 22.6 °C Humidity : 64.8 %RH Pressure : 1012.7 mbar

**Calibration conditions**

Gas Temperature : 23 °C Flow rate : 1,300 ml/min Gas pressure : 1016.3 mbar

**Calibration Results (Without adjustment) (Table 2)**

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty ( ± )
O <sub>2</sub> (%Vol)	2.50	2.47	-0.03	0.15
O <sub>2</sub> (%Vol)	9.984	9.92	-0.064	0.20
O <sub>2</sub> (%Vol)	21.02	21.12	0.10	0.30
CO (ppm)	80.45	82	1.55	3.0
CO (ppm)	302	305	3	6.0
CO (ppm)	1007	1011	4	12
NO <sub>2</sub> (ppm)	30.68	28.8	-1.88	8.0
NO <sub>2</sub> (ppm)	81.8	79.9	-1.9	8.0
NO <sub>2</sub> (ppm)	201.9	199.7	-2.2	12
NO (ppm)	30.0	31	1.0	8.0
NO (ppm)	151.5	153	1.5	8.0
NO (ppm)	322.5	324	1.5	12
SO <sub>2</sub> (ppm)	50.36	51	0.64	6.0
SO <sub>2</sub> (ppm)	100.7	102	1.3	6.0
SO <sub>2</sub> (ppm)	600.8	605	4.2	13

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

**End of Report**

Accredited by

NSC-TISI-TIS 17025

Calibration 0426



NSC-TISI-TIS 17025

CALIBRATION 0426

## Calibration certificate

Calibration Certificate No. 25BKL0003

Object	Electronic non-automatic weighing instrument	This calibration certificate documents the traceability to national standards.
Manufacturer	Sartorius	Uncertainties of measurements are taken into account when only statements of compliance are made.
Type	MSU224S-100-DU	This certificate was prepared by Sartorius Corporation in accordance to the current ISO/IEC 17025:2017 standard and Sartorius Work Instruction (Method) SOP WI 08.
Serial   QM Ident. no.	31709552   RYG_EN0003	This certificate relate and apply this equipment only.
Customer	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)	
	616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.	
Order no.	2230	
Number of pages	4	
Date of calibration	20 Feb 2025	

REVIEW BY

Thanitak.

APPROVED BY

D. Khunon.

NEXT CAL DATE

20/02/26

This calibration certificate may not be reproduced other than in full except with the permission of NSC-TISI-TIS-17025 and the issuing laboratory. Calibration certificates without signature are not valid.

The user is obliged to have the object recalibrated at appropriate intervals.

Date 06 Mar 2025

Approval of the Calibration Certificate



Mr. Chonchai Inthana

Person in charge

Kachen Lalee

Calibration object

Single range instrument

Model	MSU224S-100-DU
Serial Number	31709552
QM Ident. no   Inventory no.	RYG_EN0003   ---

Maximum capacity (Max. load)	220.0000 g
Measured range	220.0000 g
Scale interval	0.0001 g

Place of calibration

Address	According to page 1
Department   Cost center	Laboratory Department.   ---
Building   Floor	---   1st Floor.
Room	Balance Room.
Maximum temperature variation at place of calibration	5 K

Calibration procedure

EURAMET cg-18, V4.0 - Guidelines on the Calibration of Non-Automatic Weighing Instruments

Test equipment

Test equipment type	Test equipment ID	Valid until
Thermometer	MHB-382SD s/nB011342 Traceable to SI unit through DKSH	21 Aug 2025
Test weight set OIML R111 E2	Certificate No.M2308197S ,E2(Traceable to SI unit through TCS)	23 Aug 2025

Adjustment Status

The measuring device was internally adjusted before the calibration.

Environmental and measuring conditions

Date of calibration	20 Feb 2025
Temperature at place of calibration   Temp. diff. <i>T</i> <sub>weights</sub> - <i>T</i> <sub>place</sub>	24.7 °C   0.3 K
Measuring conditions	The installation site is suitable. The device was levelled. Balance was loaded up to Max before test.
Comments	Humidity 62.3 %RH.

Measurement results | Measurement uncertainties

Repeatability			Eccentricity	
Test load (nominal): 10 g   200 g			Test load (nominal): 100 g	
	10 g	200 g		
1	10.0000 g	200.0000 g	Center	
2	10.0000 g	200.0001 g	Front left	
3	9.9999 g	200.0000 g	Back left	
4	10.0000 g	200.0000 g	Back right	
5	10.0000 g	200.0001 g	Front right	
6	9.9999 g	200.0000 g	Maximum deviation from centric loading indication	
7	10.0000 g	200.0000 g	Δ <sub>ecc</sub>   max = 0.0001 g	
8	10.0000 g	200.0000 g		
9	10.0000 g	200.0000 g		
10	10.0000 g	200.0001 g		
	<i>s</i> = 0.00004 g	<i>s</i> = 0.00005 g		

Error of indication

Testload	Indication	Error	Expansion factor	Uncertainty	Uncertainty relative
<i>L</i>	<i>I</i>	<i>E</i>	<i>k</i>	<i>U</i> ( <i>E</i> )	<i>U</i> <sub>rel</sub> ( <i>E</i> )
0.0100 g	0.0100 g	0.0000 g	2.00	0.00012 g	1.2 %
0.1000 g	0.1000 g	0.0000 g	2.00	0.00013 g	0.13 %
0.5000 g	0.5000 g	0.0000 g	2.00	0.00013 g	0.026 %
1.0000 g	1.0000 g	0.0000 g	2.00	0.00013 g	0.013 %
5.0000 g	5.0000 g	0.0000 g	2.00	0.00013 g	0.0026 %
10.0000 g	10.0000 g	0.0000 g	2.00	0.00013 g	0.0013 %
20.0000 g	20.0000 g	0.0000 g	2.00	0.00014 g	0.00068 %
50.0000 g	50.0000 g	0.0000 g	2.00	0.00015 g	0.00029 %
100.0000 g	100.0001 g	0.0001 g	2.00	0.00018 g	0.00018 %
200.0000 g	200.0000 g	0.0000 g	2.00	0.00028 g	0.00014 %
220.0000 g	220.0000 g	0.0000 g	2.00	0.00032 g	0.00015 %
Maximum error of indication		<i>E</i>   <sub>max</sub> = 0.0001 g			

*U*<sub>rel</sub>(*E*) is the quotient of *U*(*E*) and test load *L*. The uncertainty of measurement *U*(*E*) is valid only if error *E* is considered. You will find reference notes on the uncertainty of measurement in use under: Appendix to the calibration certificate | Interpretation of measurement results.  
Reference note: The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the documented Expansion factor, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

End of calibration certificate



# Uncertainty of measurement in use

Device adjusted before measurement	Yes
Temperature deviation considered	1.5 K (isoCAL active)
Temperature coefficient considered	$1 \cdot 10^{-6}/\text{K}$

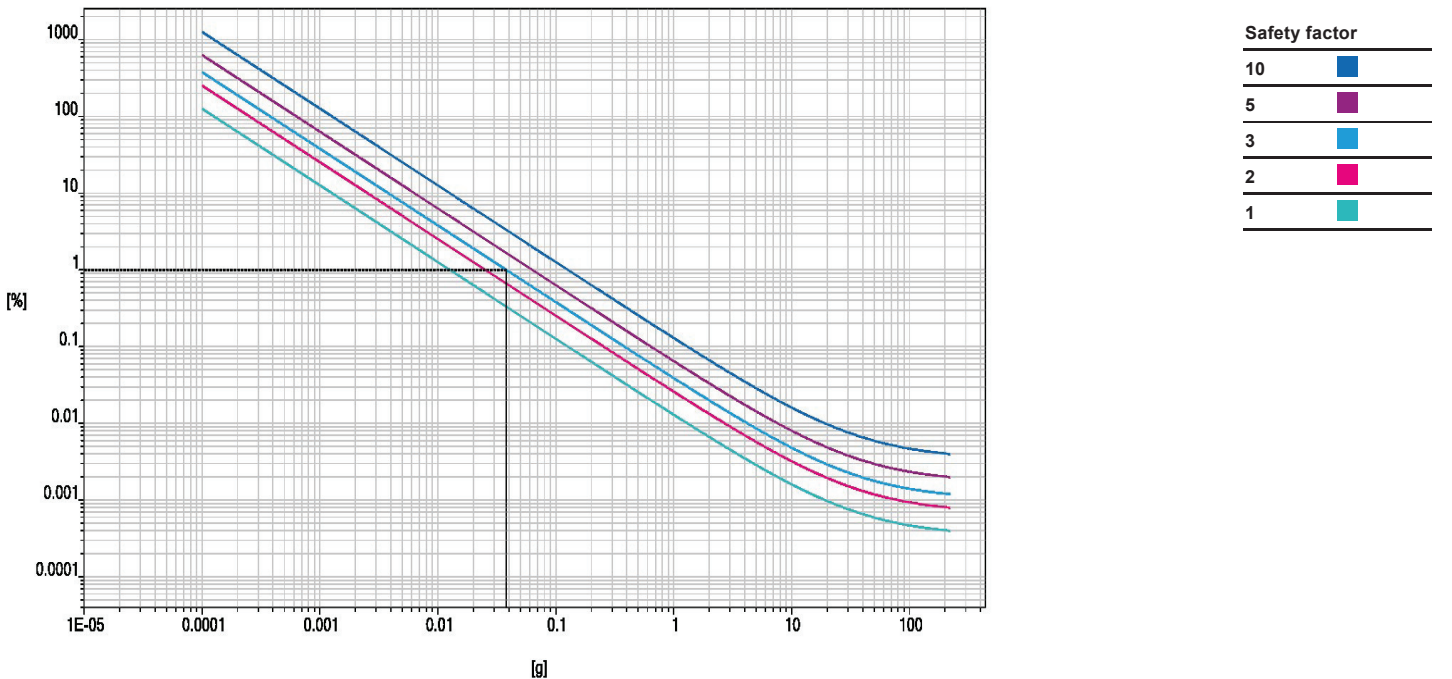
Uncertainty of the weighing result  $U_{gl}(W)$

$U_{gl}(W) = 0.00013 \text{ g} + 3.42 \cdot 10^{-6} \cdot R$

Reference note: The current uncertainty of measurement is calculated by entering of the reading  $R$  into this formula. In relation to this, there is no need for a correction of the indication error. The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied with an Expansion factor of 2, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

Indication in % from max load	Net indication $R$	Uncertainty $U_{gl}(W)$	Uncertainty relative $U_{gl}(W)_{rel}$
1 %	2.2000 g	0.00014 g	0.0063 %
25 %	55.0000 g	0.00032 g	0.00058 %
50 %	110.0000 g	0.00051 g	0.00046 %
75 %	165.0000 g	0.00069 g	0.00042 %
100 %	220.0000 g	0.00088 g	0.00040 %

Graphic realization of the relative uncertainty of measurement | process accuracy



Displayed example

Process accuracy	1.00 %
Safety factor	3
Minimum sample weight	0.0380 g

**Certificate No:** G 680210

**Date of issue :** 25-Mar-25

**Instrument description :** Flue Gas Analyzer  
**Instrument model :** Testo 350 New  
**Instrument serial no. :** 62087344/1119  
**Control unit serial no. :** 03401649/1119  
**ID no. or control no. :** RYG\_FS0464  
**Manufacturer :** Testo SE & Co. KGaA  
**Probe description :** -  
**Probe model :** -  
**Probe serial no. :** -  
**Customer name :** ALS LABORATORY GROUP (THAILAND) CO.,LTD.  
**Customer address :** 104 Phatthanakan 40, Phatthanakan Road, Khwaeng Phatthanakan, Khet Suan Luang, Bangkok, 10250 Thailand  
**Total pages of certificate :** 3 Pages  
**Receiving no. :** L-250946  
**Receiving date. :** 18-Mar-25  
**Parameter of calibration :** Gas Calibration(Oxygen 2.50,9.984,21.02 %vol, Carbon Monoxide 80.45,302,1007 ppm, Nitrogen Dioxide 30.68,81.8,202.6 ppm, Nitric Oxide 30.0,151.8,322.5 ppm, Sulphur Dioxide 50.36,100.7,600.8 ppm)  
**Condition of UUC. :** Used  
**Ambient condition :** All of the Measurment ware caried out the stabilized labotary  
Temperature : 23 ±5 °C  
Humidity : 55 ± 15 %RH  
**Calibration place :** 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND  
**Calibration procedure no :** This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no. WI-CL-28-C

REVIEW BY ..... *Supt. S.* .....  
APPROVED BY ..... *[Signature]* .....  
NEXT CAL DATE..... 23/ 03/ 2026 .....

*The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurent Multiplied by coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.  
This certificate is applied only to item under test Environmental condition.  
This Calibration Certificate may not be reporduced other than in full except with the permission of the issuing laboratory.  
Calibration certificates without signature and seal not valid and The results relate only to the items tested/calibrated.  
This calibration certificate documents are tracebility to national standards, which realize measurement according to the International System of Units (SI).*

**Date of calibration :** 24-Mar-25

*[Signature]*

Mr. Kwanchai Khamdoun  
Calibration Technician

*[Signature]*

Mrs. Nongluck Wongsettee  
Technical Manager



**Certificate No.:** G 680210

**Standard References (Table 1)**

Standard	Certificate No.	Vendor	Due date
Oxygen ( O <sub>2</sub> ) 2.50 % Vol	2412/23	Linde	27-Aug-27
Oxygen ( O <sub>2</sub> ) 9.984 % Vol	CG-0113-24	Nimt	01-Aug-29
Oxygen ( O <sub>2</sub> ) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide ( CO ) 80.45 ppm	CG-0132-24	Nimt	10-Sep-29
Carbon monoxide ( CO ) 302 ppm	1915/23	Linde	16-Jun-25
Carbon monoxide ( CO ) 1007 ppm	1870/24	Linde	17-Jun-26
Nitrogen Dioxide ( NO <sub>2</sub> ) 30.68 ppm	2832/24	Linde	08-Sep-26
Nitrogen Dioxide ( NO <sub>2</sub> ) 81.8 ppm	2330/24	Linde	01-Aug-26
Nitrogen Dioxide ( NO <sub>2</sub> ) 202.6 ppm	3794/24	Linde	23-Dec-26
Nitric Oxide ( NO ) 30.0 ppm	CG-0065-24	Nimt	06-May-26
Nitric Oxide ( NO ) 151.8 ppm	0404/25	Linde	09-Feb-27
Nitric Oxide ( NO ) 322.5 ppm	1974/23	Linde	17-Jul-25
Sulphur Dioxide ( SO <sub>2</sub> ) 50.36 ppm	2004/23	Linde	17-Jul-25
Sulphur Dioxide ( SO <sub>2</sub> ) 100.7 ppm	2662/24	Linde	25-Aug-26
Sulphur Dioxide ( SO <sub>2</sub> ) 600.8 ppm	2003/23	Linde	17-Jul-25

**Measured room conditions**

Temperature : 22.7 °C Humidity : 62.6 %RH Pressure : 1010.5 mbar

**Calibration conditions**

Gas Temperature : 23 °C Flow rate : 1,300 ml/min Gas pressure : 1016.2 mbar

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

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty ( ± )
O <sub>2</sub> (%Vol)	2.50	2.46	-0.04	0.15
O <sub>2</sub> (%Vol)	9.984	9.95	-0.034	0.20
O <sub>2</sub> (%Vol)	21.02	21.08	0.06	0.30
CO (ppm)	80.45	81	0.55	3.0
CO (ppm)	302	302	0	6.0
CO (ppm)	1007	1010	3	12
NO <sub>2</sub> (ppm)	30.68	26.9	-3.78	8.0
NO <sub>2</sub> (ppm)	81.8	67.1	-14.7	8.0
NO <sub>2</sub> (ppm)	202.6	181.3	-21.3	12
NO (ppm)	30.0	24	-6.0	8.0
NO (ppm)	151.8	145	-6.8	8.0
NO (ppm)	322.5	302	-20.5	12
SO <sub>2</sub> (ppm)	50.36	48	-2.36	6.0
SO <sub>2</sub> (ppm)	100.7	97	-3.7	6.0
SO <sub>2</sub> (ppm)	600.8	589	-11.8	13

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

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.50	2.46	-0.04	0.15
O2 (%Vol)	9.984	9.95	-0.034	0.20
O2 (%Vol)	21.02	21.08	0.06	0.30
CO (ppm)	80.45	81	0.55	3.0
CO (ppm)	302	302	0	6.0
CO (ppm)	1007	1010	3	12
NO2 (ppm)	30.68	29.4	-1.28	8.0
NO2 (ppm)	81.8	79.7	-2.1	8.0
NO2 (ppm)	202.6	199.2	-3.4	12
NO (ppm)	30.0	30	0.0	8.0
NO (ppm)	151.8	153	1.2	8.0
NO (ppm)	322.5	324	1.5	12
SO2 (ppm)	50.36	50	-0.36	6.0
SO2 (ppm)	100.7	101	0.3	6.0
SO2 (ppm)	600.8	599	-1.8	13

**Remark :** 1 cmol/mol = 1 %vol. 1 µmol/mol = 1 ppm., Sensor CO New.

**End of Report**





## ROTA METER CALIBRATION RESULT JANUARY 2025

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS0573	09 Jan 25	$Y = 1.0442x + 3.4629$	0.9998
BKK_FS0577	10 Jan 25	$Y = 1.101x + 2.2422$	0.9995
BKK_FS0584	10 Jan 25	$Y = 1.0176x + 3.74$	0.9995
BKK_FS0585	10 Jan 25	$Y = 1.0344x + 0.9767$	0.9999
BKK_FS0587	10 Jan 25	$Y = 1.0176x + 6.3433$	0.9998
BKK_FS0591	10 Jan 25	$Y = 0.9994x + 18.562$	1.0000
BKK_FS0592	10 Jan 25	$Y = 0.9996x + 12.927$	1.0000
BKK_FS0594	10 Jan 25	$Y = 1.0023x + 10.499$	1.0000
BKK_FS1006	09 Jan 25	$Y = 1.0547x + 3.8765$	0.9995
BKK_FS1007	10 Jan 25	$Y = 1.112x + 1.4085$	0.9996
BKK_FS1008	10 Jan 25	$Y = 1.1369x + 0.3976$	0.9988
BKK_FS1009	09 Jan 25	$Y = 0.9987x + 12.063$	0.9996
BKK_FS1017	10 Jan 25	$Y = 1.0649x + 4.4133$	0.9994
BKK_FS1018	10 Jan 25	$Y = 1.0108x + 4.3333$	0.9999
BKK_FS1019	10 Jan 25	$Y = 0.9996x + 12.746$	1.0000
BKK_FS1026	10 Jan 25	$Y = 1.0808x + 2.8537$	0.9990
BKK_FS1027	10 Jan 25	$Y = 1.0223x + 4.84$	0.9999
BKK_FS1028	10 Jan 25	$Y = 1.0011x + 15.808$	1.0000
BKK_FS1039	09 Jan 25	$Y = 0.9987x + 12.063$	0.9996
BKK_FS1040	09 Jan 25	$Y = 1.0013x + 3.9257$	1.0000
BKK_FS1041	09 Jan 25	$Y = 1.0299x + 3.5058$	0.9999
BKK_FS1042	09 Jan 25	$Y = 1.0058x + 10.903$	0.9993
BKK_FS1044	09 Jan 25	$Y = 1.1297x + 1.8599$	0.9994
PHK_FS0027	10 Jan 25	$Y = 1.0823x + 3.8912$	1.0000
PHK_FS0028	10 Jan 25	$Y = 1.0056x + 8.4067$	0.9998
PHK_FS0029	10 Jan 25	$Y = 1x + 14.547$	1.0000
RYG_FS0195	09 Jan 25	$Y = 1.0041x + 8.7581$	1.0000
RYG_FS0196	09 Jan 25	$Y = 0.9994x + 16.56$	1.0000
RYG_FS0197	09 Jan 25	$Y = 1.0021x + 13.837$	1.0000
RYG_FS0198	09 Jan 25	$Y = 0.9975x + 17.805$	0.9999
RYG_FS0199	09 Jan 25	$Y = 1.0294x + 4.9105$	0.9997
RYG_FS0627	09 Jan 25	$Y = 1.0235x + 4.83$	1.0000
RYG_FS0628	09 Jan 25	$Y = 1.0222x + 3.63$	0.9999
RYG_FS0654	09 Jan 25	$Y = 1.0857x - 0.0238$	1.0000
RYG_FS0655	09 Jan 25	$Y = 0.9928x + 10.99$	1.0000
RYG_FS0656	09 Jan 25	$Y = 1.003x + 9.5419$	1.0000
RYG_FS0657	09 Jan 25	$Y = 1.026x + 3.483$	0.9998
RYG_FS0658	09 Jan 25	$Y = 1.0173x + 3.57$	0.9999
RYG_FS0659	09 Jan 25	$Y = 1.0003x + 11.785$	1.0000



## ROTA METER CALIBRATION RESULT JANUARY 2025

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
SGK_FS0135	10 Jan 25	$Y = 1.0205x + 4.58$	0.9999
SGK_FS0136	10 Jan 25	$Y = 1.0299x + 1.5233$	0.9999
SGK_FS0138	10 Jan 25	$Y = 1.0865x + 3.4633$	1.0000
SGK_FS0139	10 Jan 25	$Y = 1.0186x + 4.9267$	0.9996
SGK_FS0140	10 Jan 25	$Y = 0.9997x + 15.3$	1.0000
SGK_FS0141	10 Jan 25	$Y = 1.1165x + 2.6633$	0.9999
SGK_FS0142	10 Jan 25	$Y = 1.0162x + 4.9767$	0.9999
SGK_FS0143	10 Jan 25	$Y = 1.0025x + 10.838$	1.0000

Review By :

(Mr. Wichan Choonharat)

Enviro Field Services Manager

Approved By :

(Mr. Sarayuth Jittranont)

Assistant General Manager

Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID: GM-12  
Organization Name: ALS Laboratory Group (Thailand) Co Ltd.  
Organization Location: 104 Phattanakan 40 Phatthanakan Rd Bangkok 10250  
  
Date: May 10, 2024 2:18:55 PM  
EQP Name: AgilentRecommended , AgilentRecommended  
EQP Revision: GC.02.53, GCMS.02.54  
Overall Qualification Status: Pass

REVIEW BY Suchada T.  
APPROVED BY Tanngatorn M.  
NEXT CAL. DATE 10 Nov 25

CDS Logon Verification - GC

Logon: asbkk.env03

Overall CDS Logon Verification - GC Test Status

Pass

System Inspection and Basic Safety and Operation

Name: 8890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Accuracy

Name: 8890

Front                  SSL

Setpoint Status: Pass

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

Date: May 10, 2024 2:18:55 PM  
System ID: GM-12

## Overall Inlet Pressure Accuracy Test Status

Pass

## GC Oven Temperature Accuracy

Name: 8890

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 230.0 229.1 °C

Accuracy: -0.9 °C

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

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 100.0 101.1 °C

Accuracy: 1.1 °C

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

## Overall GC Oven Temperature Accuracy Test Status

Pass

## GC Oven Temperature Stability

Name: 8890

Setpoint Status: Pass

Setpoint/Average

Temperature: 100.0 100.9 °C

Stability: 0.0 °C

Agilent Recommended:  $\leq 0.5$ 

## Overall GC Oven Temperature Stability Test Status

Pass



Log Amp

Tested Combination1	Front	SSL	/ External	SQ
Name:	5977C			
Setpoint Status:	Pass			

Overall Log Amp Test Status

Pass

RFPA

Tested Combination1	Front	SSL	/ External	SQ
Name:	5977C			
Setpoint Status:	Pass			

Amu: 1050 m/z

Drift After Five Minutes: 4 mV

RFPA Voltage: 482 mV

Agilent Recommended: >= -100 and <= 100 <= 1100

Overall RFPA Test Status

Pass

Tune EI

Tested Combination1	Front	SSL	/ External	SQ
Name:	5977C			
Setpoint Status:	Pass			

Filament: 1

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

Filament: 2

Overall Tune EI Test Status

Pass

Scouting Run

Tested Combination1	Front	SSL	/ External	SQ
Injection Tower				
Name:	7693A			
Source:	EI - Extractor			

Setpoint Status:	Completed
------------------	-----------

Injection Volume on Column:	1.0	uL
-----------------------------	-----	----

Overall Scouting Run Status	Completed
-----------------------------	-----------

Instrument Detection Limit

Tested Combination1	Front	SSL	/ External	SQ
Injection Tower				
Name:	7693A			
Source:	EI - Extractor			

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

Injection Volume on Column:	1.0	uL
-----------------------------	-----	----

	Area	Retention Time
Minimum RSD:	0.72 %	0.01 %
Agilent Recommended:	<= 5.00	<= 1.00
Status:	Pass	Pass

Instrument Detection Limit:	2.41164 fg
Agilent Recommended:	<= 16.82500
Status:	Pass

Overall Instrument Detection Limit Test Status	Pass
--	------

Mass Ratio Precision

Tested Combination1	Front	SSL	/ External	SQ
	Injection Tower			
Name:	7693A			
Source:	EI - Extractor			
Setpoint Status:	Pass			
Injection Volume on Column:	1.0		uL	
	Area Mass 1		Mass Ratio	
	Abundance*s			
RSD:	0.71 %		0.19 %	
Agilent Recommended:	<= 5.00		<= 5.00	
	Pass		Pass	
Overall Mass Ratio Precision Test Status				
Pass				

# Instrument Details

## Purpose

This section describes the as found system configuration.

## Details

### System

System ID	GM-12
Manufacturer	Agilent Technologies
Name	8890
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	CN23125102
Firmware Revision	A.11.07
Usage	Sample Injection
Location	Front
Syringe Volume (µL)	10



## Sampler 2

Manufacturer	Agilent Technologies
Type	Tray
Name	7693A
Model Number	G4514A
Serial Number	CN23147049
Firmware Revision	A.12.03
Vial Heater	Not installed

## Mainframe 1

Manufacturer	Agilent Technologies
Name	8890
Model Number	G3540A
Serial Number	CN2303A031
Firmware Revision	2.8.1.6
Oven Type	Standard

## Inlet 1

Manufacturer	Agilent Technologies
Name	8890
Type	SSL
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes

## Detector 1

Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External

Mass Spectrometer 1

Manufacturer	Agilent Technologies
Type	SQ
Name	5977C
Model Number	G7077C
Serial Number	US2307MA35
Firmware Revision	6.00.35
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN Std

MS EI Source 1

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

## Electronic Signature

### Purpose

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

### Details

Full Name of Signer:	Supasak Nimsongtham
Logged On User Name:	supasak.nimsongtham@agilent.com
Signature Creation Date:	May 10, 2024
Reason for Signature:	Executed protocol and published this original version of document

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User Name: supasak.nimsongtham  
Report Generated by Hostname: 5CG1115HKC

System Id: GM-12  
Print Date: May 10, 2024 2:18:57 PM

## GM-12 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 9, 2024 2:25:19 PM	Audit	SessionCreated	Session	None
May 9, 2024 2:25:19 PM	Start	Configuration	Session	None
May 9, 2024 2:25:19 PM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
May 9, 2024 2:31:20 PM	Audit	EqpLoaded	Session	EQP details for primary technique [Gc] - File path: [ProtocolPacks/Gc/Configurations/02.53/Gc.02.53.eqp], EQP File Name: [Gc.02.53.eqp], EQP Name: [AgilentRecommended], Protocol Revision :[Gc.02.53] EQP details for hyphenated technique [GcMs] - File path: [ProtocolPacks/GcMs/Configurations/02.54/GcMs.02.54.eqp], EQP File Name: [GcMs.02.54.eqp], EQP Name: [AgilentRecommended]
May 9, 2024 2:31:23 PM	End	Configuration	Session	None
May 9, 2024 2:31:27 PM	Start	Qualification	Session	OQ
May 9, 2024 2:31:27 PM	Start	Execution	CDS Logon Verification - GC - 8890: - Qualitative test	None
May 9, 2024 2:32:31 PM	End	Execution	CDS Logon Verification - GC - 8890: - Qualitative test	Run Count : 1
May 9, 2024 2:32:35 PM	Start	Execution	System Inspection and Basic Safety and Operation - 8890: - Qualitative Test - No setpoints associated	None



User Name: supasak.nimsongtham  
Report Generated by Hostname: 5CG1115HKC

System Id: GM-12  
Print Date: May 10, 2024 2:18:57 PM

## GM-12 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 9, 2024 2:32:44 PM	End	Execution	System Inspection and Basic Safety and Operation - 8890: - Qualitative Test - No setpoints associated	Run Count : 1
May 9, 2024 2:32:47 PM	Start	Execution	Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
May 9, 2024 2:32:54 PM	End	Execution	Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count : 1
May 9, 2024 2:33:08 PM	Audit	AceClosed	Session	None
May 9, 2024 2:33:43 PM	Audit	AceRestarted	Session	None
May 9, 2024 2:33:44 PM	Audit	SessionReloaded	Session	None
May 9, 2024 2:33:46 PM	Start	Qualification	Session	OQ
May 9, 2024 2:33:54 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front SSL, SQ: - Source: - EI - Extractor - RSD L (Area): <= 5.00% - RSD L (Ref. Time): <= 1.00%	None
May 9, 2024 2:34:16 PM	Start	Execution	Mass Ratio Precision - Injection Tower, Front SSL, SQ: - Source: EI - Extractor - L (RSD): <= 5.00%	None
May 9, 2024 2:34:29 PM	Audit	AceClosed	Session	None
May 10, 2024 10:19:05 AM	Audit	AceRestarted	Session	None
May 10, 2024 10:19:05 AM	Audit	SessionReloaded	Session	None
May 10, 2024 10:19:08 AM	Start	Qualification	Session	OQ
May 10, 2024 10:19:09 AM	Start	Execution	Mass Ratio Precision - Injection Tower, Front SSL, SQ: - Source: EI - Extractor - L (RSD): <= 5.00%	None

Page 2 / 11

User Name: supasak.nimsongtham  
Report Generated by Hostname: 5CG1115HKC

System Id: GM-12  
Print Date: May 10, 2024 2:18:57 PM

## GM-12 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 10:20:08 AM	Start	Execution	GC Oven Temperature Accuracy - 8890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
May 10, 2024 10:24:46 AM	Audit	Data	GC Oven Temperature Accuracy - 8890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
May 10, 2024 10:24:48 AM	End	Execution	GC Oven Temperature Accuracy - 8890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count : 1
May 10, 2024 10:24:50 AM	Start	Execution	GC Oven Temperature Accuracy - 8890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
May 10, 2024 10:25:33 AM	Audit	AceClosed	Session	None
May 10, 2024 10:27:35 AM	Audit	AceRestarted	Session	None
May 10, 2024 10:27:36 AM	Audit	SessionReloaded	Session	None
May 10, 2024 10:27:38 AM	Start	Qualification	Session	OQ
May 10, 2024 10:27:38 AM	Start	Execution	GC Oven Temperature Accuracy - 8890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
May 10, 2024 10:28:03 AM	Audit	Data	GC Oven Temperature Accuracy - 8890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
May 10, 2024 10:28:05 AM	End	Execution	GC Oven Temperature Accuracy - 8890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count : 1

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User Name: supasak.nimsongtham  
Report Generated by Hostname: 5CG1115HKC

System Id: GM-12  
Print Date: May 10, 2024 2:18:57 PM

## GM-12 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 10:28:06 AM	Start	Execution	GC Oven Temperature Stability - 8890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
May 10, 2024 10:51:26 AM	Audit	Data	GC Oven Temperature Stability - 8890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
May 10, 2024 10:51:28 AM	End	Execution	GC Oven Temperature Stability - 8890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count : 1
May 10, 2024 10:51:30 AM	Start	Execution	Log Amp - 5977C SQ: - Source: EI - Extractor	None
May 10, 2024 10:55:40 AM	Audit	AceClosed	Session	None
May 10, 2024 10:57:32 AM	Audit	AceRestarted	Session	None
May 10, 2024 10:57:33 AM	Audit	SessionReloaded	Session	None
May 10, 2024 10:57:35 AM	Start	Qualification	Session	OQ
May 10, 2024 10:57:35 AM	Start	Execution	Log Amp - 5977C SQ: - Source: EI - Extractor	None
May 10, 2024 11:00:05 AM	End	Execution	Log Amp - 5977C SQ: - Source: EI - Extractor	Run Count : 1
May 10, 2024 11:00:07 AM	Start	Execution	RFPA - 5977C SQ: - Source: EI - Extractor	None
May 10, 2024 11:01:19 AM	End	Execution	RFPA - 5977C SQ: - Source: EI - Extractor	Run Count : 1
May 10, 2024 11:01:25 AM	Start	Execution	Tune EI - 5977C SQ: - Source: EI - Extractor Filament 1 (Qualitative - No setpoints associated)	None
May 10, 2024 11:01:50 AM	End	Execution	Tune EI - 5977C SQ: - Source: EI - Extractor Filament 1 (Qualitative - No setpoints associated)	Run Count : 1

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User Name: supasak.nimsongtham  
Report Generated by Hostname: 5CG1115HKC

System Id: GM-12  
Print Date: May 10, 2024 2:18:57 PM

## GM-12 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 11:01:52 AM	Start	Execution	Tune EI - 5977C SQ: - Source: - None EI - Extractor Filament 2 (Qualitative - No setpoints associated)	
May 10, 2024 11:05:40 AM	End	Execution	Tune EI - 5977C SQ: - Source: - Run Count : 1 EI - Extractor Filament 2 (Qualitative - No setpoints associated)	
May 10, 2024 11:05:42 AM	Start	Execution	Scouting Run - Injection Tower, Front SSL, SQ: - Source: - EI - Extractor- Part of GCMS System Preparation	None
May 10, 2024 11:06:10 AM	Start	Execution	Instrument Detection Limit - Injection Tower, Front SSL, SQ: - Source: - EI - Extractor - RSD L (Area): <= 5.00% - RSD L (Ret. Time): <= 1.00%	None
May 10, 2024 11:17:54 AM	Start	Execution	Scouting Run - Injection Tower, Front SSL, SQ: - Source: - EI - Extractor- Part of GCMS System Preparation	None
May 10, 2024 11:17:56 AM	Start	Execution	Instrument Detection Limit - Injection Tower, Front SSL, SQ: - Source: - EI - Extractor - RSD L (Area): <= 5.00% - RSD L (Ret. Time): <= 1.00%	None
May 10, 2024 11:18:02 AM	Start	Execution	Mass Ratio Precision - Injection Tower, Front SSL, SQ: - Source: EI - Extractor - L (RSD): <= 5.00%	None
May 10, 2024 11:33:05 AM	Audit	AceClosed	Session	None
May 10, 2024 1:14:08 PM	Audit	AceRestarted	Session	None
May 10, 2024 1:14:09 PM	Audit	SessionReloaded	Session	None

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User Name: supasak.nimsongtham  
Report Generated by Hostname: 5CG1115HKC

System Id: GM-12  
Print Date: May 10, 2024 2:18:57 PM

## GM-12 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 1:14:12 PM	Start	Qualification	Session	OQ
May 10, 2024 1:14:12 PM	Start	Execution	Mass Ratio Precision - Injection Tower, Front SSL, SQ: - Source: EI - Extractor - L (RSD): <= 5.00%	None
May 10, 2024 1:15:17 PM	Start	Execution	Scouting Run - Injection Tower, Front SSL, SQ: - Source: - EI - Extractor- Part of GCMS System Preparation	None
May 10, 2024 1:15:40 PM	Audit	Data	Scouting Run - Injection Tower, Front SSL, SQ: - Source: - EI - Extractor- Part of GCMS System Preparation	Data files Path : D:\GM-12 OQ2024\ScoutingRun001.D
May 10, 2024 1:15:50 PM	Audit	Reporting	Reintegration	Reintegration Count: 1 -- [ Integration Type: Injections; BaselineCorrectionMode: Advanced; InitialSlopeSensitivity: 10; InitialPeakWidth: 0.01; InitialAreaReject: 0; InitialHeightReject: 50; Integration: Off at 0; Integration: On at 4; ]
May 10, 2024 1:15:57 PM	Audit	Reporting	Reintegration	Reintegration Count: 2 -- [ Integration Type: Injections; BaselineCorrectionMode: Advanced; InitialSlopeSensitivity: 10; InitialPeakWidth: 0.01; InitialAreaReject: 0; InitialHeightReject: 300; Integration: Off at 0; Integration: On at 4; ]

User Name: supasak.nimsongtham  
Report Generated by Hostname: 5CG1115HKC

System Id: GM-12  
Print Date: May 10, 2024 2:18:57 PM

## GM-12 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 1:16:43 PM	Audit	Reporting	Reintegration	Reintegration Count: 1 – [ Integration Type: injections; BaselineCorrectionMode: Advanced; InitialSlopeSensitivity: 10; InitialPeakWidth: 0.01; InitialAreaReject: 0; InitialHeightReject: 200; Integration: Off at 0; Integration: On at 5; ]
May 10, 2024 1:16:55 PM	Audit	Reporting	Reintegration	Reintegration Count: 2 – [ Integration Type: injections; BaselineCorrectionMode: Advanced; InitialSlopeSensitivity: 10; InitialPeakWidth: 0.01; InitialAreaReject: 0; InitialHeightReject: 200; Integration: Off at 0; Integration: On at 4; ]
May 10, 2024 1:17:02 PM	End	Execution	Instrument Detection Limit - Injection Tower, Front SSL, SQ: - Source: - EI - Extractor - RSD L (Area): <= 5.00% - RSD L (Ret. Time): <= 1.00%	Run Count : 1
May 10, 2024 1:17:06 PM	Start	Execution	Mass Ratio Precision - Injection Tower, Front SSL, SQ: - Source: EI - Extractor - L (RSD): <= 5.00%	None
May 10, 2024 1:21:35 PM	Start	Execution	Mass Ratio Precision - Injection Tower, Front SSL, SQ: - Source: EI - Extractor - L (RSD): <= 5.00%	None

User Name: supasak.nimsongtham  
Report Generated by Hostname: 5CG1115HKC

System Id: GM-12  
Print Date: May 10, 2024 2:18:57 PM

## GM-12 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 1:21:55 PM	Start	Execution	Mass Ratio Precision - Injection Tower, Front SSL, SQ: - Source: EI - Extractor - L (RSD): ≤ 5.00%	None
May 10, 2024 2:02:45 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front SSL, SQ: - Source: EI - Extractor - L (RSD): ≤ 5.00%	Data files Path : D:\GM-12 OQ2024\MRP002.D
May 10, 2024 2:02:45 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front SSL, SQ: - Source: EI - Extractor - L (RSD): ≤ 5.00%	Data files Path : D:\GM-12 OQ2024\MRP003.D
May 10, 2024 2:02:45 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front SSL, SQ: - Source: EI - Extractor - L (RSD): ≤ 5.00%	Data files Path : D:\GM-12 OQ2024\MRP004.D
May 10, 2024 2:02:45 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front SSL, SQ: - Source: EI - Extractor - L (RSD): ≤ 5.00%	Data files Path : D:\GM-12 OQ2024\MRP005.D
May 10, 2024 2:02:45 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front SSL, SQ: - Source: EI - Extractor - L (RSD): ≤ 5.00%	Data files Path : D:\GM-12 OQ2024\MRP006.D
May 10, 2024 2:02:45 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front SSL, SQ: - Source: EI - Extractor - L (RSD): ≤ 5.00%	Data files Path : D:\GM-12 OQ2024\MRP007.D

User Name: supasak.nimsongtham  
Report Generated by Hostname: 5CG1115HKC

System Id: GM-12  
Print Date: May 10, 2024 2:18:57 PM

## GM-12 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 2:03:15 PM	Audit	Reporting	Reintegration	Reintegration Count: 1 -- [ Integration Type: injections; BaselineCorrectionMode: Advanced; InitialSlopeSensitivity: 10; InitialPeakWidth: 0.01; InitialAreaReject: 0; InitialHeightReject: 50000; Integration: Off at 0; Integration: On at 2; ]
May 10, 2024 2:03:31 PM	End	Execution	Mass Ratio Precision - Injection Tower, Front SSL, SQ: - Source: EI - Extractor - L (RSD): <= 5.00%	Run Count : 1
May 10, 2024 2:03:49 PM	End	Qualification	Session	OQ
May 10, 2024 2:03:49 PM	Start	Reporting	Session	None
May 10, 2024 2:16:42 PM	Audit	Reporting	Session	Report Generated : Certificate
May 10, 2024 2:17:29 PM	Audit	Reporting	Session	Report Generated : Report

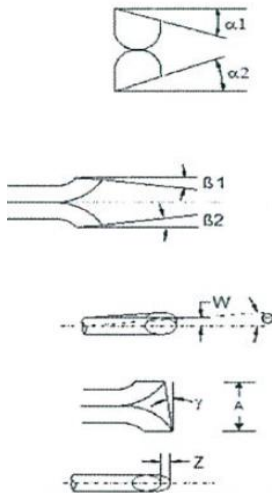




## Type S Pitot Tube Calibration

**Date Calibration** 6-Feb-25  
**Pitot ID** RYG\_FS0320  
**Pitot SN** -

**Due Date** 9-Aug-25  
**Inclinometer ID** BKK\_FS1131  
**Vernier ID** RYG\_FS0539



Parameter	Value	Allowable Range	Check
$\alpha 1$	0.5	$-10^\circ < \alpha 1 < +10^\circ$	OK
$\alpha 2$	1.5	$-10^\circ < \alpha 2 < +10^\circ$	OK
$\beta 1$	-2.2	$-5^\circ < \beta 1 < +5^\circ$	OK
$\beta 2$	-0.6	$-5^\circ < \beta 2 < +5^\circ$	OK
$\gamma$	-1.2	-	-
$\theta$	1.4	-	-
$Z = A \tan \gamma$	-0.018	$Z \leq 0.125"$	OK
$W = A \tan \theta$	0.021	$W \leq 0.031"$	OK
Dt	0.310	0.188" to 0.375"	OK
$A/2Dt$	1.403	$1.05 \leq PA/Dt \leq 1.5$	OK
A	0.87	$2.1Dt \leq A \leq 3Dt$	OK

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

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

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

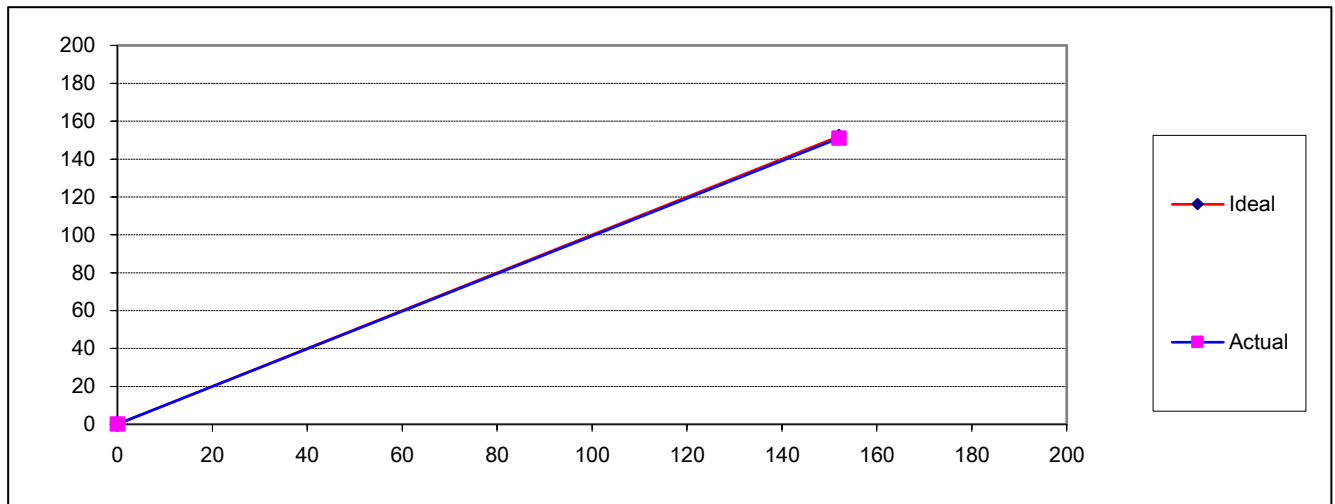


## CALIBRATION REPORT

Calibration Date	3-Jan-25	Equipment ID	BKK_FS0758
Equipment Name	FID Analyzer	Manufacturer	Baseline Mocon
Model	9000H	Serial No.	0315EF0047
Std.Gas Conc.(ppm)	152	Cylinder No.	D878173
Certified Date	27-Jun-18	Expired Date	27-Jun-26

### CALIBRATION RESULTS

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
SPAN	152.00	151.00	-1.00	-0.66
AVERAGE (%)				-0.28



Calibrated By

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

Approved By

( Mr.Sarayuth Jittrantont )  
Assistant General Manager

## Certificate of Calibration

### Customer


Name : ALS Laboratory Group Thailand Co., Ltd. **Certificate No** : 25-ACT-042  
Address : 104 Soi Phatthanakan 40, Phatthanakan Road, Suan Luang, **Request No** : Req-2025-0604  
Bangkok 10250

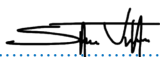
### Unit Under Calibration Details

Measurement item : Acoustic Calibrator Class : 1  
Manufacturer : RION Range : 94 dB / 1000 Hz  
Model : NC-75 Instrument Status : Used  
Serial Number : 35002736  
ID : RYG\_FS0496

### Calibration Environment and Details

Temperature : ( 23  $\pm$  2 °C )  
Humidity : ( 50  $\pm$  20 %RH )  
Barometric Pressure : ( 1013  $\pm$  10.0 hPa )  
Received Date : 6 March 2025  
Calibration Date : 19 March 2025  
Location of Calibration : LAB 1 Acoustic  
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators

REVIEW BY 

APPROVED BY 


NEXT CAL DATE 19/03/26


Reference Standard	Model	Serial Number	Traceable	Due Calibration
Sound Calibrator	SV 35A	58079	EEI	12 June 2025
THD Multimeter	2015	1047765	NIMT	4 February 2026

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

### Note

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

**Calibrated By :**   
Mr. Noppadon Luangart  
Service Calibration Engineer

**Approved By :**   
Mr. Pacit Mathavorn  
Calibration Engineer Supervisor

**Issue Date :** 19 March 2025

Certificate No : 25-ACT-042

Request No : Req-2025-0604

**Sound pressure level**

**Calibration Results : Without Adjustment**

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty (± dB)	Acceptance limit Class 1 (± dB)	Result
	Measured	Deviated value	Measured	Deviated value			
94 dB / 1000 Hz	94.06	0.06	-	-	0.13	0.25	Pass

**Frequency of Sound pressure level**

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

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

Calibration Range (Hz)	Without Adjustment	Adjustment	Uncertainty (± %)	Acceptance limit Class 1 (± %)	Result
	Measured (%)	Measured (%)			
94 dB / 1000 Hz	0.98	-	0.40	2.5	Pass

**Note :**

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

- Acceptance limit was IEC60942:2017 Class 1
- The calibration results exclude the calibrator pressure correction
- The calibration results exclude the microphone volume correction



Certificate No : 25-ACT-042

Request No : Req-2025-0604

### Decision Rule for Statements of Conformity

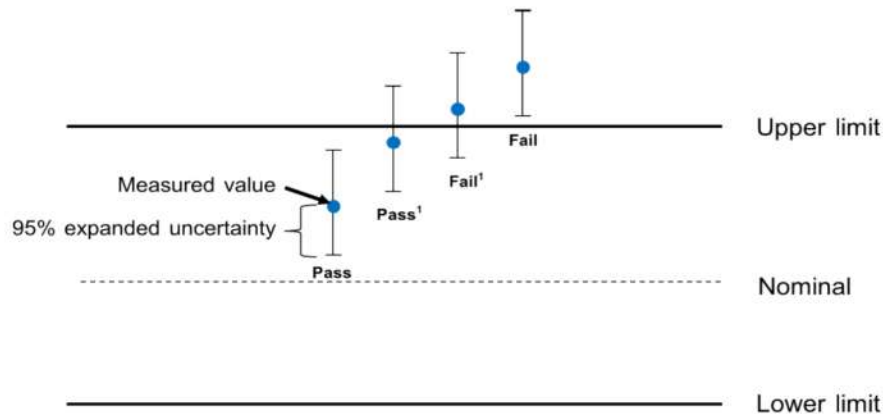
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09/2019; Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

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

Pass<sup>1</sup> = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail<sup>1</sup> = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

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



End of Calibration

**Cert. No. : ACL25073**

**Pages : 1 of 8**

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42 / Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 01222716 / 143832 / 22763  
**ID No.:** RYG\_FS0020

**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 :** 07 JANUARY 2025  
**Calibration Date :** 21 - 23 JANUARY 2025  
**Date of Issue :** 24 JANUARY 2025

REVIEW BY ..... *Supt S.*

APPROVED BY ..... *[Signature]*

NEXT CAL DATE..... 21/ 01/ 2026

**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.

**Cert. No. : ACL25073**  
**Job No. : VC68AC0059**  
**Pages : 2 of 8**

**Calibration Procedure :** CP-AC-01

**Calibration Method :**

This equipment was calibrated by follow on IEC-61672-3 (2013) Standard for sound level meter (SLM).

The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

**Condition of this result of calibration :**

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL.BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL.BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL.BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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

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

3.1 National Institute of Metrology (Thailand).

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

*S. Petch*

**Cert. No. : ACL25073**  
**Job No. : VC68AC0059**  
**Pages : 3 of 8**

**Summary of Measurement Result :**

<b>Parameter</b>	<b>Uncertainty (dB)</b>	<b>Maximum-permitted uncertainty of measurement (dB)</b>
1. Absolute sensitivity	0.2	N/A
2. Self-generated noise	0.2	N/A
3. Acoustical signal tests of frequency weightings		
125 Hz	0.3	0.6
1000 Hz	0.3	0.6
8000 Hz	0.3	0.7
4. Electrical signal tests of frequency weightings		
For 10 Hz to 4 kHz	0.3	0.6
For > 4 kHz to 10 kHz	0.3	0.7
For > 10 kHz to 20 kHz	0.3	1.0
5. Frequency and time weightings at 1 kHz	0.2	0.2
6. Long - term stability	0.1	0.1
7. Level linearity on the reference level range	0.2	0.3
8. Level linearity including the level range control	0.2	0.3
9. Tone burst response	0.2	0.3
10. Peak C sound level	0.2	0.35
11. Overload indication	0.2	0.25
12. High level stability	0.1	0.1

*T. Petchm.*

**Cert. No. : ACL25073**  
**Job No. : VC68AC0059**  
**Page : 4 of 8**

**Result of calibration :**

**1. Absolute sensitivity**

Reference Acoustic Signal ( dB )	Measured Value ( dB )	Deviation ( dB )	Acceptance Limit ( dB )
93.9 (93.94)	93.9	0.0	±0.3

**2. Self-generated noise**

**2.1 Normal test**

Measured Value ( dB )
13.4

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

Frequency Weighting	Weighting ( dB )
A - weight	10.8
C - weight	16.7
Flat	22.6

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

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	-0.2	-0.2	-0.2	± 1.5
1000	-0.6	-0.6	-0.6	± 1.0
8000	-1.0	-1.0	-1.0	±5.0

*G. Petcha*



Cert. No. : ACL25073  
Job No. : VC68AC0059  
Pages : 5 of 8

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

Weighting network response with relative to 1 kHz.

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.2	0.2	0.3	±2.0
125	0.2	0.2	0.2	±1.5
250	0.1	0.1	0.1	±1.5
500	0.1	0.1	0.1	±1.5
1000	0.0	0.0	0.1	±1.0
2000	0.0	0.0	0.0	±2.0
4000	-0.1	-0.1	0.0	±3.0
8000	-0.1	0.0	0.0	±5.0

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

##### 5.1 Frequency weightings at 1 kHz

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

##### 5.2 Time weighting at 1 kHz

Frequency Weighting	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	94.0	94.0	0.0	± 0.1
Slow	94.0	94.0	0.0	± 0.1
Leq	94.0	94.0	0.0	± 0.1

#### 6. Long - term stability

Frequency Weighting	SLM Display at initial ( dB )	SLM Display at final ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
A - weight	94.0	94.0	0.0	± 0.3

*T. Petch*

**Cert. No. : ACL25073**

**Job No. : VC68AC0059**

**Pages : 6 of 8**

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

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	140.0	3.0	± 1.1
136.0	140.0	4.0	± 1.1
135.0	140.0	5.0	± 1.1
134.0	140.0	6.0	± 1.1
133.0	133.1	0.1	± 1.1
132.0	132.1	0.1	± 1.1
131.0	131.1	0.1	± 1.1
129.0	129.1	0.1	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.1	0.1	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.1	0.1	± 1.1
29.0	29.1	0.1	± 1.1
28.0	28.2	0.2	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.2	0.2	± 1.1
25.0	25.3	0.3	± 1.1

*T. Petch*

**Cert. No. : ACL25073**  
**Job No. : VC68AC0059**  
**Pages : 7 of 8**

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

Range	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
130	29.0	29.2	0.2	±1.1

**9. Tone burst response**

Time Weighting	Tone burst duration, Tb ( ms )	Cycle	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

*G. Petch*

**Cert. No. : ACL25073**  
**Job No. : VC68AC0059**  
**Pages : 8 of 8**

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>cpeak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	130.0	130.0	0.0	±3.0
One	133.4	133.4	0.0	±3.0

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	133.0	132.9	-0.1	±2.0
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

**11. Overload indication**

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

**12. High level stability**

Frequency Weighting	SLM Display at initial ( dB )	SLM Display at final ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
A - weight	137.0	137.0	0.0	±0.3

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

**End of Calibration Certificate**

*T. Petcha*

**Cert. No. : ACL25072**

**Pages : 1 of 8**

## Calibration Certificate


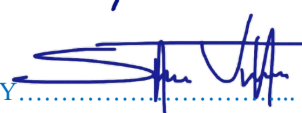
**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42 / Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 01122607 / 145554 / 34373  
**ID No.:** RYG\_FS0019

**Condition As Found :** GOOD

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

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

**Received Date :** 07 JANUARY 2025  
**Calibration Date :** 21 - 23 JANUARY 2025  
**Date of Issue :** 24 JANUARY 2025

REVIEW BY .....	
APPROVED BY .....	
NEXT CAL DATE .....	21/ 01/ 2026

**Calibrated by :**

Nathakorn Pisutpaisan

**Approved by :**

  
( Thanakul Petchurai )

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



**Cert. No. : ACL25072****Job No. : VC68AC0059****Pages : 2 of 8****Calibration Procedure : CP-AC-01****Calibration Method :**

This equipment was calibrated by follow on IEC-61672-3 (2013) Standard for sound level meter (SLM).

The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

**Condition of this result of calibration :**

## 1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL.BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL.BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL.BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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

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

3.1 National Institute of Metrology (Thailand).

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



**Cert. No. : ACL25072**  
**Job No. : VC68AC0059**  
**Pages : 3 of 8**

**Summary of Measurement Result :**

Parameter	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	0.2	N/A
2. Self-generated noise	0.2	N/A
3. Acoustical signal tests of frequency weightings		
125 Hz	0.3	0.6
1000 Hz	0.3	0.6
8000 Hz	0.3	0.7
4. Electrical signal tests of frequency weightings		
For 10 Hz to 4 kHz	0.3	0.6
For > 4 kHz to 10 kHz	0.3	0.7
For > 10 kHz to 20 kHz	0.3	1.0
5. Frequency and time weightings at 1 kHz	0.2	0.2
6. Long - term stability	0.1	0.1
7. Level linearity on the reference level range	0.2	0.3
8. Level linearity including the level range control	0.2	0.3
9. Tone burst response	0.2	0.3
10. Peak C sound level	0.2	0.35
11. Overload indication	0.2	0.25
12. High level stability	0.1	0.1

*T. Petch.*

**Cert. No. : ACL25072**

**Job No. : VC68AC0059**

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**Result of calibration :**

**1. Absolute sensitivity**

Reference Acoustic Signal ( dB )	Measured Value ( dB )	Deviation ( dB )	Acceptance Limit ( dB )
93.9 (93.94)	93.9	0.0	±0.3

**2. Self-generated noise**

**2.1 Normal test**

Measured Value ( dB )
16.0

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

Frequency Weighting	Weighting ( dB )
A - weight	12.6
C - weight	17.7
Flat	22.6

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

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.5	0.5	0.5	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-1.2	-1.2	-1.2	±5.0

*S. Petcha.*

Cert. No. : ACL25072  
Job No. : VC68AC0059  
Pages : 5 of 8

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

Weighting network response with relative to 1 kHz.

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	-0.1	-0.1	±2.0
125	-0.1	0.0	-0.1	±1.5
250	-0.1	0.0	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.0	0.0	±5.0

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

##### 5.1 Frequency weightings at 1 kHz

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

##### 5.2 Time weighting at 1 kHz

Frequency Weighting	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	94.0	94.0	0.0	± 0.1
Slow	94.0	94.0	0.0	± 0.1
Leq	94.0	94.0	0.0	± 0.1

#### 6. Long - term stability

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

*T. Petcha*

**Cert. No. : ACL25072**

**Job No. : VC68AC0059**

**Pages : 6 of 8**

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

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

*T. Petch.*



**Cert. No. : ACL25072**  
**Job No. : VC68AC0059**  
**Pages : 7 of 8**

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

Range	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
130	29.0	29.0	0.0	±1.1

**9. Tone burst response**

Time Weighting	Tone burst duration, Tb ( ms )	Cycle	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	0.25	1	108.0	108.0	0.0	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.1	0.1	1.5 ; -5.0
	200	800	127.6	127.7	0.1	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

*T. Petch.*

**Cert. No. : ACL25072**  
**Job No. : VC68AC0059**  
**Pages : 8 of 8**

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>cpeak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	130.0	130.0	0.0	±3.0
One	133.4	133.4	0.0	±3.0

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

**11. Overload indication**

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle		
89.5	89.5	0.0	±1.5

**12. High level stability**

Frequency Weighting	SLM Display at initial ( dB )	SLM Display at final ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
A - weight	137.0	137.0	0.0	±0.3

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

**End of Calibration Certificate**

*S. Petcha-*

## Certificate of Calibration

### Customer



Name : ALS Laboratory Group Thailand Co., Ltd. **Certificate No** : 25-ACT-010  
Address : 104 Soi Phatthanakan 40, Phatthanakan Road, Suan Luang, **Request No** : Req-2025-0091  
Bangkok 10250

### Unit Under Calibration Details

Measurement item : Acoustic Calibrator Class : 1  
Manufacturer : RION Range : 94 dB / 1000 Hz  
Model : NC-74 Instrument Status : Used  
Serial Number : 34178121  
ID : RYG\_FS0213

### Calibration Environment and Details

Temperature : ( 23  $\pm$  2 °C )  
Humidity : ( 50  $\pm$  20 %RH )  
Barometric Pressure : ( 1013  $\pm$  10.0 hPa )  
Received Date : 15 January 2025  
Calibration Date : 16 January 2025  
Location of Calibration : LAB 1 Acoustic  
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators


REVIEW BY   
APPROVED BY   
NEXT CAL DATE 16/01/26

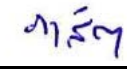
Reference Standard	Model	Serial Number	Traceable	Due Calibration
Sound Calibrator	SV 35A	58079	EEI	12 June 2025
THD Multimeter	2015	1047765	NIMT	16 January 2025

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

### Note

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

**Calibrated By :**   
Mr. Noppadon Luangart  
Service Calibration Engineer

**Approved By :**   
Mr. Pacit Mathavorn  
Calibration Engineer Supervisor

**Issue Date :** 16 January 2025

Certificate No : 25-ACT-010

Request No : Req-2025-0091

**Sound pressure level**

**Calibration Results : Without Adjustment**

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty (± dB)	Acceptance limit Class 1 (± dB)	Result
	Measured	Deviated value	Measured	Deviated value			
94 dB / 1000 Hz	94.11	0.11	-	-	0.13	0.25	Pass

**Frequency of Sound pressure level**

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

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

Calibration Range (Hz)	Without Adjustment	Adjustment	Uncertainty (± %)	Acceptance limit Class 1 (± %)	Result
	Measured (%)	Measured (%)			
94 dB / 1000 Hz	1.21	-	0.40	2.5	Pass

**Note :**

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

- Acceptance limit was IEC60942:2017 Class 1
- The calibration results exclude the calibrator pressure correction
- The calibration results exclude the microphone volume correction

Certificate No : 25-ACT-010

Request No : Req-2025-0091

### Decision Rule for Statements of Conformity

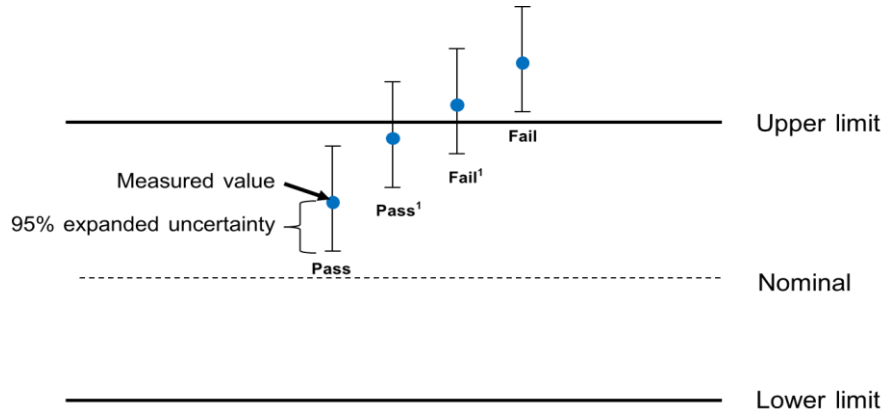
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09/2019; Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

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

Pass<sup>1</sup> = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail<sup>1</sup> = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

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



End of Calibration



**Certificate of Calibration****Customer**

Name : ALS Laboratory Group Thailand Co., Ltd.

Certificate No : 25-SLM-113

Address : 104 Soi Phatthanakan 40, Phatthanakan Road, Suan Luang, Bangkok 10250

Request No : Req-2025-0603

**Unit Under Calibration Details**

Measurement item : Sound Level Meter

Microphone Class : 2

Manufacturer : RION

Microphone Model : UC-52

Model : NL-42

Microphone S/N : 172170

Serial Number : 01173609

Preamplifier Model : NH-24

ID : RYG\_FS0388

Preamplifier S/N : 74021

Resolution : 0.1 dB

Instrument Status : Used

**Calibration Environment and Details**

Temperature : 23 °C ± 2 °C

Humidity : 50 %RH ± 20 %RH

Barometric Pressure : 1013 hPa ± 10 hPa

Received Date : 6 March 2025

Calibrated Date : 19 March 2025

Calibration Procedure : In-house method CP-SLM-01 based on IEC 61672-3 : 2013 Electroacoustics - Sound level meters - Part 3: Periodic tests

Location of Calibration : Lab Acoustic

REVIEW BY	
APPROVED BY	
NEXT CAL DATE	19/03/26

**Reference Standard**

Instrument	Brand	Model	SN.	Due calibration	Traceability
Standard Microphone	Brüel & Kjær	4192	2294985	25 June 2025	NIMT
Audio Generator	Svantek	Svan401	131	15 October 2025	WK Electric

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

Calibrated By :

Mr. Noppadon Luangart

Service Calibration Engineer

Approved By :

Mr. Pacit Mathavorn

Calibration Engineer Supervisor

Issue Date :

19 March 2025

Certificate No : 25-SLM-113

Request No : Req-2025-0603

## 1. Indication at the calibration check frequency

UUC Setting	Nominal	Before Adjust		After Adjust		UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)	Result
FAST / A / 30-130	Level	UUC	ERR	UUC	ERR			
Calibrator Setting	(dB)	(dB)	(dB)	(dB)	(dB)			
1000 Hz 94 dB	94.06	94.0	-0.06	94.1	+0.04	0.20	0.30	Pass

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand RION, Model NC-75, SN.35002736

## 2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST / 30-130		
UUC Weighting	(dB)	( ± dB)
A	15.8	0.10

## 3. Self-generated noise, Microphone replaced by the electrical input signal device

UUC Setting	Measured	UNCERTAINTY
FAST / 30-130		
UUC Weighting	(dB)	( ± dB)
A	12.4	0.10
C	16.7	0.10
Z	20.7	0.10

## 4. Acoustic signal test of frequency weightings (Without Windscreen)

UUC Setting	Deviation from various Frequency Weighting Responce curve			UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)	Result
FAST / 30-130	A	C	Z			
STD Setting	(dB)	(dB)	(dB)	( ± dB)	( ± dB)	
125 Hz	0.2	0.4	0.4	0.60	1.5	Pass
1000 Hz	0.0	0.0	0.0	0.60	1.0	Pass
4000 Hz	-0.1	-0.1	-0.1	0.60	3.0	Pass
8000 Hz	-1.4	-1.4	-1.3	0.70	5.0	Pass

Certificate No : 25-SLM-113

Request No : Req-2025-0603

5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz

UUC Setting	Deviation from various Frequency			UNCERTAINTY	Acceptance	Result
FAST / 30-130	Weighting Responce curve				Limit	
STD Setting	A (dB)	C (dB)	Z (dB)	( ± dB)	( ± dB)	
63 Hz	-0.2	-0.1	0.0	0.20	2.0	Pass
125 Hz	-0.1	0.0	0.0		1.5	Pass
250 Hz	-0.1	0.0	0.0		1.5	Pass
500 Hz	0.0	0.0	0.0		1.5	Pass
1000 Hz	0.0	0.0	0.0		1.0	Pass
2000 Hz	0.0	0.1	0.0		2.0	Pass
4000 Hz	0.0	0.0	0.0		3.0	Pass
8000 Hz	0.1	0.1	0.0		5.0	Pass
16000 Hz	-1.3	-1.4	0.0		+5, -INF.	Pass

6. Frequency and time weightings at 1kHz

UUC Setting	STD  REF  (dB)	Measured		UNCERTAINTY  ( ± dB)	Acceptance	Result
FAST / 30-130		UUC	ERR		Limit	
UUC Weighting		(dB)	(dB)		(dB)	
A	114.00	114.0	0.0	0.20	0.20	Pass
C	114.00	114.0	0.0		0.20	Pass
Z	114.00	114.0	0.0		0.20	Pass

UUC Setting	STD  REF  (dB)	Measured		UNCERTAINTY   ( ± dB)	Acceptance  Limit  ( ± dB)	Result
30-130 / A		UUC	ERR			
UUC Time Response		(dB)	(dB)			
Fast	114.00	114.0	0.0	0.20	0.10	Pass1
Slow	114.00	114.0	0.0		0.10	Pass1
Leq	114.00	114.0	0.0		0.10	Pass1

Certificate No : 25-SLM-113

Request No : Req-2025-0603

## 7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)	Result
FAST / A / 30-130	UUC			
STD Setting	(dB)			
Initial	114.0			
Final	114.0			
Deviated	0.0	0.10	0.30	Pass

## 8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation		UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)	Result
FAST / A / 30-130	REF	UUC	ERR			
STD dB	(dB)	(dB)	(dB)			
138.00	138	137.9	-0.1	0.30	1.1	Pass
134.00	134	134.0	0.0		1.1	Pass
129.00	129	128.9	-0.1		1.1	Pass
124.00	124	124.0	0.0		1.1	Pass
119.00	119	119.0	0.0		1.1	Pass
114.00	114	114.0	0.0		1.1	Pass
109.00	109	109.0	0.0		1.1	Pass
104.00	104	104.0	0.0		1.1	Pass
99.00	99	99.0	0.0		1.1	Pass
94.00	94	94.0	0.0		1.1	Pass
89.00	89	89.0	0.0		1.1	Pass
84.00	84	84.0	0.0		1.1	Pass
79.00	79	79.0	0.0		1.1	Pass
74.00	74	74.0	0.0		1.1	Pass
69.00	69	69.0	0.0		1.1	Pass
64.00	64	64.0	0.0		1.1	Pass
59.00	59	59.0	0.0		1.1	Pass
54.00	54	54.0	0.0		1.1	Pass
49.00	49	49.0	0.0		1.1	Pass
44.00	44	44.0	0.0		1.1	Pass
39.00	39	39.0	0.0		1.1	Pass
34.00	34	34.0	0.0		1.1	Pass
29.00	29	29.0	0.0		1.1	Pass
24.00	24	24.1	0.1		1.1	Pass





Certificate No : 25-SLM-113

Request No : Req-2025-0603

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

UUC Setting	STD	Measured		UNCERTAINTY	Acceptance	Result
FAST / A	REF	UUC	ERR	( ± dB)	Limit	
UUC Range	(dB)	(dB)	(dB)		( ± dB)	
30-130	29.50	29.6	0.1	0.30	1.1	Pass
	114	114.0	0.0		1.1	Pass

### 10. Tone burst response

UUC Setting	STD	Anticipated	Measured		UNCERTAINTY	Acceptance	Result
A / 30-130	Toneburst	Ref	UUC	ERR	( ± dB)	Limit	
UUC Time Response	(ms)	(dB)	(dB)	(dB)		( ± dB)	
Fast	200	126.0	126.0	0.0	0.20	1.0	Pass
	2	109.0	109.0	0.0		+1.0, -2.5	Pass
	0.25	100.0	99.9	-0.1		+1.5, -5.0	Pass
Slow	200	119.6	119.6	0.0		1.0	Pass
	2	100.0	100.0	0.0		+1.0, -5.0	Pass
SEL	200	120.0	120.0	0.0		1.0	Pass
	2	100.0	100.0	0.0		+1.0, -2.5	Pass
	0.25	91.0	90.9	-0.1		+1.5, -5.0	Pass

### 11. Peak C Sound level

UUC Setting	Anticipated	Measured		UNCERTAINTY	Acceptance	Result
FAST / C / 55-141	REF	UUC	ERR	( ± dB)	Limit	
STD Setting	(dB)	(dB)	(dB)		( ± dB)	
Complete cycle	136.4	136.4	0.00	0.20	3.0	Pass
Positive half cycle	135.4	135.2	-0.20		2.0	Pass
Negative half cycle	135.4	135.2	-0.20		2.0	Pass



Certificate No : 25-SLM-113

Request No : Req-2025-0603

**12. Overload indication**

UUC Setting	Measured	UNCERTAINTY  ( ± dB)	Acceptance	Result
FAST / A / 30-130	UUC		Limit	
STD Setting	(dB)		( ± dB)	
Positive one-half cycle	139.5			
Negative one-half cycle	139.4			
Deviated	0.1	0.20	1.5	Pass

**13. High Level Stability**

UUC Setting	Measured	UNCERTAINTY  ( ± dB)	Acceptance	Result
FAST / A / 30-130	UUC		Limit	
STD Setting	(dB)		( ± dB)	
Initial	129.0			
Final	129.0			
Deviated	0.0	0.10	0.30	Pass

**Note :**

Function	Maximum-permitted Uncertainty of measurement
1. Indication at the calibration check frequency	Not applicable
2. Self-generated noise, Microphone installed	Not applicable
3. Self-generated noise, Microphone replaced by the electrical input signal device	Not applicable
4. Acoustic signal test of frequency weightings at 10 Hz to 4 kHz	0.60 dB
4. Acoustic signal test of frequency weightings at >4 kHz to 10 kHz	0.70 dB
5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz	0.20 dB
6. Frequency and time weightings at 1kHz	0.20 dB
7. Long Term Stability	0.10 dB
8. Level linearity on the reference level range	0.30 dB
9. Level linearity including the level range control	0.30 dB
10. Tone burst response	0.30 dB
11. Peak C Sound level	0.35 dB
12. Overload indication	0.25 dB
13. High Level Stability	0.10 dB

- Acceptance limit and Maximum-permitted Uncertainty was IEC 61672-1:2013

Certificate No : 25-SLM-113

Request No : Req-2025-0603

### Decision Rule for Statements of Conformity

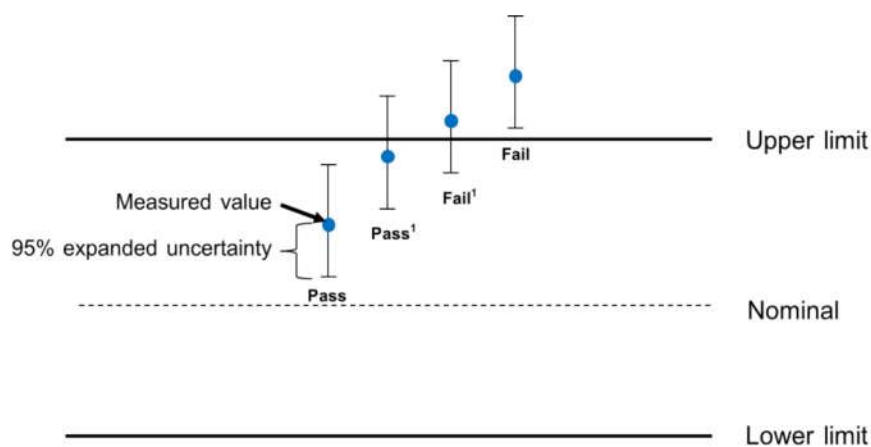
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09/2019; Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

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

Pass<sup>1</sup> = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail<sup>1</sup> = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

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



End of Certificate

**Cert. No. : ACL25101**

**Pages : 1 of 8**

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** RION  
**Model :** NL-42 / Microphone UC-52 / Preamplifier NH-24  
**Serial No.:** 01173610 / 143485 / 22619  
**ID No.:** RYG\_FS0389

**Condition As Found :** GOOD

**Customer :** ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,  
KHWAEANG 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 :** 14 JANUARY 2025  
**Calibration Date :** 27-29 JANUARY 2025  
**Date of Issue :** 30 JANUARY 2025

REVIEW BY ..... *Supt S* .....

APPROVED BY ..... *[Signature]* .....

NEXT CAL DATE..... 26/ 01/ 2026 .....

**Calibrated by :**

Nathakorn Pisutpaisan

**Approved by :**

*[Signature]*  
( Thanakul Petchurai )

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

**Cert. No. : ACL25101**  
**Job No. : VC68AC0064**  
**Pages : 2 of 8**

**Calibration Procedure :** CP-AC-01

**Calibration Method :**

This equipment was calibrated by follow on IEC-61672-3 (2013) Standard for sound level meter (SLM).

The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

**Condition of this result of calibration :**

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL.BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL.BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL.BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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

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

3.1 National Institute of Metrology (Thailand).

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

*T. Petch.*

Cert. No. : ACL25101  
Job No. : VC68AC0064  
Pages : 3 of 8

**Summary of Measurement Result :**

Parameter	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	0.2	N/A
2. Self-generated noise	0.2	N/A
3. Acoustical signal tests of frequency weightings		
125 Hz	0.3	0.6
1000 Hz	0.3	0.6
8000 Hz	0.3	0.7
4. Electrical signal tests of frequency weightings		
For 10 Hz to 4 kHz	0.3	0.6
For > 4 kHz to 10 kHz	0.3	0.7
For > 10 kHz to 20 kHz	0.3	1.0
5. Frequency and time weightings at 1 kHz	0.2	0.2
6. Long - term stability	0.1	0.1
7. Level linearity on the reference level range	0.2	0.3
8. Level linearity including the level range control	0.2	0.3
9. Tone burst response	0.2	0.3
10. Peak C sound level	0.2	0.35
11. Overload indication	0.2	0.25
12. High level stability	0.1	0.1

*g. Petch.*



**Cert. No. : ACL25101**  
**Job No. : VC68AC0064**  
**Page : 4 of 8**

**Result of calibration :**

**1. Absolute sensitivity**

Reference Acoustic Signal ( dB )	Measured Value ( dB )	Deviation ( dB )	Acceptance Limit ( dB )
93.9 (93.94)	93.9	0.0	±0.3

**2. Self-generated noise**

**2.1 Normal test**

Measured Value ( dB )
18.8

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

Frequency Weighting	Weighting ( dB )
A - weight	16.3
C - weight	22.1
Flat	28.0

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

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-0.2	-0.2	-0.2	±5.0

*Signature*

**Cert. No. : ACL25101**  
**Job No. : VC68AC0064**  
**Pages : 5 of 8**

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

Weighting network response with relative to 1 kHz.

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	-0.1	0.0	±2.0
125	0.0	0.1	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.1	±2.0
4000	0.0	0.1	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

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

##### 5.1 Frequency weightings at 1 kHz

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

##### 5.2 Time weighting at 1 kHz

Frequency Weighting	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	94.0	94.0	0.0	± 0.1
Slow	94.0	94.0	0.0	± 0.1
Leq	94.0	94.0	0.0	± 0.1

#### 6. Long - term stability

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

*T. Petch*

**Cert. No. : ACL25101**

**Job No. : VC68AC0064**

**Pages : 6 of 8**

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

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	26.0	0.0	± 1.1
25.0	24.9	-0.1	± 1.1

*N. Petchum.*

**Cert. No. : ACL25101**  
**Job No. : VC68AC0064**  
**Pages : 7 of 8**

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

Range	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
130	94.0	94.0	0.0	±1.1

Range	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
130	29.0	28.9	-0.1	±1.1

**9. Tone burst response**

Time Weighting	Tone burst duration, Tb ( ms )	Cycle	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	0.25	1	108.0	108.0	0.0	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

*T. Ketchum*

**Cert. No. : ACL25101**  
**Job No. : VC68AC0064**  
**Pages : 8 of 8**

**10. Peak C sound level**

Number of cycle in test signal	Anticipated Value ( dB )	Measured Value, L <sub>cpeak</sub> ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Continuous	130.0	130.0	0.0	±3.0
One	133.4	133.4	0.0	±3.0

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

**11. Overload indication**

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle		
89.6	89.6	0.0	±1.5

**12. High level stability**

Frequency Weighting	SLM Display at initial ( dB )	SLM Display at final ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
A - weight	137.1	137.0	0.1	±0.3

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

**End of Calibration Certificate**

*E. Petch.*



## Certificate of Calibration

Certificate No : 24-AFM-033

### Customer

Name : ALS Laboratory Group Thailand Co., Ltd.  
Address : 104 Soi Phatthanakan 40, Phatthanakan Road, Suan Luang, Bangkok  
10250

Request No : Req-2024-0241

### Unit Under Calibration Details

Measurement Item : Primary Flow Calibrator  
Manufacturer : Bios  
Model : Defender 510-L  
Serial Number : 130027  
ID : RYG\_FS0208  
Location of Calibration : LAB 4 AIR VELOCITY METER

Sensor Model : -

Sensor Serial Number : -

### Calibration Environment and Details

Temperature : 23 °C ± 3 °C  
Humidity : 55 %RH ± 20 %RH  
Barometric Pressure : 1013 hPa ± 10 hPa  
Received Date : 31 January 2024  
Calibration Date : 13 February 2024

Calibration Procedure : In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator




Reference Standard	Model	Serial Number	Traceble	Due Calibration
Air Flow Meter	Gilibrator 3 Low flow	18501010006	Sensidyne	12 July 2024
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensidyne	12 July 2024
Temperature meter	GT 11	08000057	Qreborn	27 February 2024
Pressure meter	CPG2400	41000KDU/651882	TPA	9 November 2024


### Traceability :

This Certificate is traceable to SI Unit through Sensidyne A2LA Accreditation No. 3943.01

### Note :

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

Calibration By :   
Mr. Noppadon Luangart  
Service Calibration Engineer

Approved By :   
Mr. Pacit Mathavorn  
Calibration Engineer Supervisor

Issue Date : 13 February 2024

Certificate No : 24-AFM-033

Request No : Req-2024-0241

**Result of Calibration : Without Adjustment**

Temperature (°C)	Pressure (kPa)	STD (cc/min)	UUC (cc/min)	Error (cc/min)	Uncertainty (cc/min)
24.50	101.26	20	19.965	0.0	1.3
24.20	101.25	101	100.50	-0.5	2.8
24.00	101.31	200	199.13	-0.9	5.6
23.90	101.42	301	303.56	2.6	8.4
24.10	101.41	401	404.57	4	11
24.10	101.49	480	483.81	3.8	7.0

**Note**

STD : Standard

UUC : Unit Under Calibration

- UUC Reference Condition : At atmospheric pressure and room temperature condition

- Flow Rate was corrected for non-standard operating condition by using equation :

$$Q_{meas} = Q_{ref} \times \frac{P_{ref}}{P_{meas}} \times \frac{T_{meas}}{T_{ref}}$$

where Q = Flow Rate

P = Absolute Pressure

T = Absolute Temperature

Meas = Measurement Condition

ref = Standard Condition

\* Indicates non accredited

**End of Certificate**



## Calibration Certificate

**Certificate No.** 610563  
**Product** 200-510M Defender 510 Medium Flow  
**Serial No.** 151114  
**Cal. Date** 21-May-2024

**Sold To:**

All calibrations are performed in accordance with ISO 17025 at Mesa Laboratories, Inc., 12100 W. 6th Ave, Lakewood, CO 80228, an ISO 17025:2017 accredited laboratory through NVLAP. This report shall not be reproduced except in full without the written approval of the laboratory. Results only relate to the items calibrated. This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

## As Received Calibration Data

**Technician** Derek Dellape  
**Lab. Pressure** 614.2 mmHg  
**Lab. Temperature** 24.3 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Received
0 ccm	4504.81 ccm	-100.0%	1.00%	Out of Tolerance
0 ccm	1000.98 ccm	-100.0%	1.00%	Out of Tolerance
0 ccm	249.55 ccm	-100.0%	1.00%	Out of Tolerance

## Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-24	117991	13-Nov-2023	13-Nov-2024

REVIEW BY W. Nakamura P.  
 APPROVED BY [Signature]  
 NEXT CAL. DATE 21/5/25



## As Shipped Calibration Data

<b>Certificate No</b>	610563	<b>Lab. Pressure</b>	617 mmHg
<b>Technician</b>	Derek Dellape	<b>Lab. Temperature</b>	24.6 °C

Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
4482.47 ccm	4493.49 ccm	-0.25%	1.00%	In Tolerance
997.25 ccm	996.83 ccm	0.04%	1.00%	In Tolerance
248.51 ccm	248.67 ccm	-0.06%	1.00%	In Tolerance

## Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML-800-24	211063	04-Oct-2023	04-Oct-2024

### Calibration Notes

The expanded uncertainty of flow has a coverage factor of  $k = 2$  for a confidence interval of approximately 95%.

Flow testing is in accordance with our test number MP-00672 with an expanded uncertainty of 0.27% using high-purity nitrogen or filtered laboratory air.

Traceability to the International System of Units (SI) is verified by accreditation to ISO/IEC 17025 by NVLAP under NVLAP Code 200661-0.

### Technician Notes:

By:

Approved By:



Derek Dellape  
Production Assembler II



Troy Thacker  
Quality Engineer

Mesa Laboratories, Inc. certifies that the above instrument meets or exceeds published specifications, and that the calibration results in this certificate were obtained using equipment capable of producing results that are traceable through NIST to the International System of Units (SI). Calibration results are in compliance with ISO/IEC 17025:2017. Calibrations process has a Test Uncertainty Ratio (TUR) of 4:1 or greater. Any Pass/Fail determination is made without taking measurement uncertainty into account and is based on UUT performance against required tolerance only.

## Certificate of Calibration

### Customer

Name : ALS Laboratory Group Thailand Co., Ltd.  
Address : 104 Soi Phatthanakan 40, Phatthanakan Road, Suan Luang,  
Bangkok 10250

Certificate No : 25-AFM-023

Request No : Req-2025-0169

### Unit Under Calibration Details

Measurement Item : Air Flow Meter

Manufacturer : Mesa Labs

Accuracy : 1% of Reading

Model : 200-510L

Sensor Model : -

Serial Number : 130027

Sensor Serial Number : -

ID : RYG\_FS0208

Instrument Status : Used

Location of Calibration : LAB 4 AIR VELOCITY METER

### Calibration Environment and Details

Temperature : 23 °C ± 3 °C

Humidity : 55 %RH ± 20 %RH

Barometric Pressure : 1013 hPa ± 10 hPa

Received Date : 21 January 2025

Calibration Date : 27 January 2025

Calibration Procedure : In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator

REVIEW BY 

APPROVED BY 

NEXT CAL DATE.....26/01/26.....

Reference Standard	Model	Serial Number	Traceble	Due Calibration
Air Flow Meter	Gilibrator 3 Low flow	18501010006	Sensidyne	6 August 2025
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensidyne	2 August 2025
Temperature meter	GT 11	08000057	Qreborn	1 March 2025
Pressure meter	CPG2400	41000KDU/651882	TPA	21 October 2025

### Traceability :

This Certificate is traceable to SI Unit through Sensidyne A2LA Accreditation No. 3943.01

### Note :

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

Calibration By :



Mr. Noppadon Luangart  
Service Calibration Engineer

Approved By :



Mr. Pacit Mathavorn  
Calibration Engineer Supervisor

Issue Date :

27 January 2025



Certificate No : 25-AFM-023

Request No : Req-2025-0169

**Result of Calibration : Without Adjustment**

Temperature (°C)	Pressure (kPa)	STD (cc/min)	UUC (cc/min)	Error (cc/min)	Uncertainty (cc/min)	MPE (cc/min)	Result
22.50	100.90	20	19.854	-0.1	1.3	0.2	Pass1
22.50	100.90	50	49.732	-0.3	3.3	0.5	Pass1
22.60	100.90	101	100.77	-0.2	2.8	1.0	Pass1
22.70	100.90	151	150.23	-0.8	4.2	1.5	Pass1
22.70	100.90	201	200.39	-0.6	5.6	2.0	Pass1
22.70	100.90	301	300.69	-0.3	8.4	3.0	Pass1
22.80	100.90	400	402.96	3.0	11	4.0	Pass1
23.10	100.90	500	504.62	4.6	7.2	5.0	Pass1

**Note** STD : Standard UUC : Unit Under Calibration

- UUC Reference Condition : At atmospheric pressure and room temperature condition
- Flow Rate was corrected for non-standard operating condition by using equation :

$$Q_{\text{meas}} = Q_{\text{ref}} \times \frac{P_{\text{ref}}}{P_{\text{meas}}} \times \frac{T_{\text{meas}}}{T_{\text{ref}}}$$

where Q = Flow Rate P = Absolute Pressure T = Absolute Temperature  
 Meas = Measurement Condition ref = Standard Condition

\* Indicates non accredited

MPE = Maximum Permissible Error (Specified in Manufacturer's Specifications)

N/A = Not Available, Customer does not require a statement of conformity.

**Certificate No : 25-AFM-023**

**Request No : Req-2025-0169**

### Decision Rule for Statements of Conformity

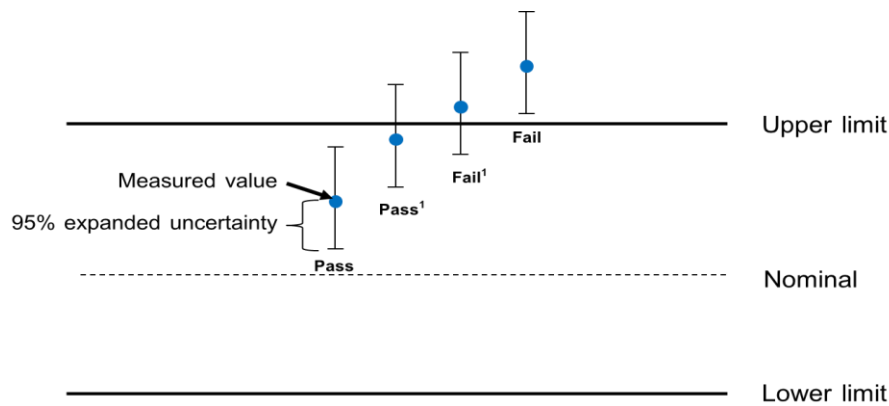
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09/2019; Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

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

Pass<sup>1</sup> = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail<sup>1</sup> = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

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



**End of Certificate**

## Certificate of Calibration

### Customer

Name : ALS Laboratory Group Thailand Co., Ltd.  
Address : 104 Soi Phatthanakan 40, Phatthanakan Road, Suan Luang,  
Bangkok 10250

Certificate No : 24-AFM-179

Request No : Req-2024-1987

### Unit Under Calibration Details

Measurement Item : Air Flow Meter  
Manufacturer : MesaLabs Accuracy : 1% of Reading  
Model : Defender 510-M Sensor Model : -  
Serial Number : 151114 Sensor Serial Number : -  
ID : BKK\_FS0614 Instrument Status : Used  
Location of Calibration : LAB 4 AIR VELOCITY METER

### Calibration Environment and Details

Temperature : 23 °C ± 3 °C  
Humidity : 55 %RH ± 20 %RH  
Barometric Pressure : 1013 hPa ± 10 hPa  
Received Date : 30 August 2024  
Calibration Date : 9 September 2024  
Calibration Procedure : In-house method CP-AFM-01 by Comparison technique with Standard Primary Flow Calibrator




Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 Low flow	18501010006	Sensidyne	6 August 2025
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensidyne	2 August 2025
Temperature meter	GT 11	08000057	Qreborn	1 March 2025
Pressure meter	CPG2400	41000KDU/651882	TPA	9 November 2024


### Traceability :

This Certificate is traceable to SI Unit through Sensidyne A2LA Accreditation No. 3943.01

### Note :

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

Calibration By :   
Mr. Noppadon Luangart  
Service Calibration Engineer

Approved By :   
Mr. Pacit Mathavorn  
Calibration Engineer Supervisor

Issue Date : 9 September 2024

Certificate No : 24-AFM-179

Request No : Req-2024-1987

**Result of Calibration : Without Adjustment**

Temperature (°C)	Pressure (kPa)	STD (cc/min)	UUC (cc/min)	Error (cc/min)	Uncertainty (cc/min)	MPE (cc/min)	Result
24.70	100.95	100	100.41	0.4	2.8	1.0	N/A
24.90	100.90	502	500.47	-1.5	7.1	5.0	N/A
24.90	100.97	1003	1001.3	-2	14	10.0	N/A
25.00	100.92	2014	2009.9	-4	29	20.1	N/A
25.20	101.03	3043	3058.3	15	44	30.4	N/A
25.30	101.10	4043	4005.1	-38	57	40.4	N/A
25.50	101.15	5052	5003.9	-48	74	50.5	N/A

**Note**

STD : Standard UUC : Unit Under Calibration

- UUC Reference Condition : At atmospheric pressure and room temperature condition

- Flow Rate was corrected for non-standard operating condition by using equation :

$$Q_{meas} = Q_{ref} \times \frac{P_{ref}}{P_{meas}} \times \frac{T_{meas}}{T_{ref}}$$

where Q = Flow Rate P = Absolute Pressure T = Absolute Temperature

Meas = Measurement Condition ref = Standard Condition

\* Indicates non accredited

MPE = Maximum Permissible Error (Specified in Manufacturer's Specifications)

N/A = Not Available, Customer does not require a statement of conformity.



Certificate No : 24-AFM-179

Request No : Req-2024-1987

### Decision Rule for Statements of Conformity

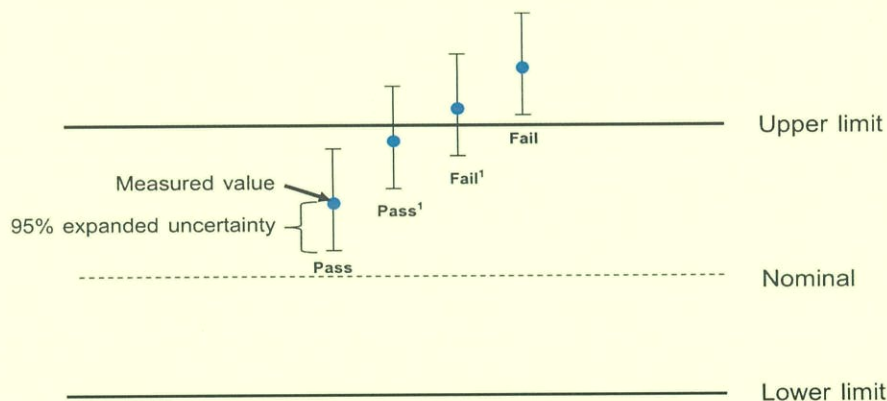
The standard decision rule employed for the statements of conformity to each calibration result will be applied using ILAC-G8:09/2019; Guidelines on the Reporting of Compliance with Specification as following Fig. and statements

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

Pass<sup>1</sup> = The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement at 95% exceeds the limit.

Fail<sup>1</sup> = The measurement result was out of the limit. However, a portion of the expanded uncertainty of measurement at 95% is within the limit.

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



End of Certificate



**Air Sampling Pump Calibration Report****Air Sampling Pump Detail**

Calibration Date	: 6 Jan 2025	Next cal.	: 6 Apr 2025
Air Sampling Pump ID	: RYG_FS0126	Barometric (mmHg)	: 755.9
Serial No.	: 20150410002	Temperature ( °C )	: 25.9

**Reference Standard Low Flow Meter**

Brand	: MesaLabs	ID	: RYG_FS0208
Model	: Defender 510-L	Serial No.	: 130027
Due Date	: 13-Aug-25		

**Reference Standard High Flow Meter**

Brand	: MesaLabs	ID	: BKK_FS0614
Model	: Defender 510-M	Serial No.	: 151114
Due Date	: 21-May-25		

**Calibration Data**

Air Sampling Pump setting (cc/min)	Reference Standard Flow Reading (cc/min)			Avg. (cc/min)	Acceptable (cc/min)		Evaluation Pass/ Fail
	1	2	3				
20	19.7	19.8	19.4	19.6	21.0	19.0	Passed
50	51.4	51.3	51.2	51.3	52.5	47.5	Passed
100	100.5	99.7	100.9	100.4	105.0	95.0	Passed
200	200.3	199.0	204.0	201.1	210.0	190.0	Passed
500	497.7	499.3	503.3	500.1	515.0	485.0	Passed
1000	1005.2	1008.0	1008.4	1007.2	1030.0	970.0	Passed
2000	2005.0	2005.5	2007.0	2005.8	2060.0	1940.0	Passed
2500	2533.9	2518.5	2530.5	2527.6	2575.0	2425.0	Passed
4000	4020.3	4025.2	4022.6	4022.7	4120.0	3880.0	Passed

Note : Reference Specifications  $\pm 5\%$  of set flow or  $\pm 3\%$  cc/min whichever is Higher

Calibrated by :

( Mr. Amnat Wongsakhen )  
Enviro Field Services Scientist (1)

Approved By :

( Mr. Wichan Choonharat )  
Enviro Field Services Manager

**Air Sampling Pump Calibration Report****Air Sampling Pump Detail**

Calibration Date	: 7 Jan 2025	Next cal.	: 7 Apr 2025
Air Sampling Pump ID	: RYG_FS0130	Barometric (mmHg)	: 751
Serial No.	: 20150410006	Temperature ( °C )	: 25.0

**Reference Standard Low Flow Meter**

Brand	: MesaLabs	ID	: RYG_FS0208
Model	: Defender 510-L	Serial No.	: 130027
Due Date	: 13-Aug-25		

**Reference Standard High Flow Meter**

Brand	: MesaLabs	ID	: BKK_FS0614
Model	: Defender 510-M	Serial No.	: 151114
Due Date	: 21-May-25		

**Calibration Data**

Air Sampling Pump setting (cc/min)	Reference Standard Flow Reading (cc/min)			Avg. (cc/min)	Acceptable (cc/min)		Evaluation Pass/ Fail
	1	2	3				
20	20.6	20.3	20.3	20.4	21.0	19.0	Passed
50	49.8	49.6	50.7	50.0	52.5	47.5	Passed
100	100.9	100.8	100.9	100.9	105.0	95.0	Passed
200	200.6	200.4	200.6	200.5	210.0	190.0	Passed
500	505.3	505.9	502.6	504.6	515.0	485.0	Passed
1000	1007.3	995.7	1009.6	1004.2	1030.0	970.0	Passed
2000	2002.1	1998.2	1997.4	1999.2	2060.0	1940.0	Passed
2500	2505.3	2514.5	2510.4	2510.1	2575.0	2425.0	Passed
4000	4025.6	4028.6	4030.3	4028.2	4120.0	3880.0	Passed

Note : Reference Specifications  $\pm 5\%$  of set flow or  $\pm 3\%$  cc/min whichever is Higher

Calibrated by : Nattakarn V.  
( Mr. Nattakarn Vonginyoo )  
Enviro Field Services Scientist (1)

Approved By : Wichan Choonharat  
( Mr. Wichan Choonharat )  
Enviro Field Services Manager



## Air Sampling Pump Calibration Report

### Air Sampling Pump Detail

Calibration Date	: 7 Jan 2025	Next cal.	: 7 Apr 2025
Air Sampling Pump ID	: RYG_FS0135	Barometric (mmHg)	: 751
Serial No.	: 20150410011	Temperature ( °C )	: 25.0

### Reference Standard Low Flow Meter

Brand	: MesaLabs	ID	: RYG_FS0208
Model	: Defender 510-L	Serial No.	: 130027
Due Date	: 13-Aug-25		

### Reference Standard High Flow Meter

Brand	: MesaLabs	ID	: BKK_FS0614
Model	: Defender 510-M	Serial No.	: 151114
Due Date	: 21-May-25		

### Calibration Data

Air Sampling Pump setting (cc/min)	Reference Standard Flow Reading (cc/min)			Avg. (cc/min)	Acceptable (cc/min)		Evaluation Pass/ Fail
	1	2	3				
20	20.2	20.6	20.0	20.3	21	19	Passed
50	50.6	50.0	50.6	50.4	52.5	47.5	Passed
100	99.4	100.3	100.7	100.1	105	95	Passed
200	200.2	199.4	199.4	199.7	210	190	Passed
500	486.9	491.2	493.5	490.5	515	485	Passed
1000	1005.6	1003.7	1005.7	1005.0	1010	990	Passed
2000	2012.1	2008.9	2004.9	2008.6	2020	1980	Passed
2500	2522.1	2519.2	2528.4	2523.2	2550	2450	Passed

Note : Reference Specifications  $\pm 5\%$  of set flow or  $\pm 3\%$  cc/min whichever is Higher

Calibrated by :

( Mr. Chanon Booncheun )  
Enviro Field Services Scientist (1)

Approved By :

( Mr. Wichan Choonharat )  
Enviro Field Services Manager



## Air Sampling Pump Calibration Report

### Air Sampling Pump Detail

Calibration Date	: 7 Jan 2025	Next cal.	: 7 Apr 2025
Air Sampling Pump ID	: RYG_FS0136	Barometric (mmHg)	: 751
Serial No.	: 20150410012	Temperature ( °C )	: 25.0

### Reference Standard Low Flow Meter

Brand	: MesaLabs	ID	: RYG_FS0208
Model	: Defender 510-L	Serial No.	: 130027
Due Date	: 13-Aug-25		

### Reference Standard High Flow Meter

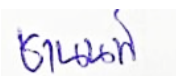
Brand	: MesaLabs	ID	: BKK_FS0614
Model	: Defender 510-M	Serial No.	: 151114
Due Date	: 21-May-25		

### Calibration Data


Air Sampling Pump setting (cc/min)	Reference Standard Flow Reading (cc/min)			Avg. (cc/min)	Acceptable (cc/min)		Evaluation Pass/ Fail
	1	2	3				
20	20.8	20.6	20.9	20.8	21	19	Passed
50	49.7	50.3	50.1	50.0	52.5	47.5	Passed
100	100.5	100.9	101.5	101.0	105	95	Passed
200	200.6	200.3	200.4	200.4	210	190	Passed
500	509.2	512.6	508.2	510.0	515	485	Passed
1000	999.4	1007.1	1002.8	1003.1	1010	990	Passed
2000	2001.1	1992.2	2002.1	1998.5	2020	1980	Passed
2500	2525.5	2514.9	2501.7	2514.0	2550	2450	Passed

Note : Reference Specifications  $\pm 5\%$  of set flow or  $\pm 3\%$  cc/min whichever is Higher

Calibrated by :

  
( Mr. Chanon Booncheun )  
Enviro Field Services Scientist (1)

Approved By :

  
( Mr. Wichan Choonharat )  
Enviro Field Services Manager



# Certificate of Calibration

Certificate No. C-070425-RYG\_FS0101

## Air Sampling Pump Detail

Equipment name : Personal Air Sampling Pump  
Brand : Gilian  
Model/Type : GilAir Plus

Equipment ID : RYG\_FS0101  
Serial No. : 20220731502  
Calibration Date : 07-Apr-25  
Next calibration date : 07-Jul-25

## Reference Standard Low Flow Meter

Equipment name : Air Flow Meter  
Brand : MesaLabs  
Model/Type : Defender 510-L

Equipment ID : RYG\_FS0208  
Serial No. : 130027  
Calibration Date : 27-Jan-25  
Due Date : 26-Jan-26

## Reference Standard High Flow Meter

Equipment name : Air Flow Meter  
Brand : MesaLabs  
Model/Type : Defender 510-M

Equipment ID : BKK\_FS0614  
Serial No. : 151114  
Calibration Date : 9-Sep-24  
Due Date : 9-Sep-25

## Calibration Data

Air Sampling Pump setting (cc/min)	Reference Std. Flow Reading (cc/min)			Avg. (cc/min)	%Error acceptance	Acceptable range (cc/min)	Evaluation (Pass/ Fail)
	1	2	3				
Low Flow							
20	20.3	20.6	20.4	20.4	5%	19   -   21	Passed
50	50.2	50.4	49.9	50.2	5%	48   -   53	Passed
100	99.9	99.7	100.1	99.9	5%	95   -   105	Passed
200	200.6	199.7	200.9	200.4	5%	190   -   210	Passed
High Flow							
500	495.1	492.8	489.6	492.5	3%	485   -   515	Passed
1000	1016.6	1018.3	1012.0	1015.6	3%	970   -   1030	Passed
2000	1984.5	1984.9	1988.7	1986.0	3%	1940   -   2060	Passed
2500	2496.8	2489.6	2502.6	2496.3	3%	2425   -   2575	Passed

----- END OF REPORT -----

Calibrated By: 

( Mr. Watcharin Pongsamsuan )

RYG Field Services Scientist (1)

Issue date : 07-Apr-25

Approved By: 

( Mr. Supot Salamteh )

RYG Field Services Section Head





# Certificate of Calibration

Certificate No. C-060425-RYG\_FS0108

## Air Sampling Pump Detail

Equipment name : Personal Air Sampling Pump  
Brand : Gilian  
Model/Type : GilAir Plus

Equipment ID : RYG\_FS0108  
Serial No. : 20150310157  
Calibration Date : 06-Apr-25  
Next calibration date : 06-Jul-25

## Reference Standard Low Flow Meter

Equipment name : Air Flow Meter  
Brand : MesaLabs  
Model/Type : Defender 510-L

Equipment ID : RYG\_FS0208  
Serial No. : 130027  
Calibration Date : 27-Jan-25  
Due Date : 26-Jan-26

## Reference Standard High Flow Meter

Equipment name : Air Flow Meter  
Brand : MesaLabs  
Model/Type : Defender 510-M

Equipment ID : BKK\_FS0614  
Serial No. : 151114  
Calibration Date : 9-Sep-24  
Due Date : 9-Sep-25

## Calibration Data

Air Sampling Pump setting (cc/min)	Reference Std. Flow Reading (cc/min)			Avg. (cc/min)	%Error acceptance	Acceptable range (cc/min)	Evaluation (Pass/ Fail)
	1	2	3				
Low Flow							
20	20.5	19.7	20.4	20.2	5%	19   -   21	Passed
50	50.1	49.7	51.2	50.3	5%	48   -   53	Passed
100	101.1	100.3	101.5	101.0	5%	95   -   105	Passed
200	201.8	204.4	202.3	202.8	5%	190   -   210	Passed
High Flow							
500	503.8	507.4	510.4	507.2	3%	485   -   515	Passed
1000	994.7	991.4	996.2	994.1	3%	970   -   1030	Passed
2000	2000.7	2019.4	2006.3	2008.8	3%	1940   -   2060	Passed
2500	2516.4	2518.4	2517.5	2517.4	3%	2425   -   2575	Passed

----- END OF REPORT -----

Calibrated By: นันทพล

( Mr.Natchapon Thamklang )

RYG Field Services Scientist (1)

Issue date : 06-Apr-25

Approved By: สุพจน์

( Mr.Suport Salamteh )

RYG Field Services Section Head



# Certificate of Calibration

Certificate No. C-070425-RYG\_FS0111

## Air Sampling Pump Detail

Equipment name : Personal Air Sampling Pump  
Brand : Gilian  
Model/Type : GilAir Plus

Equipment ID : RYG\_FS0111  
Serial No. : 20150310160  
Calibration Date : 07-Apr-25  
Next calibration date : 07-Jul-25

## Reference Standard Low Flow Meter

Equipment name : Air Flow Meter  
Brand : MesaLabs  
Model/Type : Defender 510-L

Equipment ID : RYG\_FS0208  
Serial No. : 130027  
Calibration Date : 27-Jan-25  
Due Date : 26-Jan-26

## Reference Standard High Flow Meter

Equipment name : Air Flow Meter  
Brand : MesaLabs  
Model/Type : Defender 510-M

Equipment ID : BKK\_FS0614  
Serial No. : 151114  
Calibration Date : 9-Sep-24  
Due Date : 9-Sep-25

## Calibration Data

Air Sampling Pump setting (cc/min)	Reference Std. Flow Reading (cc/min)			Avg. (cc/min)	%Error acceptance	Acceptable range (cc/min)	Evaluation (Pass/ Fail)
	1	2	3				
Low Flow							
20	20.4	20.6	20.3	20.4	5%	19   -   21	Passed
50	49.6	51.1	51.7	50.8	5%	48   -   53	Passed
100	101.9	101.7	101.5	101.7	5%	95   -   105	Passed
200	199.6	200.5	200.4	200.2	5%	190   -   210	Passed
High Flow							
500	507.8	509.8	505.6	507.7	3%	485   -   515	Passed
1000	996.8	992.5	998.6	996.0	3%	970   -   1030	Passed
2000	1996.4	1999.4	1993.4	1996.4	3%	1940   -   2060	Passed
2500	2509.2	2497.3	2495.2	2500.6	3%	2425   -   2575	Passed

----- END OF REPORT -----

Calibrated By: 

( Mr. Watcharin Pongsamsuan )

RYG Field Services Scientist (1)

Issue date : 07-Apr-25

Approved By: 

( Mr. Supot Salamteh )

RYG Field Services Section Head



# Certificate of Calibration

Certificate No. C-060425-RYG\_FS0114

## Air Sampling Pump Detail

Equipment name : Personal Air Sampling Pump  
Brand : Gilian  
Model/Type : GilAir PlusEquipment ID : RYG\_FS0114  
Serial No. : 20150310163  
Calibration Date : 06-Apr-25  
Next calibration date : 06-Jul-25

## Reference Standard Low Flow Meter

Equipment name : Air Flow Meter  
Brand : MesaLabs  
Model/Type : Defender 510-LEquipment ID : RYG\_FS0208  
Serial No. : 130027  
Calibration Date : 27-Jan-25  
Due Date : 26-Jan-26

## Reference Standard High Flow Meter

Equipment name : Air Flow Meter  
Brand : MesaLabs  
Model/Type : Defender 510-MEquipment ID : BKK\_FS0614  
Serial No. : 151114  
Calibration Date : 9-Sep-24  
Due Date : 9-Sep-25

## Calibration Data

Air Sampling Pump setting (cc/min)	Reference Std. Flow Reading (cc/min)			Avg. (cc/min)	%Error acceptance	Acceptable range (cc/min)	Evaluation (Pass/ Fail)
	1	2	3				
Low Flow							
20	20.2	20.4	20.6	20.4	5%	19   -   21	Passed
50	51.1	50.6	50.9	50.9	5%	48   -   53	Passed
100	101.6	102.1	102.7	102.1	5%	95   -   105	Passed
200	202.6	201.8	202.4	202.3	5%	190   -   210	Passed
High Flow							
500	506.2	500.2	502.3	502.9	3%	485   -   515	Passed
1000	995.9	997.7	996.9	996.8	3%	970   -   1030	Passed
2000	1994.0	1998.1	1999.4	1997.2	3%	1940   -   2060	Passed
2500	2509.9	2502.4	2505.4	2505.9	3%	2425   -   2575	Passed

----- END OF REPORT -----

Calibrated By: นันทพล

( Mr.Natchapon Thamklang )

RYG Field Services Scientist (1)

Issue date : 06-Apr-25

Approved By: Supot S

( Mr.Supot Salamteh )

RYG Field Services Section Head



# บริษัท เอกเสคคิวทิฟ เทรดดิ้ง จำกัด (สำนักงานใหญ่)

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

ที่ RA 244/24

## ใบรายงานผลการปรับเทียบ

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

### รายละเอียดเครื่องมือที่ทำการปรับเทียบ :

เครื่องมือ : เครื่องตรวจวัดไอระเหยจากสารเคมี  
ผลิตภัณฑ์ : RAE Systems  
รุ่น : MiniRAE3000  
หมายเลขเครื่อง : 592-906502  
ID : BKK\_FS0820

### สภาวะแวดล้อม :

อุณหภูมิ :  $(25 \pm 3) ^\circ\text{C}$   
ความชื้นสัมพัทธ์ :  $(35 \pm 15) \%$   
ความดันบรรยากาศ : 760 มิลลิเมตรปรอท

วันที่ปรับเทียบมาตรฐาน : 9 กันยายน 2567

วิธีการปรับเทียบมาตรฐาน : ปรับเทียบโดยใช้ Standard Reference Gas  
- Isobutylene Standard Gas 100 ppm; Cylinder No: WO349099-1.

REVIEW BY	
APPROVED BY	
NEXT CAL. DATE	9/3/26

### 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)	87.2 ppm	100.0 ppm	0.0 ppm	Pass

Flow Rate of Pump : 478 cc/min.

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

ผู้ปรับเทียบ :   
(นายสุรินทร์ สายเนตร)  
Service Engineer

ผู้ตรวจสอบ :   
(นายสุทธิวงศ์ คงทองสังข์)  
Service Engineer Manager

ผลการสอบเทียบ/ปรับเทียบ นี้ รับรองเฉพาะตัวอย่างและรายการที่ได้รับไปเท่านั้น

การนำรายงานผล/ใบรับรองนี้ไปโฆษณาและการคัดลอกหรือการนำผลบางส่วนไปเผยแพร่ต่อสาธารณะต้องได้รับอนุญาตเป็นลายลักษณ์อักษรจากทางบริษัทฯ





# บริษัท เอกเสคคิวทิฟ เทรตติ้ง จำกัด (สำนักงานใหญ่)

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

No. RA 244/24

## Certificate of Calibration

**Customer** : ALS Laboratory Group (Thailand) Co.,Ltd.  
**Address** : 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang Bangkok 10250 TH.  
**Calibration location** : Executive Trading Limited.  
**Address** : 48/194-5 Soi Praditmanutham 19, Pradit Manutham Road, Latphrao, Bangkok 10230  
**Tools :**  
Instrument : Gas Detector  
Product : RAE Systems  
Model Name : MiniRAE3000  
Serial Number : 592-906502  
ID : BKK\_FS0820  
**Environmental Condition:**  
Temperature :  $(25 \pm 3) ^\circ\text{C}$   
Relative Humidity :  $(35 \pm 15) \%$   
Pressure : 760 mmHg  
**Date of Calibration** : September 9, 2024  
**Calibration Method** : This instrument has been calibrated using calibration gases. Test and calibration data is On file with Executive trading limited.  
**Reference Standard** : Isobutylene Standard Gas 100 ppm; Cylinder No:WO349099-1.

### 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)	87.2 ppm	100.0 ppm	0.0 ppm	Pass

**Flow Rate of Pump** : 478 cc/min.

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

Calibrated By : 

(Mr. Surinthorn Sainate)

Service Engineer

Approved By : 

(Mr. Suttiwong Kongtongsang.)

Service Engineer Manager

The results relate only to the items tested or calibrated.

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





**Calgaz Ltd**  
Unit 21/22, Rosevale Road  
Parkhouse Industrial Estate West  
Newcastle-under-Lyme  
Staffordshire  
ST5 7EF  
United Kingdom  
info@calgaz.com  
Phone: +44 1782 566 897

## Certificate Of Composition WO349099 - 1

Part Code: C003448  
6DISOBUTYA-0100

Customer: Calgaz International LLc  
Customer Order Number: PO21688/SO30280HON004SG

Cylinder No: WO349099-1  
Cylinder Valve: C10  
Gross Weight: 1.5  
Nett Weight: 0.14

**Component**

Iso-Butylene  
Air

**Requested Values**

100 ppm  
Balance

**Certified Values**

100 ppm  
Balance

Pressure: 1000 psi

Volume: 1.5 ltr

Size: 6D

Please note all units are in mol % and mixture accuracy +/- 2%  
Relative Mixtures traceable to standards calibrated at the National  
Physical Laboratory, Teddington, Middlesex, England The UK  
National Physical Laboratory (NPL) Standards are internationally  
recognised and directly equivalent to the USA N.I.S.T Standards.

**Manufactured Date: 25/04/2022**

**Valid Until: 25/04/2027**

UN 1956 Compressed gas, n.o.s.

(Oxygen, Nitrogen Mixture)

Certified By: Rhys Baldwin

**DO NOT INHALE**

# **CERTIFICATE of Attendance**

It is hereby certified that

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

has successfully completed the

**RAE Service Training Course**

Conducted by

**HONEYWELL**

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



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

**Air Sampling Pump Calibration Report****Air Sampling Pump Detail**

Calibration Date	: 6 Jan 2025	Next cal.	: 6 Apr 2025
Air Sampling Pump ID	: RYG_FS0139	Barometric (mmHg)	: 755.9
Serial No.	: 20150510087	Temperature ( °C )	: 25.9

**Reference Standard Low Flow Meter**

Brand	: MesaLabs	ID	: RYG_FS0208
Model	: Defender 510-L	Serial No.	: 130027
Due Date	: 13-Aug-25		

**Reference Standard High Flow Meter**

Brand	: MesaLabs	ID	: BKK_FS0614
Model	: Defender 510-M	Serial No.	: 151114
Due Date	: 21-May-25		

**Calibration Data**

Air Sampling Pump setting (cc/min)	Reference Standard Flow Reading (cc/min)			Avg. (cc/min)	Acceptable (cc/min)		Evaluation Pass/ Fail
	1	2	3				
20	20.2	19.8	19.0	19.7	21	19	Passed
50	49.6	49.9	49.6	49.7	52.5	47.5	Passed
100	99.5	99.5	99.6	99.5	105	95	Passed
200	201.5	203.5	202.4	202.5	210	190	Passed
500	498.6	502.9	500.2	500.6	515	485	Passed
1000	1001.8	993.3	1006.9	1000.7	1010	990	Passed
2000	2011.7	2012.9	2009.6	2011.4	2020	1980	Passed
2500	2545.4	2528.4	2528.3	2534.0	2550	2450	Passed

Note : Reference Specifications  $\pm 5\%$  of set flow or  $\pm 3\%$  cc/min whichever is Higher

Calibrated by :

( Mr. Nantawat Sarin )  
Enviro Field Services Scientist (1)

Approved By :

( Mr. Wichan Choonharat )  
Enviro Field Services Manager



# Certificate of Calibration

Certificate No. C-060425-RYG\_FS0124

## Air Sampling Pump Detail

Equipment name : Personal Air Sampling Pump  
Brand : Gilian  
Model/Type : GilAir Plus

Equipment ID : RYG\_FS0124  
Serial No. : 20150310180  
Calibration Date : 06-Apr-25  
Next calibration date : 06-Jul-25

## Reference Standard Low Flow Meter

Equipment name : Air Flow Meter  
Brand : MesaLabs  
Model/Type : Defender 510-L

Equipment ID : RYG\_FS0208  
Serial No. : 130027  
Calibration Date : 27-Jan-25  
Due Date : 26-Jan-26

## Reference Standard High Flow Meter

Equipment name : Air Flow Meter  
Brand : MesaLabs  
Model/Type : Defender 510-M

Equipment ID : BKK\_FS0614  
Serial No. : 151114  
Calibration Date : 9-Sep-24  
Due Date : 9-Sep-25

## Calibration Data

Air Sampling Pump setting (cc/min)	Reference Std. Flow Reading (cc/min)			Avg. (cc/min)	%Error acceptance	Acceptable range (cc/min)	Evaluation (Pass/ Fail)
	1	2	3				
Low Flow							
20	20.1	20.6	20.4	20.4	5%	19   -   21	Passed
50	48.2	48.3	48.5	48.3	5%	48   -   53	Passed
100	102.1	102.0	101.8	102.0	5%	95   -   105	Passed
200	201.2	200.5	200.8	200.8	5%	190   -   210	Passed
High Flow							
500	500.4	500.3	500.0	500.2	3%	485   -   515	Passed
1000	997.7	995.3	997.2	996.7	3%	970   -   1030	Passed
2000	2001.9	2000.7	1999.7	2000.8	3%	1940   -   2060	Passed
2500	2498.6	2499.3	2499.9	2499.3	3%	2425   -   2575	Passed
4000	3995.7	3999.7	4000.6	3998.7	3%	3880   -   4120	Passed

-----  
END OF REPORT  
-----Calibrated By: นันทพล

( Mr.Natchapon Thamklang )

RYG Field Services Scientist (1)

Issue date : 06-Apr-25

Approved By: Supot S

( Mr.Supot Salamteh )

RYG Field Services Section Head

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

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310

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



NSC-TISI-TIS 17025

CALIBRATION 0426

**SARTORIUS**

# Certificate

## of Calibration

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

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

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

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

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

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

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

**Metrological data :**

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

**Ambients Conditions:**

Temperature : 24.0 °C ± 5.0 °C

Humidity : 60.0 % RH ± 10.0 % RH

Pressure :                      ±                     

**Reasons for calibration**

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

Equipment Condition: ☒ Good Operate ☐ Fair

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

The measurement uncertainty stated is the expended uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came form list of Sartorius Metrological Specifications.

**Traceability:**

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

This certificate relate and apply this equipment only.

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

Mr.chonchai Intrhana(Technical Manager)

S  
T  
A  
M  
P





# Certificate of Calibration

Model Number : MSE125P-100-DU

Certificate No. : 24BCI0071

Description : Semi-micro Balance

Issued Date : Friday, February 23, 2024

Serial Number : 0033108993

Reference No. : 229196

ID No. : RYG\_EN0004

Manufacturer : Sartorius

Page No. : 2 of 3

## Calibration Results : Without Adjustment

### Repeatability

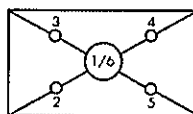
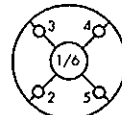
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

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

### Eccentricity (Off-center loading error)

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

Nominal value : 50 g  
Tolerance 0.00015 g



#### Difference

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

### Linearity

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

Tolerance 0.00004 g

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

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

### Calibration Results : Without Adjustment

#### Repeatability

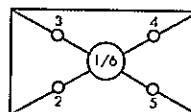
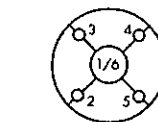
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

Nominal Value : (Low Load)		100.0000
g		100.0000
Tolerance		100.0000
0.000015 g		100.0000
		100.0000
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 (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
65	65.0000	65.0000	0.0000	0.00015
70	70.0000	70.0000	0.0000	0.00015
75	75.0001	75.0000	-0.0001	0.00015
80	80.0001	80.0000	-0.0001	0.00016
85	85.0001	85.0001	0.0000	0.00018
90	90.0001	90.0001	0.0000	0.00017
95	95.0001	95.0001	0.0000	0.00019
100	100.0000	100.0000	0.0000	0.00024
110	110.0000	110.0000	0.0000	0.00026
120	120.0000	120.0000	0.0000	0.00026

End of Report.

Accredited by

NSC-TISI-TIS 17025

Calibration 0426



NSC-TISI-TIS 17025

CALIBRATION 0426

## Calibration certificate

Calibration Certificate No. 25BKL0006

Object	Electronic non-automatic weighing instrument	This calibration certificate documents the traceability to national standards.
Manufacturer	Sartorius	Uncertainties of measurements are taken into account when only statements of compliance are made.
Type	MSE125P-100-DU	This certificate was prepared by Sartorius Corporation in accordance to the current ISO/IEC 17025:2017 standard and Sartorius Work Instruction (Method) SOP WI 08.
Serial   QM Ident. no.	33108993   RYG_EN0004	This certificate relate and apply this equipment only.
Customer	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)	
	616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.	
Order no.	2230	
Number of pages	4	
Date of calibration	20 Feb 2025	

REVIEW BY .....

Thanitak.

APPROVED BY .....

D. Khunon.

NEXT CAL DATE.....

20/02/26

This calibration certificate may not be reproduced other than in full except with the permission of NSC-TISI-TIS-17025 and the issuing laboratory. Calibration certificates without signature are not valid.

The user is obliged to have the object recalibrated at appropriate intervals.

Date 06 Mar 2025 Approval of the Calibration Certificate



Mr. Chonchai Inthana

Person in charge

Kachen Lalee

Calibration object

Multi interval instrument

Model	MSE125P-100-DU	
Serial Number	33108993	
QM Ident. no   Inventory no.	RYG_EN0004   ---	
Range	1	2
Maximum capacity (Max. load)	60.00000 g	120.0000 g
Measured range	60.00000 g	120.0000 g
Scale interval	0.00001 g	0.0001 g

Place of calibration

Address	According to page 1
Department   Cost center	Laboratory Department.   ---
Building   Floor	---   1st Floor.
Room	Balance Room.
Maximum temperature variation at place of calibration	5 K

Calibration procedure

EURAMET cg-18, V4.0 - Guidelines on the Calibration of Non-Automatic Weighing Instruments

Test equipment

Test equipment type	Test equipment ID	Valid until
Thermometer	MHB-382SD s/nB011342 Traceable to SI unit through DKSH	21 Aug 2025
Test weight set OIML R111 E2	Certificate No.M2308197S ,E2(Traceable to SI unit through TCS)	23 Aug 2025

Adjustment Status

The measuring device was internally adjusted before the calibration.

Environmental and measuring conditions

Date of calibration	20 Feb 2025
Temperature at place of calibration   Temp. diff. <i>T</i> <sub>weights</sub> - <i>T</i> <sub>place</sub>	24.2 °C   0.3 K
Measuring conditions	The installation site is suitable. The device was levelled. Balance was loaded up to Max before test.
Comments	Humidity 62.5 %RH.

Measurement results | Measurement uncertainties

Repeatability			Eccentricity	
Test load (nominal): 50 g   100 g			Test load (nominal): 50 g	
	50 g	100 g		
1	50.00002 g	100.0000 g	Center	50.00002 g
2	50.00001 g	100.0000 g	Front left	50.00000 g
3	50.00003 g	100.0000 g	Back left	50.00000 g
4	50.00002 g	100.0000 g	Back right	50.00001 g
5	50.00001 g	100.0000 g	Front right	50.00003 g
6	50.00002 g	99.9999 g	Maximum deviation from centric loading indication	
7	50.00002 g	100.0000 g	Δ <sub>ecc</sub>   max = 0.00002 g	
8	50.00001 g	100.0000 g		
9	50.00001 g	100.0000 g		
10	50.00002 g	100.0000 g		
	<i>s</i> = 0.000007 g	<i>s</i> = 0.00003 g		

Error of indication

Testload	Indication	Error	Expansion factor	Uncertainty	Uncertainty relative
<i>L</i>	<i>I</i>	<i>E</i>	<i>k</i>	<i>U</i> ( <i>E</i> )	<i>U</i> <sub>rel</sub> ( <i>E</i> )
0.01000 g	0.01000 g	0.00000 g	2.00	0.000024 g	0.24 %
0.10000 g	0.10000 g	0.00000 g	2.00	0.000037 g	0.037 %
1.00000 g	1.00000 g	0.00000 g	2.00	0.000037 g	0.0037 %
5.00002 g	5.00002 g	0.00000 g	2.00	0.000050 g	0.0010 %
20.00002 g	20.00002 g	0.00000 g	2.00	0.000069 g	0.00034 %
55.00004 g	55.00003 g	-0.00001 g	2.00	0.00017 g	0.00031 %
70.0000 g	70.0000 g	0.0000 g	2.00	0.00017 g	0.00024 %
80.0001 g	80.0001 g	0.0000 g	2.00	0.00018 g	0.00023 %
100.0000 g	100.0000 g	0.0000 g	2.00	0.00017 g	0.00017 %
110.0000 g	110.0000 g	0.0000 g	2.00	0.00028 g	0.00025 %
120.0000 g	119.9999 g	-0.0001 g	2.00	0.00028 g	0.00023 %
Maximum error of indication		<i>E</i>   <sub>max</sub> = 0.00010 g			

*U*<sub>rel</sub>(*E*) is the quotient of *U*(*E*) and test load *L*. The uncertainty of measurement *U*(*E*) is valid only if error *E* is considered. You will find reference notes on the uncertainty of measurement in use under: Appendix to the calibration certificate | Interpretation of measurement results.  
Reference note: The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the documented Expansion factor, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

End of calibration certificate



# Uncertainty of measurement in use

Device adjusted before measurement

Yes

Temperature deviation considered

1.5 K (isoCAL active)

Temperature coefficient considered

$1 \cdot 10^{-6}/\text{K}$

Uncertainty of the weighing result  $U_{gl}(W)$

Partial weighing range 1 | 0.00000 g...60.00000 g

$U_{gl}(W) = 0.000016 \text{ g} + 6.61 \cdot 10^{-6} \cdot R$

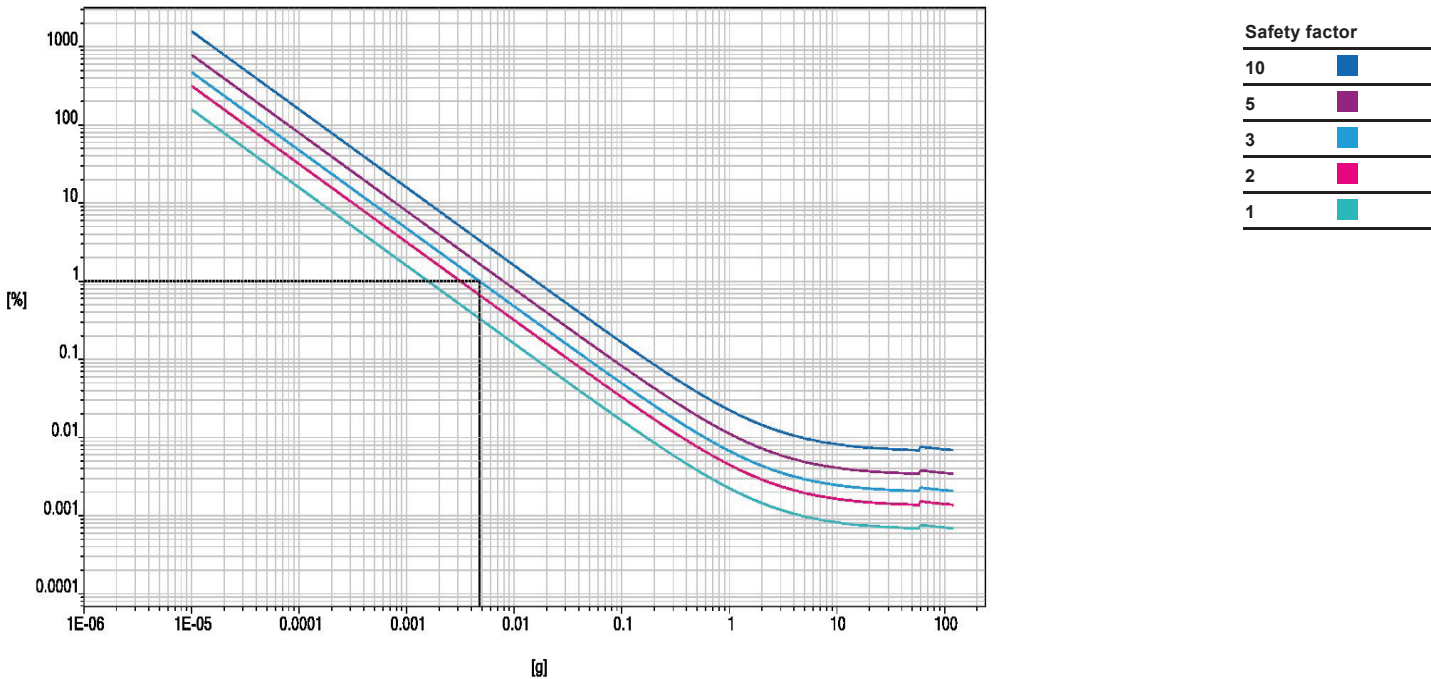
Partial weighing range 2 | 60.00000 g...120.0000 g

$U_{gl}(W) = 0.000086 \text{ g} + 6.19 \cdot 10^{-6} \cdot R$

Reference note: The current uncertainty of measurement is calculated by entering of the reading  $R$  into this formula. In relation to this, there is no need for a correction of the indication error. The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied with an Expansion factor of 2, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

Indication in % from Max1	Net indication $R$	Uncertainty $U_{gl}(W)$	Uncertainty relative $U_{gl}(W)_{rel}$
1 %	0.60000 g	0.000020 g	0.0033 %
25 %	15.00000 g	0.00012 g	0.00077 %
50 %	30.00000 g	0.00021 g	0.00071 %
75 %	45.00000 g	0.00031 g	0.00070 %
100 %	60.00000 g	0.00041 g	0.00069 %

Graphic realization of the relative uncertainty of measurement | process accuracy



Displayed example

Process accuracy

1.00 %

Safety factor

3

Minimum sample weight

0.00474 g



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



## Certificate of Calibration

Cert. No.: 25LM10

Page.: 1 of 2

Equipment : DO Meter with Sensor

Manufacturer : YSI

Model : 5000-115V

Serial No. : 15E102796

ID No. : RYG\_EN0032

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

Location : TPA On Site Calibration Laboratory

Received Order : 17 January 2025

Calibrated Date : 20 January 2025

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

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

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

Calibrated by : Warakorn Lerngagtrakul

Approved by :

Approved Signatory

( ) Chakrit Waewwanjua

(✓) Suwit Imjai

( ) Kunchit Promprat

Issue Date : 23 January 2025

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

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

REVIEW BY ..... Photchana S.

APPROVED BY .....

NEXT CAL DATE ..... 20/07/26



**Equipment :** DO Meter with Sensor  
**Condition As-Received :** Used Item  
**Reference :** 2501-0600DSC-2

**Cert. No.:** 25LM10  
**Page.:** 2 of 2

**Procedure Used :-**

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer ( IPRT ) into Temperature Bath.

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

<u>Instrument</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Traceable</u>	<u>Due Date</u>
1) Digital Thermometer	2188080	2411022	TPA	17 Sep 2025

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

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

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

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

**Function :** Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 15E100464

<u>Calibration Point</u> ( °C )	<u>Immersion Depth</u> ( mm )	<u>Standard Temperature</u> ( °C )	<u>UUC* Reading</u> ( °C )	<u>Error</u> ( °C )	<u>Uncertainty</u> ( ± °C )	<u>Coverage Factor</u> <i>k</i>
20.00	60	20.002	19.81	-0.192	0.15	2.00

**UUC\* :** Unit Under Calibration

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

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


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

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

## Certificate of Testing

**Cert.No.:** 25TW15

**Page.:** 1 of 2

<b>Equipment :</b>	DO Meter
<b>Manufacturer :</b>	YSI
<b>Model :</b>	5000-115V
<b>Serial No. :</b>	15E102796
<b>ID No. :</b>	RYG_EN0032
<b>Received Date :</b>	17 January 2025
<b>Test Date :</b>	20 January 2025
<b>Reference :</b>	2501-0600DSC-1
<b>Submitted by :</b>	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand
<b>Laboratory Condition :</b>	Temperature ( $25 \pm 5$ ) °C Humidity ( $50 \pm 20$ ) %
<b>Test Procedure :</b>	In - house method : CP-CH9 by Comparison Technique with Azide Modification Method
<b>Tested by :</b>	Walalak Sirithean
<b>Approved by :</b>	 _____ Approved Signatory
( ) Pornthippa Tameyakul ( ) Ponpan Paipim (✓) Saithip Meangmai	
<b>Issue Date :</b>	21 January 2025



Cert.No.: 25TW15

Page.: 2 of 2

**Condition of this result of calibration**

1. Reference Standard Instruments :

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

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

2. Standard Material :-

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

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

Dissolved Oxygen Probe No.: 15E100464

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.20	8.20	0.0084

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

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## Certificate of Calibration

Cert. No.: 24TM1663

Page : 1 of 3

Equipment : Low Temp. Incubator

Manufacturer : Memmert

Model : IPP750

Serial No. : V818.0084

ID No. : RYG\_EN0154

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

Location : BOD Room

Received Order : 01 November 2024

Calibration Date : 01 November 2024

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

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

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

Calibrated by : Krisda Malee

Approved by :

*Kunchit*

Approved Signatory

( ) Ponpan Paipim

( ) Suwit Imjai

(✓) Kunchit Promprat

Issue Date :

07 November 2024

REVIEW BY ..... *Thanitak* .....

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

NEXT CAL DATE..... 01/05/26 .....

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

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





**Equipment :** Low Temp. Incubator  
**Condition As-Received :** Used Item  
**Reference :** 2411-0002OC-1

**Cert. No.:** 24TM1663

**Page :** 2 of 3

**Procedure Used :-**

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

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

<u>Instrument</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Traceable</u>	<u>Due Date</u>
1 ) Data Acquisition	MY44073381	24LM73	TPA	18 May 2025

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

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

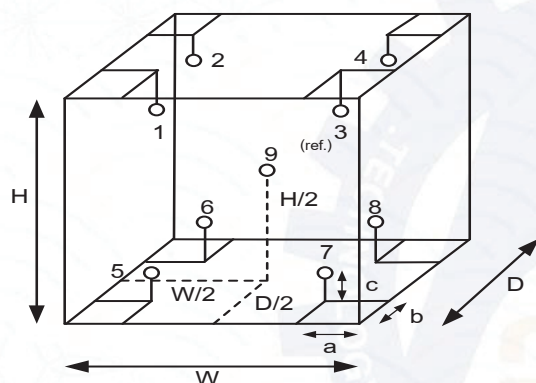
**Remark :** TPA : Technology Promotion Association ( Thailand - Japan )

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

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

**Fresh air setting :** Close

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	24	25
REL.Humid. ( % )	55	53
AC Supply ( Volt )	220	221



Position :	Ref. Std. ID No.:
1	1RTD-2/1
2	1RTD-2/2
3	22-01RTD-03
4	1RTD-2/4
5	1RTD-2/5
6	1RTD-2/6
7	23-01RTD-07
8	1RTD-2/8
9 (ref.)	23-01RTD-09

**Probe Installation Details :**

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

**Dimension of Chamber :**

D = 0.60 m  
W = 1.0 m  
H = 1.2 m  
Capacity = 0.72 m<sup>3</sup>



**Equipment :** Low Temp. Incubator  
**Condition As-Received :** Used Item  
**Reference :** 2411-0002OC-1  
**Result of Calibration :-** ( \* ) Without Adjustment  
**Function of UUC\* :** Temperature Source  
**Fresh air setting :** Close

**Cert. No.:** 24TM1663

**Page :** 3 of 3

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Coverage Factor <i>k</i>
20.0	20.0	20.0	0.026	0.26	0.53	2

Calibration Point ( °C )	Measured Temperature ( °C )									Uncertainty  ( ±°C )
	Position									
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	20.071	19.915	20.273	20.179	19.977	19.782	20.056	20.026	20.033	0.30

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

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

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

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

**UUC\* :** Unit Under Calibration

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

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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TEL.0-2717-3000-29 FAX.0-2719-9484



## Certificate of Calibration

Cert.No.: 24CG3711

Page.: 1 of 2

Equipment :	Burette
Capacity :	50 mL
Serial No. :	-
ID. No. :	RYG_EN0216
Manufacturer :	Witeg
Made in :	Germany
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch 616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng Rayong 21140, Thailand
Ambient Temperature :	(20 ± 2.5) °C
Relative Humidity :	(50 ± 10) %
Barometric Pressure :	756 mmHg
Calibration Procedure :	ASTM E 542 - 01
Calibrated by :	Sa-ngeunkam Wongsa

REVIEW BY *Thanitak.*

APPROVED BY *D. Johnson.*

NEXT CAL DATE *24/09/25*

Approved by :

*Sukh.*  
Approved Signatory

(✓) Srisuda Khamtha  
( ) Ponpan Paipim  
( ) Unnophol Harachai

Issue Date :

24 September 2024

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

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



**Equipment :** Burette  
**Received Date :** 19 September 2024  
**Condition As-Received :** Used Item  
**Calibration Date :** 24 September 2024  
**Reference :** 2409-0756DSC-3

**Cert.No.:** 24CG3711  
**Page.:** 2 of 2

**Condition of this result of calibration**

1. Reference Standard Instruments :

<u>Instruments</u>	<u>Model</u>	<u>Serial No.</u>	<u>ID. No.</u>	<u>Certificate No.</u>	<u>Traceability</u>	<u>Due date</u>
1) Balance	XP205	B134206712	140RC007	24MM316	TPA	15 July 2025
2) Data Logger	HL-20D	20683159	140EC012	23H2174	TPA	10 Oct 2024
3) Thermometer	-	1594592	140EC010	24I175	TPA	20 Feb 2025

This certification is traceable to SI Unit

2. The certificate is valid only to the item calibrated on date and place of calibration.  
3. True value is converted to true volume at the standard temperature of 20 °C

**Calibration result :**

<b>Nominal capacity ( mL )</b>	<b>Reading ( mL )</b>	<b>Uncertainty ( ± mL )</b>	<b>k Factor</b>
10	10.0259	0.0082	2.00
20	20.0214	0.0085	2.00
30	30.0006	0.0089	2.00
40	40.0003	0.0094	2.00
50	49.9988	0.011	2.00

**Remark** mL = cm<sup>3</sup>

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

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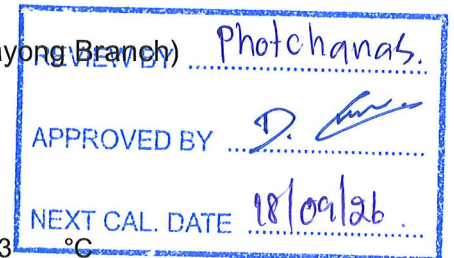


# Certificate of Calibration

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

**Certificate No.:** C06250108  
**Issued Date:** 18 March 2025  
**Job No.:** WO-00064379  
**Page:** 1 of 3

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



**Environment Condition:**

Temperature	24.4	°C	±	0.3	°C
Humidity	60.8	%RH	±	3.5	%RH

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

**Calibration By:** Mr.Preecha Phooarsai

**Calibration Date:** 18 March 2025

**The Method used:** In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04

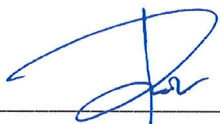
**Traceability:** This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Starna Scientific Limited.

The standard for Wavelength Certificate No. 111583 and 111584

The standard for Photometric Certificate No. 9114984 and 111588

The standard for Stray light Certificate No. 111586 and 111585

The standard for Spectral resolution Certificate No. 111587



(Mr. Preecha Phooarsai)

Person in charge



(Miss Kaewkan Suradech)

Authorized signatory

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

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

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

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด  
DKSH Technology Limited

2533 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260  
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

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



**Calibration Results:**
**Without Adjustment**

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

Standard Wavelength	Unit Under Calibration	Correction	Uncertainty
418.61	418.5	0.11	0.13
536.66	536.7	-0.04	0.13
637.98	638.3	-0.32	0.13
748.48	748.8	-0.32	0.13
807.03	807.5	-0.47	0.13

**Photometric Accuracy (Absorbance)**

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.2930	0.291	0.0020	0.0045
	0.5168	0.518	-0.0012	0.0045
	1.0298	1.031	-0.0012	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.2867	0.285	0.0017	0.0045
	0.5073	0.508	-0.0007	0.0045
	1.0083	1.009	-0.0007	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.2516	0.250	0.0016	0.0045
	0.4595	0.461	-0.0015	0.0045
	0.9334	0.935	-0.0016	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.2461	0.246	0.0001	0.0045
	0.4652	0.466	-0.0008	0.0045
	0.9468	0.948	-0.0012	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.2594	0.259	0.0004	0.0045
	0.5040	0.505	-0.0010	0.0045
	1.0032	1.004	-0.0008	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.2579	0.258	-0.0001	0.0045
	0.4971	0.497	0.0001	0.0045
	0.9720	0.973	-0.0010	0.0045

**Calibration Results:**
**Without Adjustment**
**Photometric Accuracy (Absorbance)**

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
235 nm	0.0000	0.000	0.0000	0.0080
	0.7355	0.738	-0.0025	0.0080
257 nm	0.0000	0.000	0.0000	0.0080
	0.8574	0.857	0.0004	0.0080
313 nm	0.0000	0.000	0.0000	0.0080
	0.2864	0.290	-0.0036	0.0080
350 nm	0.0000	0.000	0.0000	0.0080
	0.6374	0.637	0.0004	0.0080

**Stray light \***

Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%T)	Absorbance ( A)
260.62 +/- 0.11 nm	260.6	1.7	1.770
391.44 +/- 0.11 nm	391.4	1.4	1.854

**Spectral Resolution \***

Nominal Concentration 0.02 % v/v	Peak	Trough	Ratio	SBW
Standard Wavelength ( nm )	268.66	266.69	1.38	2.00
UUC: Wavelength (nm)	268.2	266.2		
Std Absorbance ( A)	0.4566	0.2780		
UUC: Absorbance ( A)	0.413	0.299		

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

**The End of Certificate**

## ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00064379

ชนิดเครื่องมือ: SPECTROPHOTOMETER

รุ่น: DR6000

หมายเลขเครื่อง: 1627845

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
18 Mar 2025			18 Mar 2025		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด ( ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิทช์ ปิด – เปิด เครื่อง (On-Off Swicth)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		Spectrophotometer			
<input type="checkbox"/>	<input type="checkbox"/>	6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	7. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control)	<input type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	*
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	13.5 Hours
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	893.0 Hours
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. ช่องวัดหลายตัวอย่าง (Carousel Module)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		pH Meter and Conductivity Meter			
<input type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด ( Electrode and Connection Cable )	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	13. ระดับสารละลายใน Electrode (Level KCl )	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	14. ฝาปิดกันปลาย Electrode (Dust Protection Hood)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาจับอิเล็กโทรด (Stand)	<input type="checkbox"/>	<input type="checkbox"/>	
		Turbidimeter			
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่นเกิน 3.0)	<input type="checkbox"/>	<input type="checkbox"/>	
		Automatic titrator			
<input type="checkbox"/>	<input type="checkbox"/>	18. สภาพ Piston Burettes	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	19. Function Rinsing and Dosing	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	<input type="checkbox"/>	<input type="checkbox"/>	

เพิ่มเติม/ข้อแนะนำ : \* 656.1nm = 656.1nm

\* 486.0nm = 485.7nm

Mr.Preecha Phooarsai

Service Engineer

Accredited by

NSC-TISI-TIS 17025

Calibration 0426



NSC-TISI-TIS 17025

CALIBRATION 0426

## Calibration certificate

Calibration Certificate No. 25BKL0004

Object	Electronic non-automatic weighing instrument	This calibration certificate documents the traceability to national standards.
Manufacturer	Sartorius	Uncertainties of measurements are taken into account when only statements of compliance are made.
Type	MSE224S-100-DU	This certificate was prepared by Sartorius Corporation in accordance to the current ISO/IEC 17025:2017 standard and Sartorius Work Instruction (Method) SOP WI 08.
Serial   QM Ident. no.	26207038   RYG_EN0002	This certificate relate and apply this equipment only.
Customer	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)	
	616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.	
Order no.	2230	
Number of pages	4	
Date of calibration	20 Feb 2025	

REVIEW BY *Thanita K.*APPROVED BY *D. Khunon.*

NEXT CAL DATE.....20/02/26

This calibration certificate may not be reproduced other than in full except with the permission of NSC-TISI-TIS-17025 and the issuing laboratory. Calibration certificates without signature are not valid.

The user is obliged to have the object recalibrated at appropriate intervals.

Date 06 Mar 2025 Approval of the Calibration Certificate



Mr. Chonchai Inthana

Person in charge

Kachen Lalee

Calibration object

Single range instrument

Model	MSE224S-100-DU
Serial Number	26207038
QM Ident. no   Inventory no.	RYG_EN0002   ---

Maximum capacity (Max. load)	220.0000 g
Measured range	220.0000 g
Scale interval	0.0001 g

Place of calibration

Address	According to page 1
Department   Cost center	Laboratory Department.   ---
Building   Floor	---   1st Floor.
Room	Balance Room.
Maximum temperature variation at place of calibration	5 K

Calibration procedure

EURAMET cg-18, V4.0 - Guidelines on the Calibration of Non-Automatic Weighing Instruments

Test equipment

Test equipment type	Test equipment ID	Valid until
Thermometer	MHB-382SD s/nB011342 Traceable to SI unit through DKSH	21 Aug 2025
Test weight set OIML R111 E2	Certificate No.M2308197S ,E2(Traceable to SI unit through TCS)	23 Aug 2025



Adjustment Status

The measuring device was internally adjusted before the calibration.

Environmental and measuring conditions

Date of calibration	20 Feb 2025
Temperature at place of calibration   Temp. diff. <i>T</i> <sub>weights</sub> - <i>T</i> <sub>place</sub>	24.4 °C   0.6 K
Measuring conditions	The installation site is suitable. The device was levelled. Balance was loaded up to Max before test.
Comments	Humidity 50.2 %RH.

Measurement results | Measurement uncertainties

Repeatability			Eccentricity	
Test load (nominal): 10 g   200 g			Test load (nominal): 100 g	
	10 g	200 g		
1	10.0000 g	200.0000 g	Center	
2	10.0000 g	200.0001 g	Front left	
3	10.0001 g	200.0001 g	Back left	
4	10.0000 g	200.0000 g	Back right	
5	10.0001 g	200.0000 g	Front right	
6	10.0001 g	200.0001 g	Maximum deviation from centric loading indication	
7	10.0000 g	200.0000 g	Δ <sub>ecc</sub>   max = 0.0002 g	
8	10.0000 g	200.0001 g		
9	10.0001 g	200.0000 g		
10	10.0000 g	200.0000 g		
	<i>s</i> = 0.00005 g	<i>s</i> = 0.00005 g		

Error of indication

Testload	Indication	Error	Expansion factor	Uncertainty	Uncertainty relative
<i>L</i>	<i>I</i>	<i>E</i>	<i>k</i>	<i>U</i> ( <i>E</i> )	<i>U</i> <sub>rel</sub> ( <i>E</i> )
0.0100 g	0.0100 g	0.0000 g	2.00	0.00013 g	1.3 %
0.1000 g	0.1000 g	0.0000 g	2.00	0.00013 g	0.13 %
0.5000 g	0.5000 g	0.0000 g	2.00	0.00013 g	0.027 %
1.0000 g	1.0000 g	0.0000 g	2.00	0.00013 g	0.013 %
5.0000 g	5.0000 g	0.0000 g	2.00	0.00014 g	0.0027 %
10.0000 g	10.0000 g	0.0000 g	2.00	0.00014 g	0.0014 %
20.0000 g	20.0000 g	0.0000 g	2.00	0.00014 g	0.00072 %
50.0000 g	50.0000 g	0.0000 g	2.00	0.00016 g	0.00032 %
100.0000 g	100.0001 g	0.0001 g	2.00	0.00021 g	0.00021 %
200.0000 g	200.0000 g	0.0000 g	2.00	0.00034 g	0.00017 %
220.0000 g	220.0000 g	0.0000 g	2.00	0.00039 g	0.00018 %
Maximum error of indication		<i>E</i>   <sub>max</sub> = 0.0001 g			

*U*<sub>rel</sub>(*E*) is the quotient of *U*(*E*) and test load *L*. The uncertainty of measurement *U*(*E*) is valid only if error *E* is considered. You will find reference notes on the uncertainty of measurement in use under: Appendix to the calibration certificate | Interpretation of measurement results.  
Reference note: The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the documented Expansion factor, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

End of calibration certificate

# Uncertainty of measurement in use

Device adjusted before measurement	Yes
Temperature deviation considered	1.5 K (isoCAL active)
Temperature coefficient considered	$1 \cdot 10^{-6}/\text{K}$

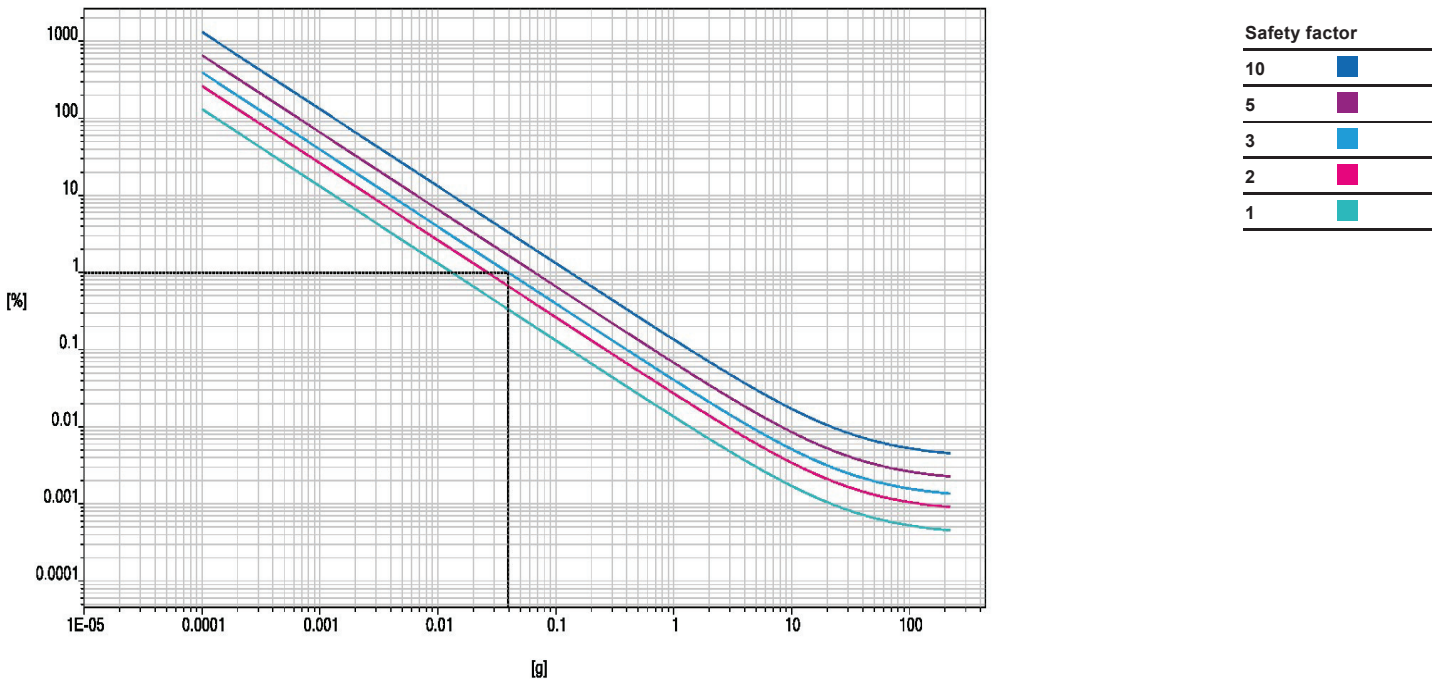
Uncertainty of the weighing result  $U_{gl}(W)$

$U_{gl}(W) = 0.00013 \text{ g} + 3.95 \cdot 10^{-6} \cdot R$

Reference note: The current uncertainty of measurement is calculated by entering of the reading  $R$  into this formula. In relation to this, there is no need for a correction of the indication error. The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied with an Expansion factor of 2, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

Indication in % from max load	Net indication $R$	Uncertainty $U_{gl}(W)$	Uncertainty relative $U_{gl}(W)_{rel}$
1 %	2.2000 g	0.00014 g	0.0063 %
25 %	55.0000 g	0.00035 g	0.00063 %
50 %	110.0000 g	0.00056 g	0.00051 %
75 %	165.0000 g	0.00078 g	0.00047 %
100 %	220.0000 g	0.00100 g	0.00045 %

Graphic realization of the relative uncertainty of measurement | process accuracy



Displayed example

Process accuracy	1.00 %
Safety factor	3
Minimum sample weight	0.0395 g



# Metrology

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.

Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100

Bangkok Tel : +668 9205 6851 , +669 8247 2360

Website : www.scieco.co.th E-Mail : calibrate@scg.com



Certificate No. T250454

Page 1 of 3

## Certificate of Calibration

Equipment : Chamber ( Oven )

Manufacturer : MEMMERT

Model : UF 110

Serial No. : B423.0853

Customer Code : RYG\_EN0213

ID No. : T5884A5

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

616/10 Moo 5 T.Maenam Khu,

A.Plukdaeng, Rayong 21140

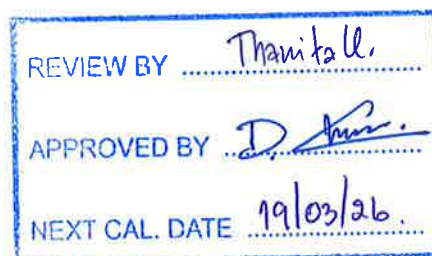
Customer Location : ENVIRONMENT LABORATORY

Date of Receipt : 12 March 2025

Calibrated By : Sujjar Naknakred ( Site Calibration Manager )

Approved By : Boonchai Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 21 MAR 2025



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

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

Certificate No. T250454

Page 2 of 3

## Calibration Report

**Equipment** : Chamber ( Oven )  
**Date of Calibration** : 19 March 2025  
**Environment** : Temperature : 26.5-26.9 °C  
Line Voltage : 223.9-231.3 V  
Relative Humidity : 55 - 65 %RH

### Condition of this results of calibration :

1. This equipment was calibrated by insert nine resistance thermometer detectors into its chamber , the other one resistance thermometer detector use for ambient temperature measurement . The calibration was done in according to WI-T20 ( based on ASTM E145-94 ( Reapproved 2019) and AS2853-1986 ).

All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
RTD	100 ohm	27-(CH1-10)	T240709	19 April 2025
DATA LOGGER	34970A	T149	T240709	19 April 2025

3. This certificate is traceable to :

National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TISI-TIS 17025 CALIBRATION 0244.)

4. Condition of calibrated item : good

Equipment Description :

Time Constant 1 Hour 44 Minute At 104 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☒ Close  
☐ Not Available

5. Adjustment :

( ) without adjustment

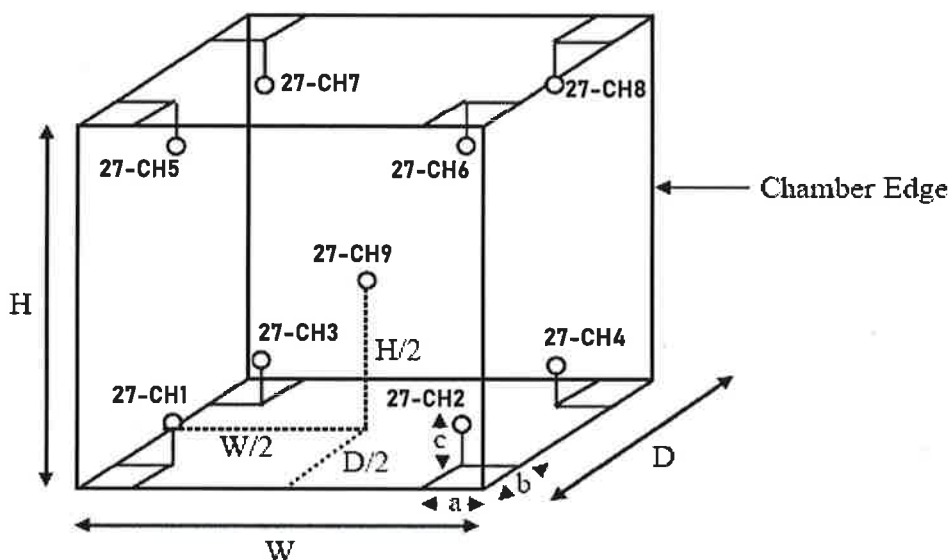
( X ) after adjustment

Approved By.

Certificate No. T250454

Page 3 of 3

## Calibration Report



**Remark :** Internal Dimensions of Chamber : W (Width) = 56 cm. , H (Height) = 48 cm. and D (Depth) = 40 cm.  
Size of Installed Standard sensor number 27-CH1 to number 27-CH8 : a = 5 cm. ,b = 5 cm. and c = 5 cm.  
Size of Installed Standard sensor number 27-CH9 : W/2 = 56 cm./2 , H/2 = 48 cm./2 and D/2 = 40cm./2

### Measurement Results

Average Standard Reading at each position (°C)									
Calibration Point	27-CH1	27-CH2	27-CH3	27-CH4	27-CH5	27-CH6	27-CH7	27-CH8	27-CH9
104	103.84	104.10	104.10	104.48	103.73	104.14	103.95	103.57	104.22
180	179.41	179.92	180.80	181.37	179.54	179.52	179.82	179.41	180.31

Chamber ( Oven )			Temperature Distribution				
Setting °C	Reading (°C )		Average ( °C )	Stability (± °C )	Uniformity ( °C )	Uncertainty (± °C )	Coverage Factor k
	Min , Max	Average					
104.0	103.9 , 104.1	104.0	104.01	0.08	0.65	0.42	2.00
180.0	-	180.0	180.01	0.17	1.26	0.49	2.00

\* The quoted uncertainty exclude "uniformity"

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 % .

End of Certificate.

Approved By. \_\_\_\_\_







TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
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TEL.0-2717-3000-29 FAX.0-2719-9484



## Certificate of Calibration

Cert. No.: 24TM635

Page : 1 of 3

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

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

Location : Wet Chemistry Lab

Received Order : 21 March 2024

Calibration Date : 21 March 2024

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

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

Calibrated by : Man Pattanapongpaiboon

Approved by :

Approved Signatory

( ) Pornthippa Tameyakul

( ) Unnoppol Harachai

(☒) Suwit Imjai

Issue Date :

23 March 2024

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

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



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

**Cert. No.:** 24TM635

**Page :** 2 of 3

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

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

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

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

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

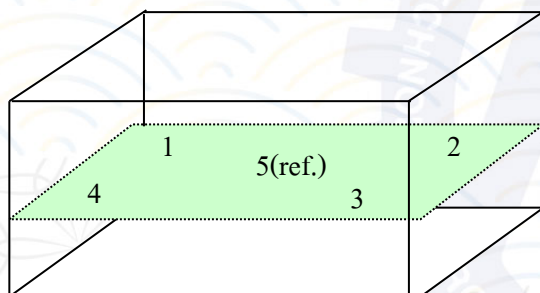
**Remark :** TPA : Technology Promotion Association ( Thailand - Japan )

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

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

**Heat transfer medium used :** Water

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



Front

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





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

**Cert. No.:** 24TM635

**Page :** 3 of 3

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

Calibration point ( °C )	Uniformity ( °C )	Stability ( ± °C )	Coverage Factor <i>k</i>
85.0	0.19	0.11	2

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

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

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

**UUC\* :** Unit Under Calibration

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

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

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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert.No.: 24CH96

Page.: 1 of 3

## Certificate of Calibration

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

REVIEW BY	<i>N. Banwit</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	19/01/25 TKU

1316174 อนุมัติ  
Cal

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

**Calibrated by :** Warakorn Lernagatrakul

**Approved by :**

*Saithip*  
Approved Signatory

(✓) Saithip Meangmai  
( ) Warakorn Lernagatrakul  
( ) Ponpan Paipim

**Issue Date :** 24 January 2024

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

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

A 0062854



Cert.No.: 24CH96

Page.: 2 of 3

### Condition of this calibration result

#### 1. Reference Standard Instrument

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

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

- Technology Promotion Association (Thailand-Japan)

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

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

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

### Calibration Results

#### Function : mV Measurement

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

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

Santhip

a 1198287





Cert.No.: 24CH96  
Page.: 3 of 3

### Calibration Results

#### Function : pH Measurement

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

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

#### Function : Temperature Measurement

##### (\*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLab®Expert Pro-ISM  
- Serial No. : 3225367

Dimension of probe

- Length : 120 mm.  
- Diameter : 12 mm.  
- Immersion Depth : 100 mm.

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

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

-o0o-

*Santhip*



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TEL. 0-2717-3000-24 FAX. 0-2719-9484



## Certificate of Calibration

Certificate No. : 24E289

Page : 1 of 2

Equipment : pH Meter  
Manufacturer: Mettler Toledo  
Model : SevenCompact S220  
Serial No.: C104059460  
ID No.: RYG\_EN0183

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

Condition As-Received: Used Item  
Received Date: 18 January 2024  
Calibration Date: 23 January 2024

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

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

### Condition of this result of calibration

1.Reference standards instruments :

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

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


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

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

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

Calibrated by : Wutchareeporn Wongchutikrane  
Issue Date : 24 January 2024

Approved Signatory :

  
[ ] Phalinee Prabpaipal  
[x] Nuntawat Khamchai  
[ ] Pongsagorn Boonyaporn

B 0333296



Cert. No.: 24E289

Page.: 2 of 2

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

Function: DC voltage measurement

Range: 2000 mV

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

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

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

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## Certificate of Calibration

Cert. No.: 24TM632

Page : 1 of 3

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

**REVIEW BY** *Thanitak.*  
**APPROVED BY** *D. J. J. J.*  
**NEXT CAL DATE** 21/09/25

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

**Location :** Oven Room

**Received Order :** 21 March 2024  
**Calibration Date :** 21 March 2024  
**Ambient Temperature :** ( 26 ± 10 ) °C  
**Relative Humidity :** ( 50 ± 30 ) %

**Calibrated by :** Man Pattanapongpaiboon

**Approved by :**

Approved Signatory

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

**Issue Date :** 22 March 2024

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

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





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

**Cert. No.:** 24TM632  
**Page :** 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector ( RTD ) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

### Condition of this result of calibration

1. Reference standard instrument:-

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

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

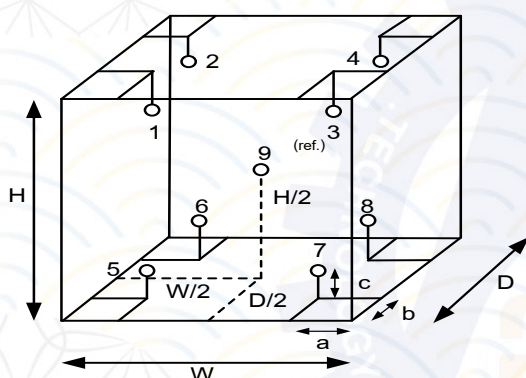
3. This certification is traceable to the International System of Unit.

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

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

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

**Fresh air setting :** Close



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

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

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

### Probe Installation Details :

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

### Dimension of Chamber :

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





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

**Cert. No.:** 24TM632

**Page :** 3 of 3

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Coverage Factor <i>k</i>
104.0	104.0	104.0	0.051	0.59	0.62	2
180.0	180.0	180.0	0.15	1.3	1.7	2

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

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

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

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

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

**UUC\* :** Unit Under Calibration

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

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

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## Certificate of Calibration

Cert.No.: 24CH774

Page.: 1 of 2

Equipment :	pH Meter	<div>REVIEW BY <i>Pitthaya T.</i></div> <div>APPROVED BY <i>Saithip S.</i></div> <div>NEXT CAL DATE.....01/07/25</div>
Manufacturer :	Mettler Toledo	
Model :	Seven2Go S2	
Serial No. :	C221115514	
ID No. :	RYG_FS0596	
Condition As-Received:	Used Item	
Received Date :	28 June 2024	
Calibration Date :	01 July 2024	
Reference :	2406-0969DSC-6	
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch 616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand	
Ambient Temperature :	(25 ± 2.5) °C	
Relative Humidity :	(50 ± 15) %	
Calibration Procedure :	In - house method : - CP-CH5 by direct measurement with DC voltage standard and direct measurement with certified reference material (CRM)	
Calibrated by :	Warakorn Lerngagtrakul	
Approved by :	<div><i>Saithip</i></div> <div>Approved Signatory</div>	
( ) Unnopphol Harachai		
( ) Ponpan Paipim		
(✓) Saithip Meangmai		
Issue Date :	03 July 2024	

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

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





Cert.No.: 24CH774

Page.: 2 of 2

### Condition of this calibration result

#### 1. Reference Standard Instrument

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Document Process Calibrator	54030049	130RC116	23E2802	27 Aug 2024

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

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

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.008	CPA chem	970851	25 Apr 2026
pH 6.986	CPA chem	970852	25 Apr 2025
pH 9.997	CPA chem	970853	25 Apr 2025

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

### Calibration Results

#### Function : mV Measurement

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

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

#### Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement (±)	Coverage factor <i>k</i>
pH Electrode S/N.: 3293232	4.008	4.01	180	0.0079	2.00
	6.986	6.99	5	0.011	2.00
	9.997	10.00	-172	0.0092	2.00

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



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



## Certificate of Calibration

Cert. No.: 24LM108

Page.: 1 of 2

**Equipment :** pH Meter with Sensor

**Manufacturer :** Mettler Toledo

**Model :** Seven2Go S2

**Serial No. :** C221115514

**ID No. :** RYG\_FS0596

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

**Location :** TPA On Site Calibration Laboratory

**Received Order :** 28 June 2024

**Calibrated Date :** 01 July 2024

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

**Relative Humidity :** ( 50 ± 30 ) %

**AC Line Voltage :** ( 220 ± 22 ) V

**Calibrated by :** Warakorn Lerngatrakul

**Approved by :**

Approved Signatory

- ( ) Ponpan Paipim  
( ✓ ) Suwit Imjai  
( ) Kunchit Promprat

**Issue Date :**

03 July 2024

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

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





**Equipment :** pH Meter with Sensor

**Condition As-Received :** Used Item

**Reference :** 2406-0969DSC-7

**Cert. No.:** 24LM108

**Page.:** 2 of 2

**Procedure Used :-**

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer ( IPRT ) into Temperature Bath.

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

<u>Instrument</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Traceable</u>	<u>Due Date</u>
1) Digital Thermometer	2188080	2311216	TPA	11 Oct 2024

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

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

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

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

**Function :** Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 3293232

<u>Calibration Point</u> ( °C )	<u>Immersion Depth</u> ( mm )	<u>Standard Temperature</u> ( °C )	<u>UUC* Reading</u> ( °C )	<u>Error</u> ( °C )	<u>Uncertainty</u> ( ± °C )	<u>Coverage Factor</u> <i>k</i>
25.0	100	25.003	25.1	0.097	0.16	2.00
30.0	100	30.002	30.2	0.198	0.16	2.00
40.0	100	40.003	40.2	0.197	0.16	2.00
50.0	100	50.002	50.2	0.198	0.16	2.00

**UUC\* :** Unit Under Calibration

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

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