

# ภาคผนวก ง

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ใบรับรองการสอบเทียบเครื่องมือ



รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Stack	Non-Methane Hydrocarbon as Propane	Pitot Tube	BKK_FS0472	13-Jan-23	13-Jul-23	6
Stack	Non-Methane Hydrocarbon as Propane	Pitot Tube	BKK_FS0560	13-Jan-23	13-Jul-23	6
Stack	Non-Methane Hydrocarbon as Propane	Pitot Tube	BKK_FS0473	13-Jan-23	13-Jul-23	6
Stack	Non-Methane Hydrocarbon as Propane	Flue gas Analyzer	RYG_FS0465	23-Jan-23	23-Jan-24	12
Stack	Non-Methane Hydrocarbon as Propane	Flue gas Analyzer	RYG_FS0565	28-Dec-22	28-Dec-23	12
Stack	Non-Methane Hydrocarbon as Propane	Field Rotameter	RYG_FS0198	1-Apr-23	1-Jul-23	3
Stack	Non-Methane Hydrocarbon as Propane	Total Hydrocarbon Analyzer	RYG_EN0038	25-Jan-23	25-Jan-24	12
Stack	Non-Methane Hydrocarbon as Propane	FID Analyzer	BKK_FS0758	4-Jan-23	4-Jul-23	6
Stack	Total Hydrocarbon as Propane	Pitot Tube	BKK_FS0472	13-Jan-23	13-Jul-23	6
Stack	Total Hydrocarbon as Propane	Pitot Tube	BKK_FS0560	13-Jan-23	13-Jul-23	6
Stack	Total Hydrocarbon as Propane	Pitot Tube	BKK_FS0473	13-Jan-23	13-Jul-23	6
Stack	Total Hydrocarbon as Propane	Flue gas Analyzer	RYG_FS0465	23-Jan-23	23-Jan-24	12
Stack	Total Hydrocarbon as Propane	Flue gas Analyzer	RYG_FS0565	28-Dec-22	28-Dec-23	12
Stack	Total Hydrocarbon as Propane	Field Rotameter	RYG_FS0198	1-Apr-23	1-Jul-23	3
Stack	Total Hydrocarbon as Propane	Total Hydrocarbon Analyzer	RYG_EN0038	25-Jan-23	25-Jan-24	12
Stack	Total Hydrocarbon as Propane	FID Analyzer	BKK_FS0758	4-Jan-23	4-Jul-23	6
Stack	Oxides of Nitrogen	Pitot Tube	BKK_FS0472	13-Jan-23	13-Jul-23	6
Stack	Oxides of Nitrogen	Pitot Tube	BKK_FS0560	13-Jan-23	13-Jul-23	6
Stack	Oxides of Nitrogen	Pitot Tube	BKK_FS0473	13-Jan-23	13-Jul-23	6
Stack	Oxides of Nitrogen	Flue gas Analyzer	RYG_FS0465	23-Jan-23	23-Jan-24	12
Stack	Oxides of Nitrogen	Flue gas Analyzer	RYG_FS0565	28-Dec-22	28-Dec-23	12
Stack	Oxides of Nitrogen	Vacuum Gauge	BKK_FS0479	14-Feb-23	14-Aug-24	18
Stack	Oxides of Nitrogen	Vacuum Gauge	BKK_FS0483	14-Feb-23	14-Aug-24	18
Stack	Oxides of Nitrogen	SPECTROPHOTOMETER	RYG_EN0179	27-Sep-22	27-Sep-23	12
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	RYG_FS0533	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	RYG_FS0272	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	RYG_FS0261	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	RYG_FS0264	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	RYG_FS0533	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO <sub>2</sub> Analyzer	RYG_FS0272	5-Jan-23	5-Jul-23	6
Ambient	Non-Methane Hydrocarbon as Propane	Total Hydrocarbon Analyzer	RYG_EN0038	25-Jan-23	25-Jan-24	12
Ambient	1,4 Dichlorobenzene	GC-MSD	RYG_EN0136	7-Jul-22	7-Jan-24	18
Ambient	Benzene	GC-MSD	RYG_EN0136	7-Jul-22	7-Jan-24	18
Ambient	n-Hexane	GC-MSD	RYG_EN0136	7-Jul-22	7-Jan-24	18
Ambient	Toluene	GC-MSD	RYG_EN0136	7-Jul-22	7-Jan-24	18
Ambient	Propylene	GC-MSD	RYG_EN0136	7-Jul-22	7-Jan-24	18

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Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Ethylene glycol	Field Rotameter	BKK_FS1044	3-Jan-23	3-Apr-23	3
Ambient	Ethylene glycol	Field Rotameter	RYG_FS0199	3-Jan-23	3-Apr-23	3
Ambient	Ethylene glycol	Field Rotameter	BKK_FS1006	1-Apr-23	1-Jul-23	3
Ambient	Ethylene glycol	GC-FID	BKK_EN0126	21-Apr-23	21-Oct-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0329	31-Jan-22	29-Jul-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0610	17-Nov-22	17-May-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0329	31-Jan-22	29-Jul-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0888	30-May-22	28-Nov-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0413	10-Feb-23	10-Aug-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0089	19-Jan-23	19-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0411	10-Feb-23	10-Aug-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0329	31-Jan-22	29-Jul-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0413	10-Feb-23	10-Aug-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0412	10-Feb-23	10-Aug-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0411	10-Feb-23	10-Aug-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0329	31-Jan-22	29-Jul-23	18
Workplace	n-Octane	Field Rotameter	BKK_FS1044	3-Jan-23	3-Apr-23	3
Workplace	n-Octane	Field Rotameter	BKK_FS1006	1-Apr-23	1-Jul-23	3
Workplace	n-Octane	GC-FID	BKK_EN0126	21-Apr-23	21-Oct-24	18
Noise	Leq 24 hrs	Sound Calibrator	RYG_FS0215	31-Aug-22	31-Aug-23	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0031	20-Jun-22	20-Jun-23	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0618	20-Oct-22	20-Oct-23	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0384	26-Aug-22	26-Aug-23	12
Noise	Leq 5 min	Sound Calibrator	RYG_FS0215	31-Aug-22	31-Aug-23	12
Noise	Leq 5 min	Sound Level Meter	RYG_FS0618	20-Oct-22	20-Oct-23	12
Noise	Leq 5 min	Sound Level Meter	RYG_FS0384	26-Aug-22	26-Aug-23	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0496	17-Jan-23	17-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0433	25-Jan-23	25-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0431	25-Jan-23	25-Jan-24	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0215	31-Aug-22	31-Aug-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0493	13-Jan-23	13-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0492	13-Jan-23	13-Jan-24	12
Noise	Octave Band	Sound Calibrator	RYG_FS0496	17-Jan-23	17-Jan-24	12
Noise	Octave Band	Sound Level Meter	RYG_FS0433	25-Jan-23	25-Jan-24	12
Noise	Octave Band	Sound Level Meter	RYG_FS0431	25-Jan-23	25-Jan-24	12
Noise	Octave Band	Sound Calibrator	RYG_FS0215	31-Aug-22	31-Aug-23	12
Noise	Octave Band	Sound Level Meter	RYG_FS0493	13-Jan-23	13-Jan-24	12
Noise	Octave Band	Sound Level Meter	RYG_FS0492	13-Jan-23	13-Jan-24	12

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Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Rayong Lab	Temperature	pH meter	RYG_FS0596	27-Jul-22	26-Jul-23	12
Rayong Lab	pH at 25 °C	pH Meter	RYG_EN0152	22-Dec-22	22-Dec-23	12
Rayong Lab	BOD	DO meter with Sensor	RYG_EN0032	14-Feb-22	15-Aug-23	18
Rayong Lab	BOD	Incubator	RYG_EN0154	22-Apr-22	21-Oct-23	18
Rayong Lab	COD	Spectrophotometer	RYG_EN0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RYG_EN0010	20-Oct-22	20-Apr-24	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RYG_EN0010	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Oil & Grease	Hot Air Oven	RYG_EN0006	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Water Bath	RYG_EN0061	20-Oct-22	20-Apr-24	18
Rayong Lab	Total Kjeldahl Nitrogen	Block Digestion Unit	RYG_EN0188	15-Mar-23	15-Mar-24	12
Rayong Lab	Total Kjeldahl Nitrogen	pH Meter	RYG_EN0152	22-Dec-22	22-Dec-23	12

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Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK\_FS0472 Calibration Date : 13 Jan 23  
 Lab test duct Number : 258-1-13-01 Standard Pitot ID : BKK\_FS0441  
 Calibration Sheet No. : C-130123-BKK\_FS0472 Cp Standard : 0.99

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

$$C_p(S) = C_{p \text{ std}} \sqrt{\frac{\Delta P(s)}{\Delta P(s)}}$$

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

$$\text{Average deviation(A or B)} = \frac{\sum_{i=1}^n [C_p(s) - C_p(A \text{ or } B)]}{3} \text{ must BE } \leq 0.01$$

Calibrated by

Saksit Phaisangphit

( Mr. Saksit Phaisangphit )

Field Scientist (4)

Approved by

Nattapon Jengwareewong

( Mr.Nattapon Jengwareewong )

Specialist (1)



### Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK\_FS0560 Calibration Date : 13 Jan 23  
Lab test duct Number : 258-1-13-01 Standard Pitot ID : BKK\_FS0441  
Calibration Sheet No. : C-130123-BKK\_FS0560 Cp Standard : 0.99

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

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

$$Cp_{(A)} - Cp_{(B)} \text{ must BE } \leq 0.01$$

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

Calibrated by : Saksit Phaisanphisit Approved by : Nattapol Jengwareewong  
( Mr. Saksit Phaisanphisit ) ( Mr.Nattapol Jengwareewong )  
Field Scientist (4) Specialist (1)

FORM NO.: F 06-025 REVISION NO.: 1 ISSUE DATE: 30 Jan 22



### Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK\_FS0473 Calibration Date : 13 Jan 23  
Lab test duct Number : 258-1-13-01 Standard Pitot ID : BKK\_FS0441  
Calibration Sheet No. : C-130123-BKK\_FS0473 Cp Standard : 0.99

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

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

$$Cp_{(A)} - Cp_{(B)} \text{ must BE } \leq 0.01$$

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

Calibrated by : Saksit Phaisanphisit Approved by : Nattapol Jengwareewong  
( Mr. Saksit Phaisanphisit ) ( Mr.Nattapol Jengwareewong )  
Field Scientist (4) Specialist (1)

FORM NO.: F 06-025 REVISION NO.: 1 ISSUE DATE: 30 Jan 22

ENTECH

Calibration Certificate



Certificate No.: G 660041  
Date of issue : 24-Jan-23

Instrument description : Fuel gas Analyzer  
Instrument model : Testo 340  
Instrument serial no. : 62150385  
ID no. or control no. : RYG\_FS0465  
Manufacturer : Testo SE & Co. KGaA  
Probe description : -  
Probe model : -  
Probe serial : -  
Customer name : ALS LABORATORY GROUP (THAILAND) CO.,LTD.  
Customer address : 104 Phatthanasirakul 46, Phatthanasirakul Road, Khwaeng Phatthanasirakul, Rhet Suan Luang, Bangkok, 10250 Thailand  
Total pages of certificate : 2 Pages  
Receiving no. : L-230166  
Receiving date : 20-Jan-23  
Parameter of calibration : Gas Calibration/Oxygen 2.498,10.04,21.02 %Vol, Carbon Monoxide 80.14,309.9,1003 ppm, Nitric Oxide 30.08,150.9,320.6 ppm, Sulphur Dioxide 50.04,80.96,601.1 ppm  
Condition of UUC : Used  
Ambient condition : All of the Measurement were carried out the stabilized laboratory:  
Temperature : 23 ± 0.5 °C  
Humidity : 55 ± 15 %RH  
Calibration place : 17/121 Soi Nigamwongwien 47 Yiek 48, Toongphongthong, Laksi, Bangkok 10210  
Calibration procedure no.: WI-CL-28-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.  
This certificate is applied only to item under test Environmental condition.  
This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory.  
Calibration certificates without signature and seal not valid.  
This calibration certificate documents are traceability to national standards, which realize measurement according to the International System of Units (SI).  
Date of calibration : 23-Jan-23

Saksit Phaisanphisit  
Mr. Saksit Phaisanphisit  
Calibration Technician

Nattapol Jengwareewong  
Mrs. Nattapol Jengwareewong  
Technical Manager

ENTECH

Calibration Certificate



Certificate No.: G 660041

#### Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen ( O <sub>2</sub> ) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen ( O <sub>2</sub> ) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen ( O <sub>2</sub> ) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide ( CO ) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide ( CO ) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide ( CO ) 1003 ppm	2583/22	Linde	09-Aug-24
Nitric Oxide ( NO ) 30.08 ppm	5655/0068	Nimt	13-Jun-24
Nitric Oxide ( NO ) 150.9 ppm	2857/21	Linde	27-Jun-23
Nitric Oxide ( NO ) 320.6 ppm	2944/21	Linde	02-Jul-23
Sulphur Dioxide ( SO <sub>2</sub> ) 50.04 ppm	3205/21	Linde	25-Jul-23
Sulphur Dioxide ( SO <sub>2</sub> ) 100.6 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide ( SO <sub>2</sub> ) 601.1 ppm	3204/21	Linde	20-Jul-23

#### Measured room conditions

Temperature : 22.6 °C Humidity : 57.8 %RH Pressure : 1013.3 mbar  
Calibration conditions  
Gas Temperature : 23 °C Flow rate : 600 ml/min Gas pressure : 1018.2 mbar

#### Calibration Results (before adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O <sub>2</sub> (%Vol)	2.498	2.46	-0.038	0.20
O <sub>2</sub> (%Vol)	10.04	9.93	-0.11	0.40
O <sub>2</sub> (%Vol)	21.02	21.18	0.16	0.60
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	309.9	326	16.1	6.0
CO (ppm)	1003	1001	-2	12
NO (ppm)	30.08	30	-0.08	0.0
NO (ppm)	150.9	144	-6.9	0.0
NO (ppm)	320.6	309	-11.9	12
SO <sub>2</sub> (ppm)	50.04	49	-1.04	6.0
SO <sub>2</sub> (ppm)	100.6	99	-1.6	6.0
SO <sub>2</sub> (ppm)	601.1	597	-4.1	13

#### Calibration Results (after adjustment) (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O <sub>2</sub> (%Vol)	2.498	2.46	-0.038	0.20
O <sub>2</sub> (%Vol)	10.04	9.93	-0.11	0.40
O <sub>2</sub> (%Vol)	21.02	21.18	0.16	0.60
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	309.9	309	-0.9	6.0
CO (ppm)	1003	1002	-1	12
NO (ppm)	30.08	30	-0.08	0.0
NO (ppm)	150.9	153	2.1	0.0
NO (ppm)	320.6	316	-4.6	12
SO <sub>2</sub> (ppm)	50.04	49	-1.04	6.0
SO <sub>2</sub> (ppm)	100.6	99	-1.6	6.0
SO <sub>2</sub> (ppm)	601.1	597	-4.1	13

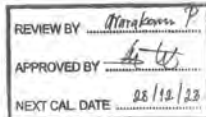
Remark : 1 cmcd/mol = 1 %Vol ; 1 sccm/mol = 1 ppm.

End of Report



Certificate No.: G 660001  
Date of Issue : 03-Jan-23

Instrument description : Flue gas Analyser  
Instrument model : Testo 340  
Instrument serial no. : 63119028  
ID no. or control no. : RYG\_FS0565  
Manufacturer : Testo SE & Co. KGaA  
Probe description :  
Probe model :  
Probe serial :  
Customer name : JLS LABORATORY GROUP (THAILAND) CO., LTD.  
Customer address : 104 Phattanasri 40, Phattanasri Road, Khwaeng Phattanasri,  
Khet Suan Luang, Bangkok, 10250 Thailand  
Total pages of certificate : 3 Pages  
Receiving no. : U-230001  
Receiving date : 26-Dec-22  
Parameter of calibration : Gas Calibration (Oxygen 2.498, 10.04, 21.02 %Vol, Carbon Monoxide 60.14, 309.9, 1003 ppm,  
Nitric Oxide 30.08, 150.9, 320.6 ppm, Sulphur Dioxide 50.04, 100.8, 601.1 ppm)



Condition of UUC : UUC  
Ambient condition : All of the Measurement were carried out in the stabilized laboratory.  
Temperature : 23 ± 0.5 °C  
Humidity : 55 ± 15 %RH  
Calibration place : 17/121 Soi Nueamwongwan 47 Yae 48, Tongprachong, Lakki, Bangkok 10210

Calibration procedure no. : WI-CL-28-C

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

Date of calibration : 28-Dec-22

Mr. Sedtaui Nuestrong  
Calibration Technician

Mrs. Nongluck Wongsatee  
Technical Manager

1M-CL-09-C Rev.8

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Issued Date 05/02/23

Entech Industrial Solution Co., Ltd.

17/121 Soi Nueamwongwan 47 Yae 48, Tongprachong, Lakki, Bangkok 10210 THAILAND TEL 0-2779-6888 Callcenter@entech.co.th  
Fax 02-0106539038881 www.entech.co.th



Certificate No.: G 660001

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen ( O2 ) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen ( O2 ) 10.04 % Vol	CG-0153-21	Nint	18-Nov-26
Oxygen ( O2 ) 21.02 % Vol	CG-0041-22	Nint	10-Feb-27
Carbon monoxide ( CO ) 80.14 ppm	CG-0040-22	Nint	14-Feb-27
Carbon monoxide ( CO ) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide ( CO ) 1003 ppm	2583/22	Linde	09-Aug-24
Nitric Oxide ( NO ) 30.08 ppm	CG-0089-22	Nint	13-Jun-24
Nitric Oxide ( NO ) 150.9 ppm	2857/21	Linde	27-Jun-23
Nitric Oxide ( NO ) 320.6 ppm	7944/21	Linde	02-Jul-23
Sulphur Dioxide ( SO2 ) 50.04 ppm	3205/21	Linde	25-Jul-23
Sulphur Dioxide ( SO2 ) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide ( SO2 ) 601.1 ppm	3294/21	Linde	20-Jul-23

Measured room conditions

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

Calibration conditions

Gas Temperature : 25 °C Flow rate : 600 ml/min Gas pressure : 1010.6 mbar

Calibration Results Before Adjustment (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (1)
O2 (%Vol)	2.498	2.47	-0.028	0.20
O2 (%Vol)	10.04	9.93	-0.11	0.40
O2 (%Vol)	21.02	21.09	0.07	0.80
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	309.9	319	9.1	6.0
CO (ppm)	1003	1038	35	12
NO (ppm)	30.08	28	-2.08	8.0
NO (ppm)	150.9	139	-11.9	8.0
NO (ppm)	320.6	299	-21.6	12
SO2 (ppm)	50.04	46	-4.04	6.0
SO2 (ppm)	100.8	96	-4.8	6.0
SO2 (ppm)	601.1	593	-8.1	13

1M-CL-09-C Rev.8

Page 2 of 3

Issued Date 26/02/23

Entech Industrial Solution Co., Ltd.

17/121 Soi Nueamwongwan 47 Yae 48, Tongprachong, Lakki, Bangkok 10210 THAILAND TEL 0-2779-6888 Callcenter@entech.co.th  
Fax 02-0106539038881 www.entech.co.th



Certificate No.: G 660001

Calibration Results After Adjustment (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (1)
O2 (%Vol)	2.498	2.47	-0.028	0.20
O2 (%Vol)	10.04	9.93	-0.11	0.40
O2 (%Vol)	21.02	21.09	0.07	0.80
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	309.9	311	1.1	6.0
CO (ppm)	1003	1004	1	12
NO (ppm)	30.08	30	-0.08	8.0
NO (ppm)	150.9	151	0.1	8.0
NO (ppm)	320.6	322	1.4	12
SO2 (ppm)	50.04	49	-1.04	6.0
SO2 (ppm)	100.8	101	0.2	6.0
SO2 (ppm)	601.1	603	1.9	13

Remark : 1 dmol/mol = 1 %Vol, 1 umol/mol = 1 ppm.

End of Report

1M-CL-09-C Rev.8

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Issued Date 26/02/23

Entech Industrial Solution Co., Ltd.

17/121 Soi Nueamwongwan 47 Yae 48, Tongprachong, Lakki, Bangkok 10210 THAILAND TEL 0-2779-6888 Callcenter@entech.co.th  
Fax 02-0106539038881 www.entech.co.th



ROTA METER CALIBRATION RESULT APRIL 2023

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



# ROTA METER CALIBRATION RESULT APRIL 2023

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

Review By :

(Mr. Wichan Choonharat)  
Enviro Field Services Manager

Approved By :

(Mr. Sarayuth Jittrantont)  
Assistant General Manager



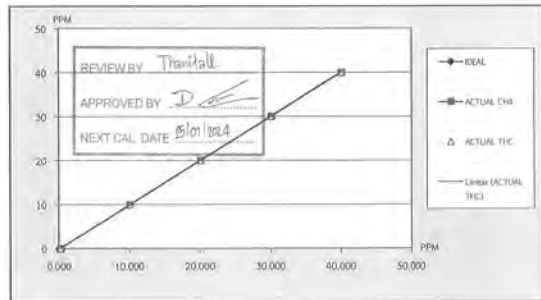
## TEST REPORT

RYG\_EN0038

CUSTOMER NAME	: ALS Laboratory Group (Thailand) Co., Ltd. (บริษัท แอลเอส แล็บอราทอรี กรุ๊ป (ประเทศไทย) จำกัด)		
EQUIPMENT NAME	: THC Analyzer		
MANUFACTURER	: HORIBA	MODEL	: APHA-370
SERIAL NO	: UA3NG4TH		
STANDARD GAS CONCENTRATION (PPM)	: 506.1 PPM		
CYLINDER NO	: CC734373		
CYLINDER PRESSURE (psig)	: 1,600 PSI		
CERTIFIED DATE	: 12/05/2020		
EXPIRED DATE	: 12/05/2028		

### TEST RESULTS

POINT NO	TEST RESULTS						
	IDEAL	ACTUAL CH4	ERROR CH4	%ERROR CH4	ACTUAL THC	ERROR THC	%ERROR THC
ZERO	0.000	0.210	0.210	-	0.200	0.200	-
1	10.000	10.050	0.050	0.50	10.050	0.050	0.50
2	20.000	20.120	0.120	0.60	20.150	0.150	0.75
3	30.000	30.110	0.110	0.37	30.050	0.050	0.17
4	40.000	40.030	0.030	0.08	40.030	0.030	0.08
AVERAGE (%)				0.39			0.37



CALIBRATED BY: [Signature] DATE: 25/1/16  
CHECKED BY: [Signature] DATE: 25/1/16  
NAC (NANOTECH ASSOCIATES CO., LTD.)

สำหรับการใช้ข้อมูลจากผลการทดสอบ: เจ้าหน้าที่ฝ่ายปฏิบัติการฝ่ายขาย โทร 02-868-0812 # 15-16, E-Mail : Engineer@nanotech.com  
เลขที่ 63/14-15, 67/35-36 ซอยทองหล่อ 7, 7/1 แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10600 โทร 02-868-0812-13 โทรสาร 02-868-1889

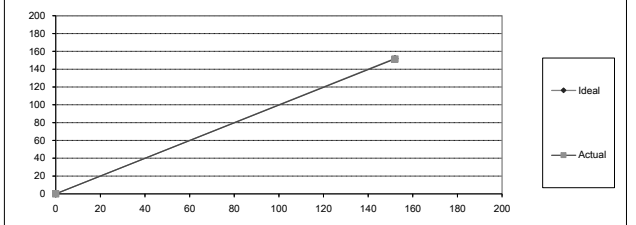


## CALIBRATION REPORT

Calibration Date	4-Jan-23	Equipment ID	BKK_FS0758
Equipment Name	FID Analyzer	Manufacturer	Baseline Mocon
Model	9000H	Serial No.	0315EF0047
Std. Gas Conc. (ppm)	152	Cylinder No.	D878173
Certified Date	27-Jun-18	Expired Date	27-Jun-26

### CALIBRATION RESULTS

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.05	0.05	0.05
SPAN	152.00	151.50	-0.50	-0.33
AVERAGE (%)				-0.14



Calibrated By

Approved By

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

(Mr. Sarayuth Jittrantont)  
Assistant General Manager



# CALIBRATION LABORATORY Co., LTD.

210-11, 14, 35 Soi Phraet Manasi 29 Yaek 4, Phraet Manasi Rd., Ladkroo, Bangkok 10230  
Tel. 02-578-0353-4 Fax. 02-578-2672 www.ccl-lab.com Email: info@ccl-lab.com



## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : VACUUM GAUGE  
MANUFACTURER : DWYER  
MODEL / TYPE : DPGA-00  
SERIAL NO. : DVG06[BKK\_FS0479]  
CLID. NO. : 212300278  
JOB CONTROL NO. : 230211016390



CUSTOMER : ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN RD.,  
KHWAENG PHATTHANAKAN, KHET SUAN LUANG, BANGKOK 10250, THAILAND

DATE OF RECEIVED : 11 February 2023 DATE OF ISSUED : 16 February 2023

Report of calibration accuracy must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

Calibrated By : Sittipong Pimdee  
Calibration Engineer



Approved By : Mongkol Yotsontorn  
Authorized Signatory  
16 February 2023

This Calibration Certificate documents the traceability in national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q23016390

F3-011-04-01-12

page 1 of 3



# CALIBRATION LABORATORY Co., LTD.

210-11, 14, 35 Soi Phraet Manasi 29 Yaek 4, Phraet Manasi Rd., Ladkroo, Bangkok 10230  
Tel. 02-578-0353-4 Fax. 02-578-2672 www.ccl-lab.com Email: info@ccl-lab.com



## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : VACUUM GAUGE  
MANUFACTURER : DWYER  
MODEL / TYPE : DPGA-00  
SERIAL NO. : DVG06[BKK\_FS0479]  
DATE OF CALIBRATION : 14 February 2023

### ENVIRONMENT CONDITIONS :

Temperature :  $(23 \pm 2) ^\circ\text{C}$

Relative Humidity :  $(55 \pm 10) \% \text{RH}$

### PROCEDURE USED :

This instrument was calibrated under procedure No. CLC-CPPP-05 according to DKD-R 6-1 as calibration guidelines.

The calibration was performed by direct measurement with Document Process Calibrator and Pressure Module which maintained by the Calibration Laboratory Co., Ltd.

### REFERENCE STANDARD USED :

Document Process Calibrator, Fluke Model 744 S/N. 9226007 with Pressure Module Model 700PV4 S/N. 19294401

### TRACEABILITY :

The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand) Certificate No. MP-0195-22, Due Date 18 November 2023.

### UNCERTAINTY :

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor of  $k = 2$ . It has been evaluated according to the "Calibration of Pressure Gauges (DKD-R 6-1)" which provides a level of confidence approximately 95%.

Certificate No. Q23016390

F3-011-04-01-12

page 2 of 3



# CALIBRATION LABORATORY Co., LTD.

210-11, 14, 35 Soi Phraet Manasi 29 Yaek 4, Phraet Manasi Rd., Ladkroo, Bangkok 10230  
Tel. 02-578-0353-4 Fax. 02-578-2672 www.ccl-lab.com Email: info@ccl-lab.com



### CONDITION OF CALIBRATION ITEM : GOOD

### MEASUREMENT RESULTS : ( X ) without adjustment ( ) adjustment

The DUC was exercised by applying a known pressure from its zero to full scale 1 times. Then 2 series of known gauge pressure were applied. The STD reading were recorded and the means value were reported in the table below.

### CALIBRATION DATA

#### CORRECTION OF PRESSURE

DUC Test point ( inHg )	STD Reading ( inHg )		Correction ( inHg )	
	Up	Down	Up	Down
0.00	0.000	0.000	0.000	0.000
-10.00	-9.985	-9.986	+0.015	+0.014
-20.00	-19.979	-19.981	+0.021	+0.019
-26.00	-25.976	-25.977	+0.024	+0.023
-27.00	-26.973	-26.974	+0.027	+0.026
-28.00	-27.971	-27.971	+0.029	+0.029

Uncertainty of measurement  $\pm 0.007$  inHg

Transmitting fluid : Air

Note: The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 36 of 54

This report is valid for the above stated instrument's only.

### End of Certificate ###

Certificate No. Q23016390

F3-011-04-01-12

page 3 of 3



# CALIBRATION LABORATORY Co., LTD.

210-11, 14, 35 Soi Phraet Manasi 29 Yaek 4, Phraet Manasi Rd., Ladkroo, Bangkok 10230  
Tel. 02-578-0353-4 Fax. 02-578-2672 www.ccl-lab.com Email: info@ccl-lab.com



## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : VACUUM GAUGE  
MANUFACTURER : DWYER  
MODEL / TYPE : DPGA-00  
SERIAL NO. : DVG08[BKK\_FS0483]  
CLID. NO. : 212300280  
JOB CONTROL NO. : 230211016392



CUSTOMER : ALS LABORATORY GROUP (THAILAND) CO., LTD.  
104 PHATTHANAKAN 40, PHATTHANAKAN RD.,  
KHWAENG PHATTHANAKAN, KHET SUAN LUANG, BANGKOK 10250, THAILAND

DATE OF RECEIVED : 11 February 2023

DATE OF ISSUED : 16 February 2023

Report of calibration accuracy must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

Calibrated By : Sittipong Pimdee  
Calibration Engineer



Approved By : Mongkol Yotsontorn  
Authorized Signatory  
16 February 2023

This Calibration Certificate documents the traceability in national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q23016392

F3-011-04-01-12

page 1 of 3





## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : VACUUM GAUGE  
MANUFACTURER : DWYER  
MODEL / TYPE : DPGA-00  
SERIAL NO. : DVG08[BKK\_FS0483]  
DATE OF CALIBRATION : 14 February 2023

#### ENVIRONMENT CONDITIONS :

Temperature :  $(23 \pm 2) ^\circ\text{C}$  Relative Humidity :  $(55 \pm 10) \% \text{RH}$

#### PROCEDURE USED :

This instrument was calibrated under procedure No. CLC-CPPP-05 according to DKD-R 6-1 as calibration guidelines.

The calibration was performed by direct measurement with Document Process Calibrator and Pressure Module which maintained by the Calibration Laboratory Co., Ltd.

#### REFERENCE STANDARD USED :

Document Process Calibrator, Fluke Model 744 S/N. 9226007 with Pressure Module Model 700PV4 S/N. 19298401.

#### TRACEABILITY :

The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand), Certificate No. MP-0195-22, Due Date 18 November 2023.

#### UNCERTAINTY :

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor of  $k=2$ . It has been evaluated according to the "Calibration of Pressure Gauges (DKD-R 6-1)" which provides a level of confidence approximately 95%.

Certificate No. Q23016392

F3-011-04/01-12

page 2 of 3



#### CONDITION OF CALIBRATION ITEM : GOOD

#### MEASUREMENT RESULTS : (X) without adjustment ( ) adjustment

The DUC was exercised by applying a known pressure from its zero to full scale 1 times. Then 2 series of known gauge pressure were applied. The STD reading were recorded and the mean value were reported in the table below.

#### CALIBRATION DATA

DUC Test point ( inHg )	STD Reading ( inHg )		Correction ( inHg )	
	Up	Down	Up	Down
0.00	0.000	0.000	0.000	0.000
-10.00	-9.961	-9.965	+0.039	+0.035
-20.00	-19.956	-19.959	+0.044	+0.041
-26.00	-25.951	-25.954	+0.049	+0.046
-27.00	-26.946	-26.948	+0.054	+0.052
-28.00	-27.939	-27.939	+0.061	+0.061

Uncertainty of measurement :  $\pm 0.007$  inHg

Transmitting fluid : Air

Note: The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 36 of 54

This report is valid for the above stated instrument's only.

### End of Certificate ###

Certificate No. Q23016392

F3-011-04/01-12

page 3 of 3



## Certificate of Calibration

Equipment: SPECTROPHOTOMETER  
Model: DR2900  
Serial No. (or ID.): 2021761 (RYG\_EN0179)  
Manufacturer: HACH  
Condition: In Condition

Certificate No.: C06220465  
Issued Date: 27 September 2022  
Job No.: KSPR2212225  
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.

REVIEW BY: N. S. S. S.  
APPROVED BY: D. S. S. S.  
NEED CAL DATE: 27/9/23

Environment Condition: Temperature  $22.5 ^\circ\text{C}$   $\pm 1.5$   $^\circ\text{C}$   
Humidity  $67.5 \% \text{RH}$   $\pm 1.5$   $\% \text{RH}$

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

Calibration By: Mr. Chaituphon Folthong

Calibration Date: 27 September 2022

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 Starra Scientific Limited.

The standard for Wavelength Certificate No. 91416 and 91435  
The standard for Photometric Certificate No. 91441  
The standard for Stray light Certificate No. 101040

(Mr. Chaituphon Folthong)  
Person in charge

(Mr. Thairongkiet Pongkum)  
Authorized signatory

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

The measurement uncertainty stated in this certificate is based on 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.

DKSH Technology Limited  
2533 Sukhumvit Road, Bangkok, Thailand 10110  
Phone: +66 2638 7000 Email: info@calibration@dksh.com Website: www.dksh.com/calibration

Delivering Growth - in Asia and Beyond.

CALFA-C06-13: 20 Jul 2022



Certificate No.: C06220465

Page 2 of 3

#### Calibration Results:

##### Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 5 nm and UUC at 5 nm

Standard Wavelength	Unit Under Calibration	Correction	Uncertainty
418.40	418	0.40	0.59
537.00	536	1.00	0.59
638.00	638	0.00	0.59
747.81	748	-0.39	0.59
807.04	807	0.04	0.59

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5605	0.562	-0.0015	0.0045
	0.7334	0.736	-0.0016	0.0045
	1.0534	1.054	-0.0006	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.5503	0.550	0.0003	0.0045
	0.7179	0.718	-0.0001	0.0045
	1.0312	1.031	0.0002	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.5024	0.506	-0.0028	0.0045
	0.9893	0.971	-0.0017	0.0045
	0.9804	0.984	-0.0036	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5198	0.519	-0.0022	0.0045
	0.6903	0.691	-0.0007	0.0045
	0.9904	0.992	-0.0016	0.0045
560 nm	0.0000	0.000	0.0000	0.0045
	0.5625	0.553	-0.0005	0.0045
	0.7175	0.717	0.0005	0.0045
	1.0301	1.030	0.0001	0.0045
535 nm	0.0000	0.000	0.0000	0.0045
	0.5367	0.538	-0.0013	0.0045
	0.6647	0.665	-0.0003	0.0045
	0.9823	0.983	-0.0007	0.0045

DKSH Technology Limited  
2533 Sukhumvit Road, Bangkok, Thailand 10110  
Phone: +66 2638 7000 Email: info@calibration@dksh.com Website: www.dksh.com/calibration

Delivering Growth - in Asia and Beyond.

CALFA-C06-13: 20 Jul 2022

Calibration Results:  
Without Adjustment

Stray light *	Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%T)	Absorbance (A)
	381.94 +/- 0.11 nm	382	4.1	1.387

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

The End of Certificate

บริษัท ดีเคเอส อีเซีย จำกัด  
DKSH Technology Limited  
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10110  
2533 Sukhumvit Road, Bangkok, Thailand, Bangkok 10110  
Phone: +66 2538 7000 Email: info.asia@dksh.com Website: www.dksh.com/asia-thailand

Delivering Growth - in Asia and Beyond.

CAL-FM-C06-13: 30 Jul 2022

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2212225

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR3800

หมายเลขเครื่อง: 2021761

ตรวจสอบ (รับ)	ตรวจสอบ (ส่ง)	หมายเหตุ
27 Sep 2022	27 Sep 2022	
ปกติ	ไม่ปกติ	
<b>General</b>		
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิตช์ เปิด - ปิด เครื่อง (On-Off Switch)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)
<b>Spectrophotometer</b>		
<input type="checkbox"/>	<input type="checkbox"/>	6. แบตเตอรี่สำรอง (Battery Backup) >= 2.5 VDC
<input type="checkbox"/>	<input type="checkbox"/>	7. ตัวควบคุมความยาวคลื่น (Wavelength Control)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check) 807 โท้ 807.0 nm
<input type="checkbox"/>	<input type="checkbox"/>	9. แสงยูวี (UV < 3,000 hour)
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. แสงที่มองเห็น (Visible < 5,000 hour)
<input type="checkbox"/>	<input type="checkbox"/>	11. ช่องวัดหลายตัวอย่าง (Carousel Module)
<b>pH Meter and Conductivity Meter</b>		
<input type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด (Electrode and Connection Cable)
<input type="checkbox"/>	<input type="checkbox"/>	13. ระดับสารละลายใน Electrode (Level KCl)
<input type="checkbox"/>	<input type="checkbox"/>	14. ฝาปิดกันเปื้อน Electrode (Dust Protection Hood)
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาตั้งอิเล็กโทรด (Stand)
<b>Turbidimeter</b>		
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นที่ต่ำสุด (No Sample)
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่น้อย 3.0)
<b>Automatic titrator</b>		
<input type="checkbox"/>	<input type="checkbox"/>	18. สภาพ Piston Burettes
<input type="checkbox"/>	<input type="checkbox"/>	19. Function Rinsing and Dosing
<input type="checkbox"/>	<input type="checkbox"/>	20. ระบบท่อจ่ายยาและอุปกรณ์ประกอบ

เพิ่มเติมหมายเหตุ :

Mr. Chattaphon Folthong  
Service Engineer

บริษัท ดีเคเอส อีเซีย จำกัด  
DKSH Technology Limited  
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10110  
2533 Sukhumvit Road, Bangkok, Thailand, Bangkok 10110  
Phone: +66 2538 7000 Email: info.asia@dksh.com Website: www.dksh.com/asia-thailand

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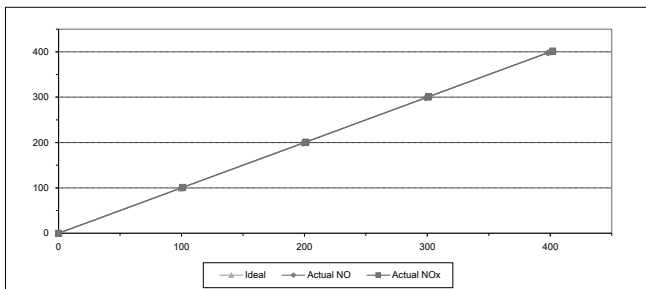
CAL-FM-RS1-03: 20 Jul 2022



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	Equipment Name	NOx Analyzer
Manufacturer	Teledyne API	Model	T200
Serial No.	7238	Equipment ID	RYG_FS0533
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.50	-0.50	-0.50	101.10	1.10	1.10
2	200.00	198.70	-1.30	-0.65	201.20	1.20	0.60
3	300.00	298.80	-1.20	-0.40	301.10	1.10	0.37
4	400.00	398.00	-2.00	-0.50	402.00	2.00	0.50
AVERAGE (%)				-0.39			0.53



Calibrated By

(Mr. Jirawut Sakam)  
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jittrantont)  
Assistant General Manager

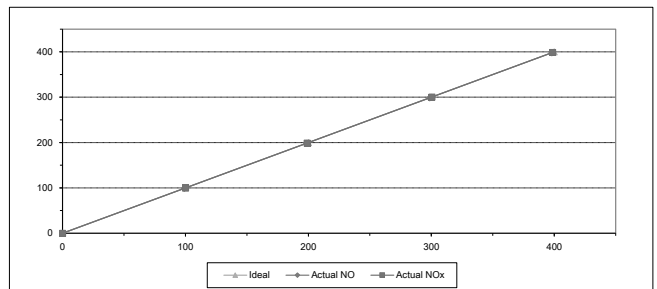
ALS Laboratory Group  
FORM NO.: F 06-056 REVISION NO.: ISSUE DATE: 02/04/12



MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	7AV88544	Equipment ID	RYG_FS0272
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.05	0.05	0.05	0.10	0.10	0.10
1	100.00	99.10	-0.90	-0.90	100.10	0.10	0.10
2	200.00	198.60	-1.40	-0.70	199.00	-1.00	-0.50
3	300.00	298.70	-1.30	-0.43	300.50	0.50	0.17
4	400.00	398.00	-2.00	-0.50	398.70	-1.30	-0.33
AVERAGE (%)				-0.50			-0.09



Calibrated By

(Mr. Jirawut Sakam)  
Field Environmental Scientist (3)

Approved By

(Mr. Sarayuth Jittrantont)  
Assistant General Manager

ALS Laboratory Group  
FORM NO.: F 06-056 REVISION NO.: ISSUE DATE: 02/04/12

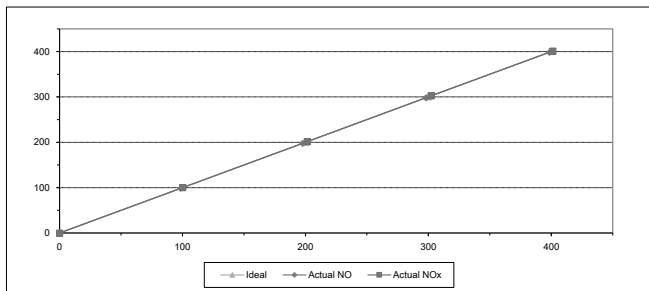




## MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	SEEAW53E	Equipment ID	RYG_FS0261
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.70	-1.30	-1.30	100.40	0.40	0.40
2	200.00	197.80	-2.20	-1.10	201.50	1.50	0.75
3	300.00	298.10	-1.90	-0.63	302.20	2.20	0.73
4	400.00	398.50	-1.50	-0.38	401.40	1.40	0.35
AVERAGE (%)				-0.66			0.47



Calibrated By

( Mr.Jirawut Sakam )  
Field Environmental Scientist (3)

Approved By

( Mr.Sarayuth Jitranont )  
Assistant General Manager

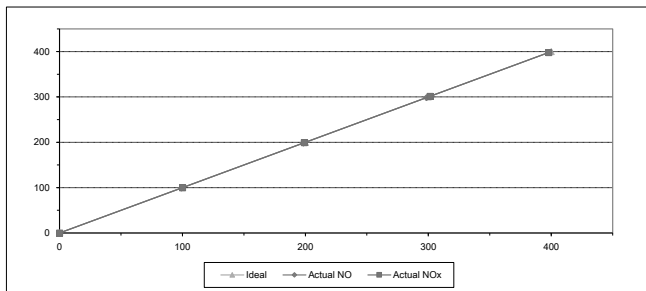
ALS Laboratory Group  
FORM NO.: F 06-056 REVISION NO.: ISSUE DATE: 02/04/12



## MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	8G314J3K	Equipment ID	RYG_FS0264
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.05	0.05	0.05	0.10	0.10	0.10
1	100.00	99.20	-0.80	-0.80	100.10	0.10	0.10
2	200.00	198.40	-1.60	-0.80	199.10	-0.90	-0.45
3	300.00	298.60	-1.40	-0.47	301.50	1.50	0.50
4	400.00	398.10	-1.90	-0.47	398.00	-2.00	-0.50
AVERAGE (%)				-0.50			-0.05



Calibrated By

( Mr.Jirawut Sakam )  
Field Environmental Scientist (3)

Approved By

( Mr.Sarayuth Jitranont )  
Assistant General Manager

ALS Laboratory Group  
FORM NO.: F 06-056 REVISION NO.: ISSUE DATE: 02/04/12

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Agilent CrossLab Compliance Services

## Certificate of System Qualification

GC-OQ + GCMS-OQ

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

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

## CDS Logon Verification - GC

Logon: dej.changchon

## Overall CDS Logon Verification - GC Test Status

Pass

## System Inspection and Basic Safety and Operation

Name: 7890  
Setpoint Status: Pass

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

Pass

## Inlet Pressure Accuracy

Name: 7890  
Front SSL  
Setpoint Status: Pass  
Setpoint: 25.0 psi  
Actual: 25.1 psi  
Accuracy: 0.1 psi  
Agilent Recommended: <= 1.2

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

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Agilent CrossLab Compliance Services

## Overall Inlet Pressure Accuracy Test Status

Pass

## GC Oven Temperature Accuracy

Name: 7890  
Setpoint Status: Pass  
Zone: Oven  
Setpoint/Actual  
Temperature: 230.0 230.6 °C  
Accuracy: 0.6 °C  
Agilent Recommended: >= -1.0 % setpoint in K ( -5.0 °C )  
<= 1.0 % setpoint in K ( 5.0 °C )  
Setpoint Status: Pass  
Zone: Oven  
Setpoint/Actual  
Temperature: 100.0 99.9 °C  
Accuracy: -0.1 °C  
Agilent Recommended: >= -1.0 % setpoint in K ( -3.7 °C )  
<= 1.0 % setpoint in K ( 3.7 °C )

## Overall GC Oven Temperature Accuracy Test Status

Pass

## GC Oven Temperature Stability

Name: 7890  
Setpoint Status: Pass  
Setpoint/Average  
Temperature: 100.0 99.91667 °C  
Stability: 0.1 °C  
Agilent Recommended: <= 0.5

## Overall GC Oven Temperature Stability Test Status

Pass

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

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## Log Amp

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

## Overall Log Amp Test Status

Pass
------

## RFPA

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

Amu:	1050	m/z	Drift After Five Minutes:	-1	mV	RFPA Voltage:	479	mV
Agilent Recommended:	>=	-100	and	<=	100	<=	1100	

## Overall RFPA Test Status

Pass
------

## Tune EI

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

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

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

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

## Overall Tune EI Test Status

Pass
------

## Signal to Noise EI

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

Tested Combination1	Front	SSL	/ External	SQ
Name:	5977B			

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

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

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

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

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

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

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

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

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

## Overall Signal to Noise EI Test Status

Pass
------

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

## Instrument Details

## Purpose

This section describes the as found system configuration.

## Details

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

Tested Combination1	
Injection Technique	Manual Injection
Inlet	Front
Detector	External
LTM Included?	No

Sampler 1	
Manufacturer	Agilent Technologies
Type	Manual Injection
Usage	Sample Injection
Syringe Volume (µL)	10

Mainframe 1	
Manufacturer	Agilent Technologies
Name	7890
Model Number	G3442B
Serial Number	CN16463238
Firmware Revision	B.02.04.3
Component ID/Asset No.	081117000236
Oven Type	Standard

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

## Inlet 1

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

## Detector 1

Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External

## Mass Spectrometer 1

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

## MS EI Source 1

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

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

## Electronic Signature

### Purpose

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

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

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User Name: eaknarin\_puangsope  
Hostname: ASRYGW7002

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

#### ALS\_RYG\_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 6, 2022 1:11:54 PM	Audit	SessionCreated	Session	None
July 6, 2022 1:11:54 PM	Start	Configuration	Session	None
July 6, 2022 1:11:54 PM	Audit	Entitlement	Licensing	User is Nonpaying and does not require an unlock code
July 6, 2022 1:17:19 PM	Audit	EqLoaded	Session	EQP details for primary technique [Sc] - File path: [ProtocolPacks\Go\Configurations\02.52\GcMs\02.52.eqp], EQP File Name: [Sc.02.52.eqp], EQP Name: [AgilentRecommended] EQP details for hyphenated technique [ScMs] - File path: [ProtocolPacks\GcMs\Configurations\02.52\GcMs\02.52.eqp], EQP File Name: [GcMs.02.52.eqp], EQP Name: [AgilentRecommended]
July 6, 2022 1:17:25 PM	End	Configuration	Session	None
July 6, 2022 1:17:29 PM	Start	Qualification	Session	OQ
July 6, 2022 1:17:30 PM	Start	Execution	CDS Logon Verification - GC : - Qualitative test	None
July 6, 2022 1:19:43 PM	End	Execution	CDS Logon Verification - GC : - Qualitative test	Run Count : 1
July 6, 2022 1:19:48 PM	Start	Execution	System Inspection and Basic Safety and Operation - 7890 : - Qualitative Test - No setpoints associated	None

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

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User Name: eaknarin\_puangsope  
Hostname: ASRYGW7002

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

#### ALS\_RYG\_EN0136 Transaction log :

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

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

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User Name: eaknarin\_puangsope  
Hostname: ASRYGW7002

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

#### ALS\_RYG\_EN0136 Transaction log :

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

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

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User Name: eaknarin\_puangsoipa  
Hostname: ASRYGW7002

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

## ALS\_RYG\_EN0136 Transaction log :

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

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

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User Name: eaknarin\_puangsoipa  
Hostname: ASRYGW7002

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

## ALS\_RYG\_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 6, 2022 2:55:40 PM	End	Execution	Tune EI - 5977B SQ: - Source: - Run Count : 1 EI - Extractor Filament 2 (Qualitative - No setpoints associated)	
July 6, 2022 2:56:45 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
July 6, 2022 3:21:52 PM	End	Qualification	Session	OQ
July 6, 2022 3:21:52 PM	Start	Reporting	Session	None
July 6, 2022 3:25:04 PM	End	Reporting	Session	None
July 6, 2022 3:25:04 PM	Start	Qualification	Session	OQ
July 6, 2022 3:25:04 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
July 6, 2022 4:06:40 PM	Audit	AccClosed	Session	None
July 7, 2022 9:13:47 AM	Audit	AccRestarted	Session	None
July 7, 2022 9:13:49 AM	Audit	SessionReloaded	Session	None
July 7, 2022 9:13:54 AM	Start	Qualification	Session	OQ
July 7, 2022 9:13:54 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
July 7, 2022 9:58:06 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : D:\OQ2022\OFN_SN_F01.D

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

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User Name: eaknarin\_puangsoipa  
Hostname: ASRYGW7002

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

## ALS\_RYG\_EN0136 Transaction log :

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

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

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User Name: eaknarin\_puangsoipa  
Hostname: ASRYGW7002

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

## ALS\_RYG\_EN0136 Transaction log :

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

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

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User Name: eaknarin\_puangsoipa  
Hostname: ASRYGW7002

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

## ALS\_RYG\_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 7, 2022 10:15:27 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Run Count : 5
July 7, 2022 10:16:48 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Deviation filed for Run Count : 5
July 7, 2022 10:16:48 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
July 7, 2022 10:17:05 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : D:\OQ2022\OQFN_SN_F01.D
July 7, 2022 10:17:14 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Run Count : 6
July 7, 2022 10:18:40 AM	End	Qualification	Session	OQ
July 7, 2022 10:18:40 AM	Start	Reporting	Session	None
July 7, 2022 10:21:10 AM	End	Reporting	Session	None
July 7, 2022 10:21:10 AM	Start	Qualification	Session	OQ
July 7, 2022 10:21:17 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
July 7, 2022 10:56:49 AM	End	Qualification	Session	OQ
July 7, 2022 10:56:49 AM	Start	Reporting	Session	None
July 7, 2022 10:57:38 AM	End	Reporting	Session	None

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

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User Name: eaknarin\_puangsoipa  
Hostname: ASRYGW7002

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

## ALS\_RYG\_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 7, 2022 10:57:38 AM	Start	Qualification	Session	OQ
July 7, 2022 10:57:38 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
July 7, 2022 11:05:50 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : D:\OQ2022\OQFN_SN_F021.D
July 7, 2022 11:11:47 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
July 7, 2022 11:13:13 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Run Count : 1
July 7, 2022 11:14:29 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Deviation filed for Run Count : 1
July 7, 2022 11:14:29 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
July 7, 2022 11:14:47 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : D:\OQ2022\OQFN_SN_F021.D
July 7, 2022 11:16:34 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Run Count : 2

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

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User Name: eaknarin\_puangsoipa  
Hostname: ASRYGW7002

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

## ALS\_RYG\_EN0136 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
July 7, 2022 11:19:58 AM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Deviation filed for Run Count : 2
July 7, 2022 11:19:58 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
July 7, 2022 11:20:13 AM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : D:\OQ2022\OQFN_SN_F021.D
July 7, 2022 11:21:52 AM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Run Count : 3
July 7, 2022 11:22:49 AM	End	Qualification	Session	OQ
July 7, 2022 11:22:49 AM	Start	Reporting	Session	None
July 7, 2022 11:26:46 AM	Audit	Reporting	Session	Report Generated : Certificate

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

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## ROTA METER CALIBRATION RESULT JANUARY 2023

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R <sup>2</sup> )
BKK_FS0577	03 Jan 23	Y = 1.0259x - 0.6354	0.9997
BKK_FS0579	05 Jan 23	Y = 1.0005x + 0.2803	1.0000
BKK_FS0583	05 Jan 23	Y = 0.9976x + 1.2146	1.0000
BKK_FS0584	03 Jan 23	Y = 1.0104x - 0.3929	1.0000
BKK_FS0586	05 Jan 23	Y = 1.001x - 1.3619	0.9999
BKK_FS0587	03 Jan 23	Y = 1.0038x + 0.881	1.0000
BKK_FS0588	05 Jan 23	Y = 1.0015x - 0.6876	0.9999
BKK_FS0590	05 Jan 23	Y = 0.9958x + 1.7452	1.0000
BKK_FS0591	03 Jan 23	Y = 0.9677x + 64.54	0.9951
BKK_FS0593	03 Jan 23	Y = 0.9792x + 21.393	0.9972
BKK_FS0594	03 Jan 23	Y = 1.0455x - 43.344	0.9976
BKK_FS0595	05 Jan 23	Y = 0.9993x + 1.18	1.0000
BKK_FS0597	05 Jan 23	Y = 0.9788x + 22.286	0.9971
BKK_FS1004	03 Jan 23	Y = 0.9943x + 7.1619	0.9996
BKK_FS1005	03 Jan 23	Y = 1.0045x + 2.1167	0.9998
BKK_FS1006	03 Jan 23	Y = 1.0288x - 0.3852	0.9999
BKK_FS1008	03 Jan 23	Y = 1.0181x + 0.1282	0.9998
BKK_FS1009	05 Jan 23	Y = 1.0018x + 1.1293	1.0000
BKK_FS1011	03 Jan 23	Y = 1.0463x - 1.9344	0.9985
BKK_FS1012	03 Jan 23	Y = 1.0082x - 53.425	0.9999
BKK_FS1013	03 Jan 23	Y = 1.0058x - 9.701	1.0000
BKK_FS1014	05 Jan 23	Y = 0.9869x + 1.2643	0.9995
BKK_FS1015	05 Jan 23	Y = 1.004x - 0.7571	0.9999
BKK_FS1016	05 Jan 23	Y = 0.978x + 24.623	0.9973
BKK_FS1017	17 Jan 23	Y = 1.0022x + 0.4211	1.0000
BKK_FS1018	17 Jan 23	Y = 0.9893x + 5.8317	1.0000
BKK_FS1019	17 Jan 23	Y = 0.9859x - 11.574	0.9986
BKK_FS1020	03 Jan 23	Y = 1.0208x - 0.6221	0.9998
BKK_FS1021	03 Jan 23	Y = 0.992x - 44.599	0.9997
BKK_FS1022	03 Jan 23	Y = 1.0067x - 12.483	0.9999
BKK_FS1023	03 Jan 23	Y = 1.0013x + 0.5823	0.9993
BKK_FS1024	03 Jan 23	Y = 1.0036x - 50.787	0.9999
BKK_FS1025	03 Jan 23	Y = 0.974x + 27.034	0.9969
BKK_FS1026	05 Jan 23	Y = 0.9783x + 1.7075	0.9991
BKK_FS1027	05 Jan 23	Y = 1.145x - 90.325	0.9797
BKK_FS1028	05 Jan 23	Y = 0.9815x + 13.626	0.9969
BKK_FS1029	03 Jan 23	Y = 0.9706x + 3.6283	0.9951
BKK_FS1030	03 Jan 23	Y = 1.0197x - 52.982	0.9999
BKK_FS1031	03 Jan 23	Y = 0.9995x - 0.1581	1.0000



## ROTA METER CALIBRATION RESULT JANUARY 2023

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

Review By :

(Mr. Wichan Choonharat)  
Enviro Field Services Manager

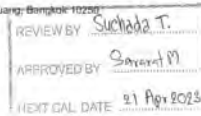
Approved By :

(Mr. Sarayuth Jittrantoni)  
Assistant General Manager

## Certificate of System Qualification

GC-00

System ID: GC-6  
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.  
Organization Location: 104 Phattanakarn 40, Phattanakarn Rd., Suan Luang, Bangkok 10250  
Date: October 21, 2021 10:05:40 AM  
EQP Name: AgilentRecommended  
EQP Revision: GC-02 50  
Overall Qualification Status: Pass



## System Inspection and Basic Safety and Operation

Name: 7890  
Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status  
Pass

## Inlet Pressure Decay

Name: 7890  
Front SSL  
Setpoint Status: Pass  
Pressure: 25.0 psi  
Pressure Change: 0.0 psi (5 minutes)  
Agilent Recommended: >= -2.0 and <= 0.5

Overall Inlet Pressure Decay Test Status  
Pass

## Inlet Pressure Accuracy

Name: 7890  
Front SSL

Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

Setpoint Status: Pass

Setpoint: 25.0 psi  
Actual: 24.9 psi  
Accuracy: 0.1 psi  
Agilent Recommended: <= 1.2

Overall Inlet Pressure Accuracy Test Status  
Pass

## Inlet Pressure Decay

Name: 7890  
Back SSL  
Setpoint Status: Pass  
Pressure: 25.0 psi  
Pressure Change: 0.0 psi (5 minutes)  
Agilent Recommended: >= -2.0 and <= 0.5

Overall Inlet Pressure Decay Test Status  
Pass

## Inlet Pressure Accuracy

Name: 7890  
Back SSL  
Setpoint Status: Pass  
Setpoint: 25.0 psi  
Actual: 24.9 psi  
Accuracy: 0.1 psi  
Agilent Recommended: <= 1.2

Overall Inlet Pressure Accuracy Test Status  
Pass

## Detector Flow Accuracy

Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

Name: 7890  
Front FID  
Setpoint Status: Pass  
Flow Type: Fuel  
Setpoint: 30.0 mL/min Measured Flow: 30.5 mL/min  
Accuracy: 0.5 mL/min  
Agilent Recommended: <= 10.0 % setpoint ( 3.0 mL/min )  
Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status: Pass  
Flow Type: Oxidizer  
Setpoint: 400.0 mL/min Measured Flow: 394.0 mL/min  
Accuracy: 6.0 mL/min  
Agilent Recommended: <= 10.0 % setpoint ( 40.0 mL/min )  
Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status: Pass  
Flow Type: Makeup  
Setpoint: 25.0 mL/min Measured Flow: 24.2 mL/min  
Accuracy: 0.8 mL/min  
Agilent Recommended: <= 10.0 % setpoint ( 2.5 mL/min )  
Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Overall Detector Flow Accuracy Test Status  
Pass

## Detector Flow Accuracy

Name: 7890  
Back FID

Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

**Setpoint Status:** Pass

Flow Type: Fuel

Setpoint: 30.0 mL/min Measured Flow: 29.1 mL/min

Accuracy: 0.9 mL/min

Agilent Recommended: <= 10.0 % setpoint ( 3.0 mL/min )

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

**Setpoint Status:** Pass

Flow Type: Oxidizer

Setpoint: 400.0 mL/min Measured Flow: 397.3 mL/min

Accuracy: 2.7 mL/min

Agilent Recommended: <= 10.0 % setpoint ( 40.0 mL/min )

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

**Setpoint Status:** Pass

Flow Type: Makeup

Setpoint: 25.0 mL/min Measured Flow: 24.4 mL/min

Accuracy: 0.6 mL/min

Agilent Recommended: <= 10.0 % setpoint ( 2.5 mL/min )

Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

**Overall Detector Flow Accuracy Test Status**

Pass

**GC Oven Temperature Accuracy**

Name: 7890

Date: October 21, 2021 10:55:40 AM  
System ID: GC-6

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**Setpoint Status:** Pass

Zone: Oven

Setpoint/Actual: 230.0 231.5 °C

Temperature: 230.0 231.5 °C

Accuracy: 1.5 °C

Agilent Recommended: >= -1.0 % setpoint in K ( -5.0 °C )  
<= 1.0 % setpoint in K ( 5.0 °C )

**Setpoint Status:** Pass

Zone: Oven

Setpoint/Actual: 100.0 100.5 °C

Temperature: 100.0 100.5 °C

Accuracy: 0.5 °C

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

**Overall GC Oven Temperature Accuracy Test Status**

Pass

**GC Oven Temperature Stability**

Name: 7890

**Setpoint Status:** Pass

Setpoint/Average: 100.0 100.4667 °C

Temperature: 100.0 100.4667 °C

Stability: 0.1 °C

Agilent Recommended: <= 0.5

**Overall GC Oven Temperature Stability Test Status**

Pass

**Scouting Run**

Tested Combination1 Front SSL / Front FID

Injection Tower

Name: 7693A

Date: October 21, 2021 10:55:40 AM  
System ID: GC-6

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**Setpoint Status:** Completed

Injection Volume on Column: 1.0 µL

**Overall Scouting Run Status**

Completed

**Noise and Drift**

Tested Combination1 Front SSL / Front FID

Name: 7890

**Setpoint Status:** Pass

Base Signal: 12.7 pA

ASTM Noise: 0.06 pA

Drift: 0.10 pA/hr

Agilent Recommended: <= 0.10 <= 2.50

Status: Pass Pass

**Overall Noise and Drift Test Status**

Pass

**Injection Precision**

Tested Combination1 Front SSL / Front FID

Name: 7693A

**Setpoint Status:** Pass

Injection Volume on Column: 1.0 µL

Area RSD: 0.42 %

Retention Time RSD: 0.16 %

Agilent Recommended: <= 3.00 <= 1.00

**Overall Injection Precision Test Status**

Pass

**Signal to Noise**

Date: October 21, 2021 10:55:40 AM  
System ID: GC-6

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Tested Combination1 Front SSL / Front FID

Injection Tower

Name: 7890

**Setpoint Status:** Pass

Signal to Noise: 1174861

Agilent Recommended: >= 300000

**Overall Signal to Noise Test Status**

Pass

**Scouting Run**

Tested Combination2 Back SSL / Back FID

Injection Tower

Name: 7693A

**Setpoint Status:** Completed

Injection Volume on Column: 1.0 µL

**Overall Scouting Run Status**

Completed

**Noise and Drift**

Tested Combination2 Back SSL / Back FID

Name: 7890

**Setpoint Status:** Pass

Base Signal: 10.4 pA

ASTM Noise: 0.05 pA

Drift: 0.00 pA/hr

Agilent Recommended: <= 0.10 <= 2.50

Status: Pass Pass

Date: October 21, 2021 10:55:40 AM  
System ID: GC-6

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## Overall Noise and Drift Test Status

Pass

## Injection Precision

Tested Combination2 Back SSL / Back FID  
Name: 7893A

Setpoint Status: Pass

Injection Volume on Column: 1.0 µL

Area RSD: 1.16 % Retention Time RSD: 0.12 %

Agilent Recommended: &lt;= 3.00 &lt;= 1.00

## Overall Injection Precision Test Status

Pass

## Signal to Noise

Tested Combination2 Back SSL / Back FID  
Injection Tower  
Name: 7890

Setpoint Status: Pass

Signal to Noise: 805466

Agilent Recommended: &gt;= 300000

## Overall Signal to Noise Test Status

Pass

Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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## Instrument Details

## Purpose

This section describes the as found system configuration

## Details

## System

System ID GC-6  
Manufacturer Agilent Technologies  
Name 7890  
Flow Data Input Manual Data  
Temperature Data Input Manual Data or Other Data Logging

## Tested Combination1

Injection Technique Injection Tower  
Sampler Identifier Sampler 2  
Inlet Front  
Detector Front  
LTM Included? No

## Tested Combination2

Injection Technique Injection Tower  
Sampler Identifier Sampler 3  
Inlet Back  
Detector Back  
LTM Included? No

## Sampler 1

Manufacturer Agilent Technologies  
Type Tray  
Name 7893A  
Model Number G4514A  
Serial Number CN15380030  
Firmware Revision A.11.01  
Val Heater Not Installed

Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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## Sampler 2

Manufacturer Agilent Technologies  
Type Injection Tower  
Name 7893A  
Model Number G4513A  
Serial Number CN10340103  
Firmware Revision A.10.09  
Usage Sample Injection  
Location Front  
Syringe Volume (µL) 10

## Sampler 3

Manufacturer Agilent Technologies  
Type Injection Tower  
Name 7893A  
Model Number G4513A  
Serial Number CN16280128  
Firmware Revision A.10.09  
Usage Sample Injection  
Location Back  
Syringe Volume (µL) 10

## Mainframe 1

Manufacturer Agilent Technologies  
Name 7890  
Model Number G3440A  
Serial Number CN11461060  
Firmware Revision Version 4.27  
Component ID/Asset No. GC-6  
Oven Type Standard

Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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## Inlet 1

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

## Inlet 2

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

## Detector 1

Manufacturer Agilent Technologies  
Name 7890  
Type FID  
Adapter Capillary  
Control Type Electronic Pressure Control (EPC)  
Location Front  
Makeup Gas Nitrogen

## Detector 2

Manufacturer Agilent Technologies  
Name 7890  
Type FID  
Adapter Capillary  
Control Type Electronic Pressure Control (EPC)  
Location Back  
Makeup Gas Nitrogen

Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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## Electronic Signature

### Purpose

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### Details

Full Name of Signer: Suriya Thongkiew  
Logged On User Name: suriya.thongkiew@non.agilent.com  
Signature Creation Date: October 21, 2021  
Reason for Signature: Executed protocol and published this original version of document

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Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

User Name: suriya.thongkiew  
Host Name: ASDKXW7915  
System ID: GC-6  
Print Date: October 21, 2021 10:05:40 AM

### QC GC ALS CH1461066 Transaction log

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 20, 2021 12:19:50 PM	Auth	SessionCreated	Session	None
October 20, 2021 12:19:50 PM	Start	Configuration	Session	None
October 20, 2021 12:19:50 PM	Auth	Enrollment	License	User is Nonpaying and does not require an unlock code
October 20, 2021 12:24:57 PM	Auth	EngLanded	Session	EOP details for primary technique (SQ) - File path: (Protocol\wabs\GC\Configure\smc02110c101311.esq) EOP File Name: (GC 02.01.esq), EOP Name: (AgilentRecommended)
October 20, 2021 12:25:02 PM	End	Configuration	Session	None
October 20, 2021 12:25:06 PM	Start	Qualification	Session	QC
October 20, 2021 12:25:08 PM	Start	Execution	System Inspection and Basic Safety and Operation - 7650 - Qualitative Test - No sample associated	None
October 20, 2021 12:30:25 PM	End	Execution	System Inspection and Basic Safety and Operation - 7650 - Qualitative Test - No sample associated	Run Count: 1
October 20, 2021 12:38:28 PM	Start	Execution	Intel Pressure Decay - Front SSI - Pressure Controlled Inlet - S: 25.0 psi - L: -2.0 psi and -1.0 psi	None

Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

User Name: suriya.thongkiew  
Host Name: ASDKXW7915  
System ID: GC-6  
Print Date: October 21, 2021 10:05:40 AM

### QC GC ALS CH1461066 Transaction log

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 20, 2021 1:02:18 PM	End	Execution	Intel Pressure Decay - Front SSI - Pressure Controlled Inlet - S: 25.0 psi - L: -2.0 psi and -1.0 psi	Run Count: 1
October 20, 2021 1:02:18 PM	Start	Execution	Intel Pressure Accuracy - Front SSI - Pressure Controlled Inlet - S: 25.0 psi - L: -1.2 psi	None
October 20, 2021 1:02:26 PM	End	Execution	Intel Pressure Accuracy - Front SSI - Pressure Controlled Inlet - S: 25.0 psi - L: -1.2 psi	Run Count: 1
October 20, 2021 1:02:25 PM	Start	Execution	Intel Pressure Decay - Back SSI - Pressure Controlled Inlet - S: 25.0 psi - L: -2.0 psi and -1.0 psi	None
October 20, 2021 1:04:21 PM	End	Execution	Intel Pressure Decay - Back SSI - Pressure Controlled Inlet - S: 25.0 psi - L: -2.0 psi and -1.0 psi	Run Count: 1
October 20, 2021 1:07:53 PM	Start	Execution	Intel Pressure Accuracy - Back SSI - Pressure Controlled Inlet - S: 25.0 psi - L: -1.2 psi	None
October 20, 2021 1:08:11 PM	End	Execution	Intel Pressure Accuracy - Back SSI - Pressure Controlled Inlet - S: 25.0 psi - L: -1.2 psi	Run Count: 1
October 20, 2021 1:08:16 PM	Start	Execution	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: -10.0% setpoint	None
October 20, 2021 1:10:23 PM	Auth	Diag	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: -10.0% setpoint	Manual Data Entry
October 20, 2021 1:20:26 PM	End	Execution	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: -10.0% setpoint	Run Count: 1

Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

User Name: suriya.thongkiew  
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System ID: GC-6  
Print Date: October 21, 2021 10:05:40 AM

### QC GC ALS CH1461066 Transaction log

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 20, 2021 1:30:29 PM	Start	Execution	Detector Flow Accuracy - Front FID - Type: Fuel - S: 400.0 mL/min - L: -10.0% setpoint	None
October 20, 2021 1:33:27 PM	Auth	Diag	Detector Flow Accuracy - Front FID - Type: Fuel - S: 400.0 mL/min - L: -10.0% setpoint	Manual Data Entry
October 20, 2021 1:33:29 PM	End	Execution	Detector Flow Accuracy - Front FID - Type: Fuel - S: 400.0 mL/min - L: -10.0% setpoint	Run Count: 1
October 20, 2021 1:33:31 PM	Start	Execution	Detector Flow Accuracy - Front FID - Type: Makeup - S: 25.0 mL/min - L: -10.0% setpoint	None
October 20, 2021 1:37:40 PM	Auth	Diag	Detector Flow Accuracy - Front FID - Type: Makeup - S: 25.0 mL/min - L: -10.0% setpoint	Manual Data Entry
October 20, 2021 1:37:42 PM	End	Execution	Detector Flow Accuracy - Front FID - Type: Makeup - S: 25.0 mL/min - L: -10.0% setpoint	Run Count: 1
October 20, 2021 1:37:46 PM	Start	Execution	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: -10.0% setpoint	None
October 20, 2021 1:37:50 PM	Auth	Diag	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: -10.0% setpoint	Manual Data Entry
October 20, 2021 1:37:51 PM	End	Execution	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: -10.0% setpoint	Run Count: 1
October 20, 2021 1:37:54 PM	Start	Execution	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: -10.0% setpoint	None
October 20, 2021 1:37:54 PM	Auth	Diag	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: -10.0% setpoint	Manual Data Entry

Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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User Name: suriya.thongkham Hostname: A580K67915		System ID: GC-6 Print Date: October 21, 2021 10:05:40 AM		
OQ GC ALS CN11461066 Transaction log:				
Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2021 9:33:01 AM	Start	Execution	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Run Count: 1
October 21, 2021 9:33:28 AM	Start	Execution	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L <= 300000	None
October 21, 2021 9:34:01 AM	Avail	Data	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L <= 300000	Data File Path: C:\ChemStation\DATA\OQPV20\21OQPV2021_B 2021-10-20 16-11-18\SGTONG_0001.D\FID1A.ch
October 21, 2021 9:34:15 AM	Start	Execution	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L <= 300000	Run Count: 1
October 21, 2021 9:34:16 AM	Start	Execution	OQ Scouting Run - Injection Tower, Back SSL, Back FID - Part of System Preparation - No limit associated	None
October 21, 2021 9:35:04 AM	Avail	Data	OQ Scouting Run - Injection Tower, Back SSL, Back FID - Part of System Preparation - No limit associated	Data File Path: C:\ChemStation\DATA\OQPV20\21OQPV2021_B 2021-10-20 17-13-45\SGTONG_0001.D\FID2B.ch
October 21, 2021 9:35:29 AM	Start	Execution	OQ Scouting Run - Injection Tower, Back SSL, Back FID - Part of System Preparation - No limit associated	Run Count: 1
October 21, 2021 9:35:30 AM	Start	Execution	Attest and Det - Back FID - Detector FID - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	None

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Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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User Name: suriya.thongkham Hostname: A580K67915		System ID: GC-6 Print Date: October 21, 2021 10:05:40 AM		
OQ GC ALS CN11461066 Transaction log:				
Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2021 9:36:08 AM	Start	Data	Attest and Det - Back FID - Detector FID - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\ChemStation\DATA\OQPV20\21OQPV2021_B 2021-10-20 17-13-45\SGTONG_0001.D\FID2B.ch
October 21, 2021 9:36:19 AM	Start	Execution	Attest and Det - Back FID - Detector FID - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Run Count: 1
October 21, 2021 9:36:30 AM	Start	Execution	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	None
October 21, 2021 9:36:37 AM	Avail	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\ChemStation\DATA\OQPV20\21OQPV2021_B 2021-10-20 17-13-45\SGTONG_0001.D\FID2B.ch
October 21, 2021 9:36:57 AM	Avail	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\ChemStation\DATA\OQPV20\21OQPV2021_B 2021-10-20 17-13-45\SGTONG_0001.D\FID2B.ch
October 21, 2021 9:36:57 AM	Avail	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\ChemStation\DATA\OQPV20\21OQPV2021_B 2021-10-20 17-13-45\SGTONG_0001.D\FID2B.ch
October 21, 2021 9:36:57 AM	Avail	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\ChemStation\DATA\OQPV20\21OQPV2021_B 2021-10-20 17-13-45\SGTONG_0001.D\FID2B.ch

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Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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User Name: suriya.thongkham Hostname: A580K67915			System ID: GC-6 Print Date: October 21, 2021 10:05:40 AM	
OQ GC ALS CN11461066 Transaction log:				
Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 21, 2021 9:36:57 AM	Avail	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\ChemStation\DATA\OQPV20\21OQPV2021_B 2021-10-20 17-13-45\SGTONG_0001.D\FID2B.ch
October 21, 2021 9:36:57 AM	Avail	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path: C:\ChemStation\DATA\OQPV20\21OQPV2021_B 2021-10-20 17-13-45\SGTONG_0001.D\FID2B.ch
October 21, 2021 9:36:58 AM	End	Execution	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Run Count: 1
October 21, 2021 9:36:11 AM	Start	Execution	Signal to Noise - Injection Tower, Back SSL, Back FID - Detector FID - L <= 300000	None
October 21, 2021 9:36:26 AM	Avail	Data	Signal to Noise - Injection Tower, Back SSL, Back FID - Detector FID - L <= 300000	Data File Path: C:\ChemStation\DATA\OQPV20\21OQPV2021_B 2021-10-20 17-13-45\SGTONG_0001.D\FID2B.ch
October 21, 2021 9:36:39 AM	End	Execution	Signal to Noise - Injection Tower, Back SSL, Back FID - Detector FID - L <= 300000	Run Count: 1
October 21, 2021 9:36:43 AM	End	Qualification	Setpoint	OQ
October 21, 2021 9:36:43 AM	Start	Reporting	Setpoint	None
October 21, 2021 10:04:16 AM	Avail	Reporting	Setpoint	Report Generated Certificate

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Date: October 21, 2021 10:05:40 AM  
System ID: GC-6

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Certificate of System Qualification  
GC-OQSystem ID: CN11461066  
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.  
Organization Location: 104 Soi 40 Phatthanasri Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250Date: April 21, 2023 3:26:38 PM  
EQP Name: AgilentRecommended  
EQP Revision: GC.02.52  
Overall Qualification Status: Pass

CDS Logon Verification - GC

Logon: Saenguthai Tarak

Overall CDS Logon Verification - GC Test Status

Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Decay

Name: 7890

Front SSL

Setpoint Status: Pass

Pressure: 25.0 psi

Pressure Change: -0.1 psi

Agilent Recommended: &gt;= -2.0 and &lt;= 0.5

Date: April 21, 2023 3:26:38 PM  
System ID: CN11461066

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## Overall Inlet Pressure Decay Test Status

Pass

## Inlet Pressure Accuracy

Name: 7890  
Front SSL

## Setpoint Status:

Pass

Setpoint Actual  
Inlet Pressure: 25.0 psi 25.2 psi  
Accuracy: 0.2 psi  
Agilent Recommended: <= 1.2

## Overall Inlet Pressure Accuracy Test Status

Pass

## Inlet Pressure Decay

Name: 7890  
Back SSL

## Setpoint Status:

Pass

Pressure: 25.0 psi  
Pressure Change: 0.0 psi /5 minutes  
Agilent Recommended: >= -2.0 and <= 0.5

## Overall Inlet Pressure Decay Test Status

Pass

## Inlet Pressure Accuracy

Name: 7890  
Back SSLDate: April 21, 2023 3:26:38 PM  
System ID: CN11481066

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## Setpoint Status:

Pass

Setpoint Actual  
Inlet Pressure: 25.0 psi 24.8 psi  
Accuracy: 0.2 psi  
Agilent Recommended: <= 1.2

## Overall Inlet Pressure Accuracy Test Status

Pass

## Detector Flow Accuracy

Name: 7890  
Front FID

## Setpoint Status:

Pass

Flow Type: Fuel  
Setpoint: 30.0 mL/min Measured Flow: 28.9 mL/min  
Accuracy: 1.1 mL/min  
Agilent Recommended: <= 10.0 % setpoint ( 3.0 mL/min )  
Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

## Setpoint Status:

Pass

Flow Type: Oxidizer  
Setpoint: 400.0 mL/min Measured Flow: 400 mL/min  
Accuracy: 0.0 mL/min  
Agilent Recommended: <= 10.0 % setpoint ( 40.0 mL/min )  
Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

## Setpoint Status:

Pass

Flow Type: Makeup  
Setpoint: 25.0 mL/min Measured Flow: 24.9 mL/min  
Accuracy: 0.1 mL/min  
Agilent Recommended: <= 10.0 % setpoint ( 2.5 mL/min )  
Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.Date: April 21, 2023 3:26:38 PM  
System ID: CN11481066

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## Overall Detector Flow Accuracy Test Status

Pass

## Detector Flow Accuracy

Name: 7890  
Back FID

## Setpoint Status:

Pass

Flow Type: Fuel  
Setpoint: 30.0 mL/min Measured Flow: 30.7 mL/min  
Accuracy: 0.7 mL/min  
Agilent Recommended: <= 10.0 % setpoint ( 3.0 mL/min )  
Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

## Setpoint Status:

Pass

Flow Type: Oxidizer  
Setpoint: 400.0 mL/min Measured Flow: 399 mL/min  
Accuracy: 1.0 mL/min  
Agilent Recommended: <= 10.0 % setpoint ( 40.0 mL/min )  
Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

## Setpoint Status:

Pass

Flow Type: Makeup  
Setpoint: 25.0 mL/min Measured Flow: 24.6 mL/min  
Accuracy: 0.4 mL/min  
Agilent Recommended: <= 10.0 % setpoint ( 2.5 mL/min )  
Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

## Overall Detector Flow Accuracy Test Status

Pass

## GC Oven Temperature Accuracy

Name: 7890

Date: April 21, 2023 3:26:38 PM  
System ID: CN11481066

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## Setpoint Status:

Pass

Zone: Oven  
Setpoint/Actual  
Temperature: 230.0 230.6 °C  
Accuracy: 0.6 °C  
Agilent Recommended: >= -1.0 % setpoint in K ( -5.0 °C )  
<= 1.0 % setpoint in K ( 5.0 °C )

## Setpoint Status:

Pass

Zone: Oven  
Setpoint/Actual  
Temperature: 100.0 100.9 °C  
Accuracy: 0.9 °C  
Agilent Recommended: >= -1.0 % setpoint in K ( -3.7 °C )  
<= 1.0 % setpoint in K ( 3.7 °C )

## Overall GC Oven Temperature Accuracy Test Status

Pass

## GC Oven Temperature Stability

Name: 7890  
Setpoint Status: PassSetpoint/Average  
Temperature: 100.0 100.8833 °C  
Stability: 0.1 °C  
Agilent Recommended: <= 0.5

## Overall GC Oven Temperature Stability Test Status

Pass

## Scouting Run

Tested Combination1 Front SSL / Front FID  
Injection Tower  
Name: 7893ADate: April 21, 2023 3:26:38 PM  
System ID: CN11481066

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Setpoint Status: Completed

Injection Volume on Column: 1.0 uL

Overall Scouting Run Status

Completed

Noise and Drift

Tested Combination1 Front SSL / Front FID

Name: 7890

Setpoint Status: Pass

Base Signal: 22.7 pA

ASTM Noise		Drift	
pA		pA/Hr	
0.06		0.05	
≤ 0.10		≤ 2.50	
Pass		Pass	

Overall Noise and Drift Test Status

Pass

Injection Precision

Tested Combination1 Front SSL / Front FID

Name: 7693A

Setpoint Status: Pass

Injection Volume on Column: 1.0 uL

Area RSD:		Retention Time RSD:	
%		%	
0.32		0.67	
≤ 3.00		≤ 1.00	
Pass		Pass	

Overall Injection Precision Test Status

Pass

Signal to Noise

Date: April 21, 2023 3:26:38 PM  
System ID: CN11461066

Tested Combination1 Front SSL / Front FID

Injection Tower

Name: 7890

Setpoint Status: Pass

Signal to Noise: 721755

Agilent Recommended: ≥ 300000

Overall Signal to Noise Test Status

Pass

Scouting Run

Tested Combination2 Back SSL / Back FID

Injection Tower

Name: 7693A

Setpoint Status: Completed

Injection Volume on Column: 1.0 uL

Overall Scouting Run Status

Completed

Noise and Drift

Tested Combination2 Back SSL / Back FID

Name: 7890

Setpoint Status: Pass

Base Signal: 22.6 pA

ASTM Noise		Drift	
pA		pA/Hr	
0.07		0.09	
≤ 0.10		≤ 2.50	
Pass		Pass	

Agilent Recommended:

Status:

Date: April 21, 2023 3:26:38 PM  
System ID: CN11461066

Overall Noise and Drift Test Status

Pass

Injection Precision

Tested Combination2 Back SSL / Back FID

Name: 7693A

Setpoint Status: Pass

Injection Volume on Column: 1.0 uL

Area RSD:		Retention Time RSD:	
%		%	
1.28		0.83	
≤ 3.00		≤ 1.00	
Pass		Pass	

Overall Injection Precision Test Status

Pass

Signal to Noise

Tested Combination2 Back SSL / Back FID

Injection Tower

Name: 7890

Setpoint Status: Pass

Signal to Noise: 2404398

Agilent Recommended: ≥ 300000

Overall Signal to Noise Test Status

Pass

Date: April 21, 2023 3:26:38 PM  
System ID: CN11461066

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

System ID	CN11461066
Manufacturer	Agilent Technologies
Name	7890
Flow Data Input	Manual Data
Temperature Data Input	Manual Data or Other Data Logging

Tested Combination1

Injection Technique	Injection Tower
Sampler Identifier	Sampler 2
Inlet	Front
Detector	Front
LTM Included?	No

Tested Combination2

Injection Technique	Injection Tower
Sampler Identifier	Sampler 3
Inlet	Back
Detector	Back
LTM Included?	No

Sampler 1

Manufacturer	Agilent Technologies
Type	Tray
Name	7693A
Model Number	G4514A
Serial Number	CN15380030
Firmware Revision	A.11.01
Vial Heater	Not installed

Date: April 21, 2023 3:26:38 PM  
System ID: CN11461066

Sampler 2	
Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7693A
Model Number	G4513A
Serial Number	CN16280128
Firmware Revision	A.10.09
Usage	Sample Injection
Location	Front
Syringe Volume (µL)	10
Sampler 3	
Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7693A
Model Number	G4513A
Serial Number	CN10340103
Firmware Revision	A.10.09
Usage	Sample Injection
Location	Back
Syringe Volume (µL)	10
Mainframe 1	
Manufacturer	Agilent Technologies
Name	7890
Model Number	G3440A
Serial Number	CN11461066
Firmware Revision	Version 4.27
Oven Type	Standard

Date: April 21, 2023 3:26:38 PM  
System ID: CN11461066

Inlet 1	
Manufacturer	Agilent Technologies
Name	7890
Type	SSL
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes
Inlet 2	
Manufacturer	Agilent Technologies
Name	7890
Type	SSL
Location	Back
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes
Detector 1	
Manufacturer	Agilent Technologies
Name	7890
Type	FID
Adapter	Capillary
Control Type	Electronic Pressure Control (EPC)
Location	Front
Makeup Gas	Nitrogen
Detector 2	
Manufacturer	Agilent Technologies
Name	7890
Type	FID
Adapter	Capillary
Control Type	Electronic Pressure Control (EPC)
Location	Back
Makeup Gas	Nitrogen

Date: April 21, 2023 3:26:38 PM  
System ID: CN11461066

## Electronic Signature

### Purpose

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### Details

Full Name of Signer: Saenguthai Tarak  
Logged On User Name: saenguthai.tarak@non.agilent.com  
Signature Creation Date: April 21, 2023  
Reason for Signature: Executed protocol and published this original version of document

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This document provides a protocol to verify and record instrument configuration and evidence of proper operation. It has been prepared from our interpretation of applicable regulations as well as industry best practices. The document is designed to provide an important component of a complete compliance package. Validation depends upon many factors and use of this protocol alone does not assure compliance. Agilent Technologies makes no promises or representations as to its sufficiency for any specific regulatory program.

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Date: April 21, 2023 3:26:38 PM  
System ID: CN11461066

User Name: saenguthai.tarak  
Host Name: LAPTOP-CQ3SR0MV  
System ID: CN11461066  
Print Date: April 21, 2023 3:26:40 PM

### GC-5\_BKK\_EN0127\_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:21:36 AM	Audit	SessionCreated	Session	None
April 21, 2023 11:21:36 AM	Start	Configuration	Session	None
April 21, 2023 11:21:36 AM	Audit	Entitlement	Licensing	User is Nonpaying and does not require an unlock code
April 21, 2023 11:22:04 AM	Audit	ExpLoaded	Session	EQP details for primary technique [Gc] - File path: [ProtocolPacks\Go\Confgurations\02.52\Gc.02.52.eqp], EQP File Name: [Gc.02.52.eqp], ECP Name: [AgilentRecommended], Protocol Revision: [Gc.02.52]
April 21, 2023 11:22:06 AM	End	Configuration	Session	None
April 21, 2023 11:22:14 AM	Start	Qualification	Session	OQ
April 21, 2023 11:22:14 AM	Start	Execution	CDS Logon Verification - GC : - Qualitative test	None
April 21, 2023 11:23:14 AM	End	Execution	CDS Logon Verification - GC : - Qualitative test	Run Count : 1
April 21, 2023 11:23:16 AM	Start	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	None
April 21, 2023 11:23:35 AM	End	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	Run Count : 1
April 21, 2023 11:23:37 AM	Start	Execution	Inlet Pressure Decay - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi	None

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## GC-6\_BKK\_EN127\_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:24:01 AM	End	Execution	Inlet Pressure Decay - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and ≤ 0.5 psi	Run Count : 1
April 21, 2023 11:24:04 AM	Start	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: ≤ 1.2 psi	None
April 21, 2023 11:24:09 AM	End	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: ≤ 1.2 psi	Run Count : 1
April 21, 2023 11:24:11 AM	Start	Execution	Inlet Pressure Decay - Back SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and ≤ 0.5 psi	None
April 21, 2023 11:24:43 AM	End	Execution	Inlet Pressure Decay - Back SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and ≤ 0.5 psi	Run Count : 1
April 21, 2023 11:24:45 AM	Start	Execution	Inlet Pressure Accuracy - Back SSL - Pressure Controlled Inlet - S: 25.0 psi - L: ≤ 1.2 psi	None
April 21, 2023 11:24:51 AM	End	Execution	Inlet Pressure Accuracy - Back SSL - Pressure Controlled Inlet - S: 25.0 psi - L: ≤ 1.2 psi	Run Count : 1
April 21, 2023 11:24:53 AM	Start	Execution	Detector Flow Accuracy - Front FID - Type : Fuel - S: 30.0 mL/min - L: ≤ 10.0% setpoint	None
April 21, 2023 11:25:20 AM	Audit	Data	Detector Flow Accuracy - Front FID - Type : Fuel - S: 30.0 mL/min - L: ≤ 10.0% setpoint	Manual Data Entry
April 21, 2023 11:25:25 AM	End	Execution	Detector Flow Accuracy - Front FID - Type : Fuel - S: 30.0 mL/min - L: ≤ 10.0% setpoint	Run Count : 1

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## GC-6\_BKK\_EN127\_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:25:26 AM	Start	Execution	Detector Flow Accuracy - Front FID - Type : Oxidizer - S: 400.0 mL/min - L: ≤ 10.0% setpoint	None
April 21, 2023 11:25:40 AM	Audit	Data	Detector Flow Accuracy - Front FID - Type : Oxidizer - S: 400.0 mL/min - L: ≤ 10.0% setpoint	Manual Data Entry
April 21, 2023 11:25:42 AM	End	Execution	Detector Flow Accuracy - Front FID - Type : Oxidizer - S: 400.0 mL/min - L: ≤ 10.0% setpoint	Run Count : 1
April 21, 2023 11:25:44 AM	Start	Execution	Detector Flow Accuracy - Front FID - Type : Makeup - S: 25.0 mL/min - L: ≤ 10.0% setpoint	None
April 21, 2023 11:26:01 AM	Audit	Data	Detector Flow Accuracy - Front FID - Type : Makeup - S: 25.0 mL/min - L: ≤ 10.0% setpoint	Manual Data Entry
April 21, 2023 11:26:04 AM	End	Execution	Detector Flow Accuracy - Front FID - Type : Makeup - S: 25.0 mL/min - L: ≤ 10.0% setpoint	Run Count : 1
April 21, 2023 11:26:09 AM	Start	Execution	Detector Flow Accuracy - Back FID - Type : Fuel - S: 30.0 mL/min - L: ≤ 10.0% setpoint	None
April 21, 2023 11:26:19 AM	Audit	Data	Detector Flow Accuracy - Back FID - Type : Fuel - S: 30.0 mL/min - L: ≤ 10.0% setpoint	Manual Data Entry
April 21, 2023 11:26:22 AM	End	Execution	Detector Flow Accuracy - Back FID - Type : Fuel - S: 30.0 mL/min - L: ≤ 10.0% setpoint	Run Count : 1
April 21, 2023 11:26:24 AM	Start	Execution	Detector Flow Accuracy - Back FID - Type : Oxidizer - S: 400.0 mL/min - L: ≤ 10.0% setpoint	None
April 21, 2023 11:26:38 AM	Audit	Data	Detector Flow Accuracy - Back FID - Type : Oxidizer - S: 400.0 mL/min - L: ≤ 10.0% setpoint	Manual Data Entry

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## GC-6\_BKK\_EN127\_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:26:43 AM	End	Execution	Detector Flow Accuracy - Back FID - Type : Oxidizer - S: 400.0 mL/min - L: ≤ 10.0% setpoint	Run Count : 1
April 21, 2023 11:26:45 AM	Start	Execution	Detector Flow Accuracy - Back FID - Type : Makeup - S: 25.0 mL/min - L: ≤ 10.0% setpoint	None
April 21, 2023 11:27:01 AM	Audit	Data	Detector Flow Accuracy - Back FID - Type : Makeup - S: 25.0 mL/min - L: ≤ 10.0% setpoint	Manual Data Entry
April 21, 2023 11:27:05 AM	End	Execution	Detector Flow Accuracy - Back FID - Type : Makeup - S: 25.0 mL/min - L: ≤ 10.0% setpoint	Run Count : 1
April 21, 2023 11:27:07 AM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND ≤ 1.0 % setpoint in K	None
April 21, 2023 11:27:33 AM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND ≤ 1.0 % setpoint in K	Manual Data Entry
April 21, 2023 11:27:35 AM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND ≤ 1.0 % setpoint in K	Run Count : 1
April 21, 2023 11:27:37 AM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND ≤ 1.0 % setpoint in K	None
April 21, 2023 11:27:54 AM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND ≤ 1.0 % setpoint in K	Manual Data Entry

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## GC-6\_BKK\_EN127\_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:27:57 AM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND ≤ 1.0 % setpoint in K	Run Count : 1
April 21, 2023 11:27:59 AM	Start	Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: ≤ 0.5°C	None
April 21, 2023 11:28:07 AM	Audit	Data	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: ≤ 0.5°C	Manual Data Entry
April 21, 2023 11:28:10 AM	End	Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: ≤ 0.5°C	Run Count : 1
April 21, 2023 11:29:12 AM	Start	Execution	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	None
April 21, 2023 11:30:27 AM	Audit	Data	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	Data file Path : C:\Users\Public\Documents\C hemStation\3\Data\OQ_GC-6 _ALS_2023-04-20\OQ_GC-6 _2023 2023-04-20 14-36-09F_SC01.D\FID1A.s h
April 21, 2023 11:31:04 AM	End	Execution	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	Run Count : 1
April 21, 2023 11:31:07 AM	Start	Execution	Noise and Drift - Front FID - Detector FID - L (Noise): ≤ 0.10 pA - L (Drift): ≤ 2.50 pA/hour	None

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## GC-6\_BKK\_EN0127\_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:31:43 AM	Audit	Data	Noise and Drift - Front FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	Data files Path : C:\Users\Public\Documents\C hemStation\3\Data\OQ_GC-6 _ALS_2023-04-20\OQ_GC-6 _2023-2023-04-20 14-36-08\ND-01--005F.D\FID 1A.ch
April 21, 2023 11:32:00 AM	End	Execution	Noise and Drift - Front FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	Run Count : 1
April 21, 2023 11:32:03 AM	Start	Execution	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	None
April 21, 2023 11:32:23 AM	Start	Execution	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	None
April 21, 2023 11:33:55 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data files Path : C:\Users\Public\Documents\C hemStation\3\Data\OQ_GC-6 _ALS_2023-04-20\OQ_GC-6 _2023-2023-04-20 14-36-08\Pre01--013F.D\FID 1A.ch
April 21, 2023 11:33:55 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data files Path : C:\Users\Public\Documents\C hemStation\3\Data\OQ_GC-6 _ALS_2023-04-20\OQ_GC-6 _2023-2023-04-20 14-36-08\Pre01--014F.D\FID 1A.ch

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## GC-6\_BKK\_EN0127\_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:33:55 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data files Path : C:\Users\Public\Documents\C hemStation\3\Data\OQ_GC-6 _ALS_2023-04-20\OQ_GC-6 _2023-2023-04-20 14-36-08\Pre01--015F.D\FID 1A.ch
April 21, 2023 11:33:55 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data files Path : C:\Users\Public\Documents\C hemStation\3\Data\OQ_GC-6 _ALS_2023-04-20\OQ_GC-6 _2023-2023-04-20 14-36-08\Pre01--016F.D\FID 1A.ch
April 21, 2023 11:33:59 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data files Path : C:\Users\Public\Documents\C hemStation\3\Data\OQ_GC-6 _ALS_2023-04-20\OQ_GC-6 _2023-2023-04-20 14-36-08\Pre01--017F.D\FID 1A.ch
April 21, 2023 11:33:59 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data files Path : C:\Users\Public\Documents\C hemStation\3\Data\OQ_GC-6 _ALS_2023-04-20\OQ_GC-6 _2023-2023-04-20 14-36-08\Pre01--018F.D\FID 1A.ch
April 21, 2023 11:35:00 AM	End	Execution	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Run Count : 1
April 21, 2023 11:35:04 AM	Start	Execution	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L >= 300000	None

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## GC-6\_BKK\_EN0127\_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:35:28 AM	Audit	Data	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L >= 300000	Data files Path : C:\Users\Public\Documents\C hemStation\3\Data\OQ_GC-6 _ALS_2023-04-20\OQ_GC-6 _2023-2023-04-20 14-36-08\N_Front\FID1A.ch
April 21, 2023 11:36:00 AM	End	Execution	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L >= 300000	Run Count : 1
April 21, 2023 11:36:03 AM	Start	Execution	GC Scouting Run - Injection Tower, Back SSL, Back FID - Part of System Preparation - No limits associated	None
April 21, 2023 11:36:36 AM	Audit	Data	GC Scouting Run - Injection Tower, Back SSL, Back FID - Part of System Preparation - No limits associated	Data files Path : C:\Users\Public\Documents\C hemStation\3\Data\OQ_GC-6 _ALS_2023-04-20\OQ_GC-6 _2023-2023-04-20 14-36-08\B_S001.D\FID2B.ch
April 21, 2023 11:37:30 AM	End	Execution	GC Scouting Run - Injection Tower, Back SSL, Back FID - Part of System Preparation - No limits associated	Run Count : 1
April 21, 2023 11:37:32 AM	Start	Execution	Noise and Drift - Back FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	None

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## GC-6\_BKK\_EN0127\_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:38:06 AM	Audit	Data	Noise and Drift - Back FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	Data files Path : C:\Users\Public\Documents\C hemStation\3\Data\OQ_GC-6 _ALS_2023-04-20\OQ_GC-6 _2023-2023-04-20 14-36-08\ND-01--005B.D\FID 2B.ch
April 21, 2023 11:38:23 AM	End	Execution	Noise and Drift - Back FID - Detector FID - L (Noise) <= 0.10 pA - L (Drift) <= 2.50 pA/hour	Run Count : 1
April 21, 2023 11:38:32 AM	Start	Execution	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	None
April 21, 2023 11:38:51 AM	Start	Execution	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	None
April 21, 2023 11:40:17 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data files Path : C:\Users\Public\Documents\C hemStation\3\Data\OQ_GC-6 _ALS_2023-04-20\OQ_GC-6 _2023_Pre 2023-04-21 10-37-32\Pre11--004B.D\FID 2B.ch
April 21, 2023 11:40:17 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data files Path : C:\Users\Public\Documents\C hemStation\3\Data\OQ_GC-6 _ALS_2023-04-20\OQ_GC-6 _2023_Pre 2023-04-21 10-37-32\Pre11--005B.D\FID 2B.ch

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## GC-6\_BKK\_EN0127\_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:40:17 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data files Path : C:\Users\Public\Documents\hemStation3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023_Pre 2023-04-21 10-37-32Pre11--0068.D\FID 28.ch
April 21, 2023 11:40:17 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data files Path : C:\Users\Public\Documents\hemStation3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023_Pre 2023-04-21 10-37-32Pre11--007B.D\FID 28.ch
April 21, 2023 11:40:21 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data files Path : C:\Users\Public\Documents\hemStation3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023_Pre 2023-04-21 10-37-32Pre11--008B.D\FID 28.ch
April 21, 2023 11:40:21 AM	Audit	Data	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data files Path : C:\Users\Public\Documents\hemStation3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023_Pre 2023-04-21 10-37-32Pre11--008B.D\FID 28.ch
April 21, 2023 11:41:29 AM	End	Execution	Injection Precision - Injection Tower, Back SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Run Count : 1
April 21, 2023 11:41:33 AM	Start	Execution	Signal to Noise - Injection Tower, Back SSL, Back FID - Detector FID - L >= 300000	None

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Hostname: LAPTOP-QQ3SKOMV  
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## GC-6\_BKK\_EN0127\_ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 21, 2023 11:42:22 AM	Audit	Data	Signal to Noise - Injection Tower, Back SSL, Back FID - Detector FID - L >= 300000	Data files Path : C:\Users\Public\Documents\hemStation3\Data\OQ_GC-6_ALS_2023-04-20\OQ_GC-6_2023_Pre 2023-04-21 10-38-06SN_Back.D\FID28.ch
April 21, 2023 11:42:50 AM	End	Execution	Signal to Noise - Injection Tower, Back SSL, Back FID - Detector FID - L >= 300000	Run Count : 1
April 21, 2023 11:42:53 AM	End	Qualification	Session	OQ
April 21, 2023 11:42:53 AM	Start	Reporting	Session	None
April 21, 2023 12:01:47 PM	Audit	AcqClosed	Session	None
April 21, 2023 3:16:07 PM	Audit	AcqRestarted	Session	None
April 21, 2023 3:16:10 PM	Audit	SessionReloaded	Session	None
April 21, 2023 3:16:31 PM	Start	Qualification	Session	OQ
April 21, 2023 3:20:09 PM	Audit	AcqRestarted	Session	None
April 21, 2023 3:21:00 PM	Audit	SessionReloaded	Session	None
April 21, 2023 3:21:07 PM	Start	Qualification	Session	OQ
April 21, 2023 3:25:45 PM	Audit	Reporting	Session	Report Generated : Certificate

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63/14-15,67/35-36, Soi Petchkasem 7/1, Petchkasem Rd,  
Walthapra, Bangkokyai, Bangkok 10600 Thailand.  
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jiranaalee.com

## CERTIFICATE OF CALIBRATION

Certificate No: WS-05012022  
Page 1 of 2 pages

Measurement Item	Cap anemometer with data logger
Manufacturer	Data logger: Kowayix Cap anemometer: Kowayix
Model/Type	Data logger: 200 WS-25LB Cap anemometer: WS-03P
Serial Number	Data logger: A01V0 Cap anemometer
ID No	Data logger: RFD F80339 Cap anemometer
Customer	ALS Laboratory Group (Thailand) Co., Ltd. 134 Phatthanaong, 40, Phatthanaong Rd, Kwangjai, Wat Luang, Khao Sai Luang, Bangkok 10300, Thailand
Test Conditions	Wind levels: cross flow station area: 400 m/s Anemometer frontal area: 100 m/s Diameter of mounting pole: 1 mm Massage ratio of test object: 0.111
Test Condition	Air temperature: 23.6 ±0.8 °C Air pressure: 1014.6 ±0.4 hPa Relative air humidity: 53.4 ±3.6 %RH
Calibration Procedure	Calibration was carried out based on: ISO 17025:2017 (SCL): 2023-Power Performance Measurements of Stability Evaluating Wind Turbines M868907 Anemometer Calibration Procedure - Version 2, 2020
Traceability	This calibration documents the hierarchy to national standards, which realize the unit of measurement according to the international system of units (SI) through National Institute of Metrology (Thailand) (NIMT)
Measurement Date	JAN 28, 2022
Issue Date	JAN 31, 2022
Calibrated by	Mr. Somsak Thachai Mr. Chaitan Waiwattana



Approved Signatory: Mr. Panyee Boonchaisan  
Calibration Department Manager



63/14-15,67/35-36, Soi Petchkasem 7/1, Petchkasem Rd,  
Walthapra, Bangkokyai, Bangkok 10600 Thailand.  
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Continuation of Certificate of Calibration Number

Certificate No: WS-05012022  
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Result of calibration: ☒ Without adjustment ☐ With adjustment  
Calibration is the range of 1 ± 1.6 m/s at a calibration interval of 1 m/s  
The results of calibration and associated measurement uncertainties are reported in the table below:

V <sub>ref</sub> Reading m/s	V <sub>unc</sub> Reading m/s	Error m/s	Uncertainty (%)
2.075	2.0	0.1	2.4
4.101	4.1	0.0	1.2
5.99	6.0	0.0	0.95
8.01	8.0	0.0	0.83
10.01	10.1	0.1	0.75
12.01	12.1	0.1	0.57
13.49	14.1	0.1	0.70
15.99	16.4	0.4	0.43
18.00	18.2	0.2	0.76
19.01	19.0	0.0	0.63
11.02	11.0	0.0	0.75
9.00	9.0	0.0	0.81
7.02	7.0	0.0	0.80
5.120	5.1	0.0	0.96
2.901	3.0	0.0	1.6
1.036	0.0	-0.1	4.5

LUCK Unit Under Calibration

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

## Appendix 1: Instrumentation

NO.	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Wind static	TUSTO INC.	06302145	Aug 07, 2021	MW-0034-21	5 - 30 m/s
2	Pressure Differential Pressure Meter	Zorgas	2PM2000	Aug 07, 2021	MW-0034-21	5 - 30 m/s
3	48 velocity transducer and wind	TIS INC.	8455-12	Aug 08, 2021	MW-0035-21	0 - 5 m/s
4	Temperature	Zorgas	GM-T1-01	Mar 30, 2021	CL-027-24	-30 - 70 °C
5	Relative humidity	Zorgas	GM-RH-01	Mar 30, 2021	PH-03032021	0 - 100 %RH
6	Atmospheric pressure	Zorgas	GM-T1-01	Mar 30, 2021	PH-03032021	800 - 1100 hPa
7	Wind tunnel	EDSON	MP350			0 - 50 m/s

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



## CERTIFICATE OF CALIBRATION

Certificate No: WD-05012022  
Page 1 of 2 pages

Measurement Item: Wind direction sensor with data logger.

Manufacturer: Data logger: Novasys,  
Wind direction sensor: Novasys.

Model/Type: Data logger: 200-WS-25LE,  
Wind direction sensor: WS-00P

Serial Number: Data logger: A5190,  
Wind direction sensor: -

ID No: Data logger: PMJ\_150329,  
Wind direction sensor: -

Customer: ALS Laboratory group (Thailand) Co., Ltd.,  
104 Phatthanasak 40, Phatthanasak Rd, Khwaeng Sam Luang, Khet Sam Luang, Bangkok 10200  
Thailand.

### Environmental Condition

The measurement was carried out in an ambient temperature of (23±3) °C and relative humidity of (40±10) %.

### Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and the same is used for axis control. The measurement were taken at 45° interval in clockwise and counterclockwise directions.

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

### Traceability:

The measurement results are traceable to the International system of units (SI) through Certificate No.: 02106014, Certificate No.: WWS64/0026.

Measurement Date: JAN 26, 2022  
Issued Date: JAN 31, 2022

### Performed by

☒ Mr. Somchai Thachad  
☐ Miss Orathai Winitayakul



Approved Signature:

Mr. Pannya Razanwong,  
Calibration Department Manager

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Continuation of Certificate of Calibration Number

Certificate No: WD-05012022  
Page 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

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

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	0	0	0	3.0
2		45	45	43	-2	3.0
3		90	90	90	0	3.0
4		135	135	135	0	3.0
5		180	180	181	1	3.0
6		225	225	227	2	3.0
7		270	270	273	3	3.0
8		315	315	316	1	3.0
9	Counterclockwise	0/360	0	0	0	3.0
10		45	45	43	-2	3.0
11		90	90	90	0	3.0
12		135	135	135	0	3.0
13		180	180	181	1	3.0
14		225	225	227	2	3.0
15		270	270	273	3	3.0
16		315	315	316	1	3.0

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

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



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Accredited calibration laboratory  
ISO/IEC 17025:2017  
ASC-10-18-1025  
CALIBRATION 0367

An independent measurement laboratory  
Calibration services department



Certificate Number

CL-003-65

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

### MEASUREMENT ITEM

### MANUFACTURER

### MODEL/TYPE

### SERIAL NUMBER

### ID NUMBER

### CONDITION AS-RECEIVED

### CUSTOMER

Cup anemometer:

Novasys

Sensor: WS-00P

Data logger: 110-WS-25DL-D

Sensor: WS-013

Data logger: A5511

RYG\_150610

New Item

ALS Laboratory group (Thailand) Co., Ltd.

104 Phatthanasak 40, Phatthanasak Rd, Khwaeng Sam Luang, Khet Sam Luang, Bangkok 10200 Thailand

10 Nov 2022

17 Nov 2022

23 Nov 2022

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature: 23.0 ± 3.0 °C

Relative Humidity: 55.0 ± 15.0 %RH

Atmospheric Pressure: 1010.0 hPa

### PLACE OF CALIBRATION

Diff-type wind tunnel of Jiranatee Associates Co., Ltd.

### CALIBRATION CONDITIONS

Wind tunnel cross-section area: 900 cm<sup>2</sup>

Wind direction frontal area: 100 cm<sup>2</sup>

Diameter of mounting pipe: - mm

Blockage ratio of test object: 0.333 [-]

### Calibration procedure:

The cup anemometer was calibrated against Standard air velocity transducer model: R55-12 and pitot tube with precision differential pressure meter model: DPM5500 in a clean test-section of 1800 mm wind tunnel with 900 cm<sup>2</sup> cross test section area. The UUC (B2) based on IEC 61400-14-1, Wind energy generation systems - Part 14-1: 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 calibration of the international system of units (SI) through the NIM (National Metrology Institute of Thailand) via certificate number: MW-0012-21 and MW-0016-22.

### Uncertainty of Measurement:

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

### Preconditioning

~24 hours at ambient condition.

### Measurement Condition:

The average values during measurement are (24.1) °C, (68.8) %RH and (1015.4) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

Mr. Somchai Thachad

Mr. Jiranatee Lerisungkul



Approved Signature:

Mr. Pannya Razanwong,

Calibration Department Manager

### Remark:

\* Inside cross-section area of the wind tunnel

\* Projected cross-section area of the tested object include mounting pipe

\* Diameter of mounting pipe

\* Ratio "a" to "b"

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Page 2 of 2 Pages

### MEASUREMENT RESULTS<sup>1</sup>

The cup anemometer, Unit Under Calibration (UUC) was corrected at 10 m/s for 3 minutes prior to calibration being performed. The standard air velocity (U<sub>s</sub>) of 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 80 mm and 100 mm respectively (away from end tunnel) inside, but was installed in center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 5 m/s to 30 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

U <sub>s</sub> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	U <sub>meas</sub> (m/s)	Error (m/s)	U (k=2) (m/s)
0.994	24.08	24.05	0.8	-0.2	0.17
2.036	24.10	24.05	1.8	-0.2	0.17
3.044	24.06	24.05	2.9	-0.2	0.17
4.217	24.10	24.05	3.9	-0.4	0.19
5.02	23.92	24.05	4.9	-0.1	0.17
6.00	24.24	24.05	5.9	-0.1	0.18
7.08	23.88	24.05	6.8	-0.2	0.20
8.20	24.12	24.05	7.9	-0.3	0.20
9.13	23.74	24.05	8.8	-0.3	0.19
10.11	24.04	24.05	9.8	-0.3	0.19
11.17	23.80	24.05	10.9	-0.3	0.20
12.15	23.98	24.05	11.8	-0.3	0.21
13.20	23.78	24.05	12.9	-0.3	0.26
14.25	23.80	24.05	14.0	-0.2	0.26
15.25	23.80	24.05	14.9	-0.3	0.23
16.30	23.80	24.05	16.0	-0.3	0.23

### Remark:

<sup>1</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.

<sup>2</sup> Velocity of standard

<sup>3</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 setup is not true to scale due to imaging geometry.





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CALIBRATION 0367

Advanced measurement laboratory  
Calibration services department

Certificate Number

CL-003-65

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

### MEASUREMENT ITEM

1 Cup anemometer

### MANUFACTURER

Novatek

### MODEL/TYPE

Sensor: WS-02F

### SERIAL NUMBER

Data logger: 110 WS-3500-D

### ID NUMBER

Sensor: WS-02F

### CONDITION AS RECEIVED

Data logger: A5911

### CUSTOMER

RGV, 150610  
New item  
ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanasak Rd, Phatthanasak Rd, Khlong Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand

### RECEIVED DATE

09 Nov 2022

### MEASUREMENT DATE

17 Nov 2022

### ISSUE DATE

23 Nov 2022

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature

23.0 ± 3.0 °C

Relative Humidity

55.0 ± 15.0 %RH

Atmospheric Pressure

1010.10 hPa

### PLACE OF CALIBRATION

Edible-type wind tunnel of Iranate Associates Co., Ltd.

### CALIBRATION CONDITION

Wind tunnel cross-section area<sup>1</sup> 900 cm<sup>2</sup>  
Win direction frontal area<sup>2</sup> 100 cm<sup>2</sup>  
Diameter of mounting pipe<sup>3</sup> 8mm  
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, (46.8) %RH and (1015.4) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values

### Calibrated by:

Mr. Sornwit Thachakul  
Miss Jiraporn Lertsamphol



Approved signature

Mr. Parinya Booncharoen  
Calibration Department Manager

### Remark:

<sup>1</sup> Inside 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>1</sup> to<sup>2</sup>

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Certificate Number

CL-003-65

Page 2 of 2 Pages

### MEASUREMENT RESULTS<sup>1</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 calibrated by a standard air velocity transducer and above 5 m/s to 10 m/s was calibrated by a pitot tube with pressure differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

$v_{ref}$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$v_{UUC}$ (m/s)	Error (m/s)	U (k=2) (m/s)
0.994	24.08	24.05	0.8	-0.2	0.17
2.036	24.10	24.05	1.8	-0.2	0.17
3.044	24.00	24.05	2.9	-0.2	0.17
4.217	24.10	24.05	3.9	-0.4	0.19
5.02	23.92	24.05	4.9	-0.1	0.17
6.00	24.24	24.05	5.9	-0.1	0.18
7.08	23.88	24.05	6.8	-0.2	0.20
8.20	24.12	24.05	7.9	-0.3	0.20
9.13	23.74	24.05	8.8	-0.3	0.19
10.11	24.04	24.05	9.8	-0.3	0.19
11.17	23.80	24.05	10.9	-0.3	0.20
12.15	23.98	24.05	11.8	-0.3	0.21
13.20	23.78	24.05	12.9	-0.3	0.26
14.25	23.82	24.05	14.0	-0.2	0.26
15.25	23.80	24.05	14.5	-0.1	0.21
16.10	23.80	24.05	16.0	-0.1	0.21

### Remark:

<sup>1</sup> Calibration results only cover for the tested circumstances and environmental conditions during which calibration took place

<sup>2</sup> Velocity of standard

<sup>3</sup> Velocity of Unit Under Calibration

### PHOTO OF CALIBRATION SET-UP



Calibration set up of the cup anemometer calibration in the wind tunnel of Iranate Associates Co., Ltd. The cup anemometer shown very different from the calibrated unit. Remark: The proportion of the set up is not true to scale due to imaging geometry.



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CALIBRATION 0367

Pressure measurement laboratory  
Calibration services department



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Pressure measurement laboratory  
Calibration services department



## CERTIFICATE OF CALIBRATION

Certificate No. CL-010-65

Page 1 of 2 Pages

### MEASUREMENT ITEM

Digital barometer

### MANUFACTURER

Novatek

### MODEL/TYPE

110 WS-250P

### SERIAL NUMBER

A5911

### ID NUMBER

RGV, 150610

### CONDITION AS RECEIVED

New item

### CUSTOMER

ALS laboratory group (Thailand) Co., Ltd.  
104 Phatthanasak Rd, Phatthanasak Rd,  
Khlong Suan Luang, Khet Suan Luang,  
Bangkok 10250 Thailand

### RECEIVED DATE

09 Nov 2022

### MEASUREMENT DATE

22 Nov 2022

### ISSUE DATE

23 Nov 2022

### Calibration procedure:

The pressure calibration was done by in-house calibration method as WI CL 001 according to comparison method with digital pressure calibrator based on DMD-R 6.1

### Traceability:

The measurement results are traceable to the international system of units (SI) through MENSOR which complies with the requirements of ISO/IEC 17025:2017, ANSI/NCSL 2540-1 via Certificate number: 201479

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

### CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument:

Instruments

Model

Serial No.

Certificate No.

Due Date

Absolute Pressure Transducer

CPG2500

41001011

651479

13 Sep 2022

1. Calibration effort for calibration sequence A

2. The UUC<sup>1</sup> was installed in vertical orientation above reference standard instrument and center of UUC<sup>1</sup> was fixed at the reference level.

3. Calibration conditions:

4. Condition

Pressure transmitting medium

Normal

Alt

$p_{ref}$  (hPa, 1 bar)

1.19 kg/m<sup>3</sup>

$T_{ref}$

(55±15) °C

$T_{UUC}$

(23±3) °C

$p_{UUC}$

(1010±10) mbar

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

### Calibrated by:

Mr. Sornwit Thachakul

Miss Jiraporn Lertsamphol



Approved signature

Mr. Parinya Booncharoen

Calibration Department Manager

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## CERTIFICATE OF CALIBRATION

Certificate No. CL-010-65

Page 2 of 2 Pages

### MEASUREMENT RESULTS

1. Without adjustment 1.1 With adjustment

### CALIBRATION IN THE RANGE OF

950 - 1050 mbar

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

STD (mbar)	UUC <sup>1</sup> (mbar)	Error (mbar)	Uncertainty (k=2) (mbar)
950.00	950.0	0.0	0.37
970.00	969.8	0.2	0.49
990.00	989.6	0.4	0.62
1010.00	1009.5	0.4	0.64
1030.00	1029.1	0.9	1.1
1050.00	1049.0	-1.0	1.2

Note: UUC<sup>1</sup> Unit Under Calibration

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

\*End of certificate\*





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## CERTIFICATE OF CALIBRATION

Certificate No.: J-158-05  
Page 1 of 2

Equipment Name: Data Logger with Temperature Sensor  
Manufacturer: Novolyne  
Model: L10 WS 250L D  
Serial No.: A5911  
ID No.: RYG\_F50610

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

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

Reference Used During Calibration  
1. Standard Temperature Probe Model: STS-100 A500, Serial No.: 667682-03, Due date: 23 Mar 2023  
2. Digital Temperature Indicator Model: D11 1000 A MK II, Serial No.: 671407-00591 Due date: 22 July 2023

Calibration Condition  
Temperature: (23±3) °C  
Relative Humidity: (55±15)%

Calibration Procedure  
The temperature calibration was done by in-house calibration method as WCL 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) (NIM) Certificate number: TT 0934 22, Certificate number: IR-0092 22

Calibrated by  
Mr. Sorawat Thachakul  
Miss Jitraporn Lertsomphol



Approved Signatory: *Mr. Panyia Booncharoen*  
Calibration Department Manager

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Certificate No.: J-158-05  
Page: 2 of 2

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment  
Calibration Range: 20-40 °C

### Function:

This equipment was connected with temperature sensor Model: HMP60 S/R: U3911245.

Dimension: Diameter 12 mm, Length 80 mm

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
80	29.01	19.9	0.1	0.30
80	25.02	24.9	0.2	0.30
80	29.99	20.8	0.2	0.30
60	35.00	34.6	0.4	0.30
60	40.00	39.4	0.6	0.30

### UUC\*: Unit Under Calibration

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

★ End of Certificate ★



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## CERTIFICATE OF CALIBRATION

Calibration No.: RH-03112022  
Page 1 of 1 Pages

Measurement Item: Relative humidity with data logger  
Manufacturer: Novolyne  
Model/Type: L10 WS 250L D  
Serial Number: A5911  
ID No.: RYG\_F50610  
Customer: ALS Laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand

Environmental Condition:  
The measurement was carried out in an ambient temperature of (25±3) °C, and relative humidity of (50±10)%

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

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

Measurement Date: Nov 18, 2022  
Issue Date: Nov 23, 2022

Measurement Results:  
This equipment was connected with indoor air quality probe and displayed RH on display, Model: HMP60, Serial number: U3911245  
Calibration was performed in the range of 20RH% to 80RH%  
The results of calibration are reported in table below.

Determined (RH%)	Standard Reading (RH%)	UUC Reading (RH%)	Error (RH%)	Uncertainty (RH%)
20	20.07	18.0	-2.0	0.55
50	50.29	48.2	-2.1	0.60
80	80.24	78.4	-1.8	0.55

Performed by  
☒ Mr. Sorawat Thachakul  
☐ Miss Jitraporn Lertsomphol



Approved Signatory: *Mr. Panyia Booncharoen*  
Calibration Department Manager

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## CALIBRATION REPORT

Calibration Number: RH-01112022  
Page 1 of 2 Pages

Measurement Item: Rain gauge with data logger

Manufacturer: Data logger: Novolyne  
Rain gauge: Novolyne

Model/Type: Data logger: L10 WS 250L D  
Rain gauge: L10 WS 250L D

Serial Number: Data logger: A5911  
Rain gauge: RG4307

ID NO: RYG\_F50610

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

Environmental Condition:  
The measurement was carried out in an ambient temperature of (25±3) °C, and relative humidity of (50±10)%

Measurement Method:  
The Rain gauge Unit Under Calibration (UUC) was calibrated by Precision reference facility with flow adjuster of 10 to 100 mm rain volume or 1 tapping every 20 seconds. The tapping number was determined by procedures below.

- Obtain rain gauge wet area.  
Rain gauge profile (diameter in cm = Diameter/2 = 11 inches)  
Rain gauge area =  $\pi \times (11)^2 \times 1.4$  (0.07) diameter 293.3 cm, UUC radius 101.3 cm  
Rain gauge area: 323.6 cm<sup>2</sup>
- Obtain theoretical correct rain gauge power (number of tapping) using 323.6 cm<sup>2</sup> wet area and 0.1 l of rain.  
a) 10,000 cm<sup>3</sup> / 323.6 cm<sup>2</sup> wet area = 30.90 rain gauge area = 1/30.90 of square meter  
b) 30.90 \* 0.5 l volume = 15.45 mm (mm of rain over 1 m<sup>2</sup> surface) 500 ml of rain volume on the rain gauge area = 15.45 mm of rain  
c) Number of tapping: 15.45 / 0.75 mm = 20.60 tapping

Note: Rain gauge is fully cleaned and leveling prior the calibration performed.

Measurement Date: Nov 18, 2022  
Issue Date: Nov 23, 2022

Performed by  
☒ Mr. Sorawat Thachakul  
☐ Miss Jitraporn Lertsomphol



Approved Signatory: *Mr. Panyia Booncharoen*  
Calibration Department Manager



63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,  
Wathapra, Bangkokyai,Bangkok 10600 Thailand.  
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jranatee.com

Continuation of Calibration of Calibration Number

Calibration Number: RH-01112022  
Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment  
The results of Calibration are reported in table below:

Quantity of H <sub>2</sub> O (ml)	Determined Tipping	Tipping count	Acceptable Tipping count
500	60	61	60 - 64
500	62	61	60 - 64
500	62	60	60 - 64
500	62	60	60 - 64
500	62	61	60 - 64

Remark: The procedure is made to verify the correct reading of the Unit under Calibration rain gauge when a precise volume of water can be added. We suggest that the number of tipping should be within ±2% different from the 60 tipping (average) range 60-64 tipping it means that the rain gauge meets the manufacturer's acceptable limit.

\*\*\*End of calibration report\*\*\*



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## CERTIFICATE OF CALIBRATION

Certificate No.: CL-077-65  
Page 1 of 2

Equipment Name: Data Logger with Temperature  
Sensor

Manufacturer: Novolyns  
Model: 200-WS-25LB  
Serial No.: A5261  
ID No.: BKK\_FS0888

Customer  
Name: ALS laboratory group (Thailand) Co.,Ltd.  
Address: 304 Phatthanasak 40, Phatthanasak Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Received date: 23 May 2022  
Calibration date: 30 May 2022  
Issue date: 02 Jun 2022

Reference Used During Calibration  
1. Standard Temperature Probe Model: STS-100 A500,  
Serial No.: 667682 09, Due date: 23 Mar 2023  
2. Digital Temperature Indicator Model: DTI-1000-A MK II,  
Serial No.: 671407-00591 Due date: 04 June 2022

Calibration Condition  
Temperature: (23±3) °C  
Relative Humidity: (55±15)%

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

Traceability  
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0034-22, Certificate number: ER-0032-21

REVIEW BY: *[Signature]*  
APPROVED BY: *[Signature]*  
NEXT CAL DATE: 28/11/23

Calibrated by  
☒ Mr. Sorawit Thachalea  
☐ Miss Jitraporn Lertsomphol



Approved Signatory: *[Signature]*  
Mr. Parinya Booncharoen  
Calibration Department Manager

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Wathapra, Bangkokyai,Bangkok 10600 Thailand.  
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jranatee.com



Certificate No.: CL-077-65  
Page 2 of 2

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20-40 °C

### Function:

This equipment was connected with temperature sensor Model : HMP60 S/N : N0330783

Dimension : Diameter 12mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	19.98	20.0	0.1	0.30
60	24.98	24.7	-0.3	0.30
60	30.02	29.6	-0.4	0.30
60	35.01	34.5	-0.5	0.30
60	40.01	39.3	-0.7	0.30

UUC\*: Unit Under Calibration

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

★ End of Certificate ★



63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,  
Wathapra, Bangkokyai,Bangkok 10600 Thailand.  
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jranatee.com

## CALIBRATION REPORT

Calibration No.: RH-02052022  
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger  
Manufacturer : Novolyns  
Model/Type : 200-WS-25LB  
Serial Number : A5261  
ID No. : BKK\_FS0888  
Customer : ALS laboratory group (Thailand) Co.,Ltd.  
104 Phatthanasak 40, Phatthanasak Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

### Environmental Condition:

The measurement was carried out in an ambient temperature of (25±3)°C, and relative humidity of (50±16)%.

### Measurement Method:

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

### Traceability:

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

Measurement Date : Jun 01, 2022  
Issued Date : Jun 02, 2022

### Measurement Results:

This equipment was connected with indoor air quality probe and Displayed (UUC) on display. Model: HMP60. Serial number: N0330783

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

The results of calibration are reported in table below.

Determined (RH)	Standard (RH)	UUC Reading (RH)	Error (RH)	Uncertainty (RH)
20	20.02	18.8	-1.2	0.61
50	50.22	49.4	-0.8	0.57
80	80.50	79.3	-1.3	0.69

Performed by  
☒ Mr. Sorawit Thachalea  
☐ Miss Jitraporn Lertsomphol



Approved Signatory: *[Signature]*  
Mr. Parinya Booncharoen  
Calibration Department Manager

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

## CERTIFICATE OF CALIBRATION

Certificate No. WS-02042022  
Page 1 of 2 pages

**Measurement Item** : Cup anemometer with data logger.  
**Manufacturer** : Data logger: Novalynx  
: Cup anemometer: Novalynx  
**Model/Type** : Data logger: 200-WS-201B  
: Cup anemometer: WS-02F  
**Serial Number** : Data logger: A5251  
: Cup anemometer :  
**ID No** : Data logger: BKH\_F30888  
: Cup anemometer :  
**Customer** : ALS laboratory group (Thailand) co., Ltd.  
: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250, Thailand.  
**Test Conditions** : Wind tunnel, cross test section area 900 cm<sup>2</sup>  
: Anemometer frontal area 100 cm<sup>2</sup>  
: Diameter of mounting pipe 8mm  
: Blockage ratio of test object 0.111 [-]  
**Test Conditions** : Air temperature 24.3 ±0.8 °C  
: Air pressure 1005.2 ±0.4 hPa  
: Relative air humidity 46.1 ±3.5 %RH  
**Calibration Procedure** : Calibration was carried out by one person.  
: ISO 51400-12-1 60.1.1.005-Power Performance Measurements of Electricity Producing Wind Turbines.  
: MCA/NET Anemometer Calibration Procedure - Version 2: 2009.  
**Traceability** : This calibration documents the traceability to national standard, which realize the unit of measurement according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).  
**Measurement Date** : Jun 01, 2022.  
**Issue Date** : Jun 02, 2022.

Calibrated by  
☒ Mr. Soravit Thachaisri  
☐ Miss Jiraporn Lertsaengphol



Approved Signature:   
Mr. Panyia Booncharoen  
Calibration Department Manager

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Continuation of Certificate of Calibration Number

Certificate No. WS-02042022  
Page 2 of 2 pages

**Result of calibration:** ☒ Without adjustment. ☐ With adjustment.  
Calibration in the range of 1 - 15 m/s at a calibration interval of 1 m/s.  
The results of calibration and associated measurement uncertainties are reported in the table below:

V <sub>ref</sub> Reading m/s	V <sub>ref</sub> Reading m/s	Error (m/s)	Uncertainty (%)
2.087	2.0	-0.1	2.4
4.140	4.2	0.1	1.0
6.08	6.0	0.0	0.88
8.00	8.0	0.0	0.74
10.00	10.0	0.0	0.69
11.99	12.1	0.1	0.65
14.02	14.3	0.3	0.42
16.00	16.4	0.4	0.63
18.01	18.4	0.4	0.39
19.97	19.1	-0.1	0.59
21.99	21.0	-0.9	0.52
23.99	24.0	0.0	0.66
25.99	26.0	0.0	0.86
27.99	28.0	0.0	0.96
29.99	30.1	0.1	1.0
31.99	32.0	0.0	1.0

UUC\* Unit Under Calibration

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

### Appendix 1: Instrumentation

ID	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Wind speed	TESTO AG	0352145	Aug 07, 2021	MW-0034-21	5 - 30 m/s
2	Pressure Differential Pressure Mtd.	Zepac	0942503	Aug 07, 2021	MW-0034-21	5 - 30 m/s
3	Air velocity measurement (hot wire)	TS MC	8455-12	Aug 08, 2021	MW-0035-21	0 - 5 m/s
4	Temperature	Zepac	020-THP	March 30, 2022	SP-0103-22	-35 - 70°C
5	Relative Humidity	Zepac	020-THP	March 30, 2022	SP-0103-22	0 - 100 %RH
6	Atmospheric pressure	Zepac	020-THP	March 30, 2022	SP-0103-22	500 - 1100 hPa
7	Wind speed	CSOM	MP3300			0 - 50 m/s

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



## CERTIFICATE OF CALIBRATION

Certificate No. WS-02042022  
Page 1 of 2 pages

**Measurement Item** : Wind direction sensor with data logger.  
**Manufacturer** : Data logger: Novalynx  
: Wind direction sensor: Novalynx  
**Model/Type** : Data logger: 200-WS-201B  
: Wind direction sensor: WS-02F  
**Serial Number** : Data logger: A5251  
: Wind direction sensor :  
**ID No** : Data logger: BKH\_F30888  
: Wind direction sensor :  
**Customer** : ALS laboratory group (Thailand) co., Ltd.  
: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250, Thailand.  
**Environmental Condition:** : The measurement was carried out in an ambient temperature of (23±3) °C, and relative humidity of (40±10) %.  
**Measurement Method:** : The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and fine laser is used for axis control. The measurement were taken at 45° intervals in clockwise and counterclockwise directions.  
**Note:** The UUC was warmed up for 1 hour prior to the calibration being performed.  
**Traceability:** : The measurement results are traceable to the international system of units (SI) through Certificate No: 02105014, Certificate No: RW504/0025.  
**Measurement Date** : Jun 01, 2022.  
**Issue Date** : Jun 02, 2022.

Calibrated by  
☒ Mr. Soravit Thachaisri  
☐ Miss Jiraporn Lertsaengphol



Approved Signature:   
Mr. Panyia Booncharoen  
Calibration Department Manager

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Continuation of Certificate of Calibration Number

Certificate No. WS-02042022  
Page 2 of 2 pages

**Result of calibration:** ☐ Without adjustment. ☒ With adjustment.  
Calibration in the range of 0 - 360 ° at a calibration interval of 45°.  
The results of calibration and associated measurement uncertainties are reported in table below:

NO	Turning Direction	Nominal Angle [°]	Standard Reading [°]	UUC* Reading [°]	Error [°]	Uncertainty x[°]
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	41	-4	3.0
3		90	90	87	-3	3.0
4		135	135	133	-2	3.0
5		180	180	181	1	3.0
6		225	225	229	4	3.0
7		270	270	274	4	3.0
8		315	315	319	4	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	41	-4	3.0
11		90	90	87	-3	3.0
12		135	135	133	-2	3.0
13		180	180	181	1	3.0
14		225	225	229	4	3.0
15		270	270	274	4	3.0
16		315	315	319	4	3.0

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

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







Certificate Number

CL-020-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

### MEASUREMENT ITEM MANUFACTURER MODEL/TYPE

Cup anemometer  
Novelty  
Sensor: WS-02F  
Data logger: ZOD-WS-25L8

### SERIAL NUMBER

Sensor: -  
Data logger: AS375  
RYE\_F50413

### ID NUMBER CONDITION AS-RECEIVED CUSTOMER

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

### RECEIVED DATE

27 Jan 2023

### MEASUREMENT DATE

10 Feb 2023

### ISSUE DATE

10 Feb 2023

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

### PLACE OF CALIBRATION

Effel-type wind tunnel of Jirunatee Associates Co., Ltd.

### CALIBRATION CONDITIONS

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

### Preconditioning

24 hours at ambient conditions.

### Measurement Condition

The average values during measurement are (24.0) °C, (41.7) %RH and (1015.0) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

Mr. Sorawat Thachakul  
Miss Jiraporn Uerthongphol



### Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

### Remark:

<sup>1</sup> Blockage correction area of the wind tunnel  
<sup>2</sup> Inspected cross-section area of the tested object include mounting pipe  
<sup>3</sup> Diameter of mounting pipe  
<sup>4</sup> Ratio "a/b"

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Certificate Number

CL-020-66

Page 1 of 2 Pages

### MEASUREMENT RESULTS<sup>1</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 0.3 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

$V_{ref}$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$V_{UUC}$ (m/s)	Error (m/s)	$U$ (k=2) (m/s)
0.584	24.10	24.00	0.7	-0.3	0.16
2.029	23.98	24.00	1.8	-0.3	0.16
3.044	23.96	24.00	2.9	-0.2	0.19
4.116	24.20	24.00	3.8	-0.3	0.20
5.00	23.80	24.00	4.8	-0.2	0.21
5.98	24.24	24.00	5.8	-0.2	0.17
7.05	23.90	24.00	6.9	-0.2	0.19
8.19	24.14	24.00	8.0	-0.2	0.19
9.29	23.88	24.00	8.9	-0.2	0.20
10.09	23.88	24.00	9.8	-0.2	0.19
11.16	23.74	24.00	11.0	-0.2	0.23
12.13	23.82	24.00	12.0	-0.2	0.24
13.19	23.70	24.00	13.0	-0.2	0.22
14.26	23.66	24.00	14.0	-0.3	0.28
15.24	23.66	24.00	14.9	-0.3	0.23
16.30	23.70	24.00	16.0	-0.3	0.23

### Remark:

<sup>1</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

<sup>2</sup> Velocity of standard

<sup>3</sup> Velocity at Unit Under Calibration

### PHOTO OF CALIBRATION SET-UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of Jirunatee 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 missing geometry.



Certificate Number

CL-018-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

### MEASUREMENT ITEM MANUFACTURER MODEL/TYPE

Wind Direction Sensor  
Novelty  
Sensor: WS-02F  
Data logger: ZOD-WS-25L8

### SERIAL NUMBER

Sensor: -  
Data logger: AS375  
RYE\_F50413

### ID NUMBER CONDITION AS-RECEIVED CUSTOMER

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

### RECEIVED DATE

27 Jan 2023

### MEASUREMENT DATE

10 Feb 2023

### ISSUE DATE

10 Feb 2023

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

### PLACE OF CALIBRATION

Effel-type wind tunnel of Jirunatee Associates Co., Ltd.

### CALIBRATION CONDITION

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

### Preconditioning

24 hours at ambient conditions.

### Measurement Condition

The average values during measurement are (23.0) °C, (50.2) %RH and (1012.3) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibrated by:

Mr. Sorawat Thachakul  
Miss Jiraporn Uerthongphol



### Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

### Remark:

<sup>1</sup> Blockage correction area of the wind tunnel  
<sup>2</sup> Inspected cross-section area of the tested object include mounting pipe  
<sup>3</sup> Diameter of mounting pipe  
<sup>4</sup> Ratio "a/b"

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Certificate Number

CL-018-66

Page 2 of 2 Pages

### MEASUREMENT RESULTS<sup>1</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	$D_{true}$ Degree (°)	$D_{UUC}$ Degree (°)	Error Degree (°)	$U$ (k=2) Degree (°)
	0.000	0	0	0.58
	45.000	41	-4	0.58
	90.001	87	-3	0.74
4.99	135.000	133	-2	0.74
	180.000	180	0	0.74
	225.000	227	2	0.68
	270.000	273	3	0.68
	315.000	318	3	0.74

### Remark:

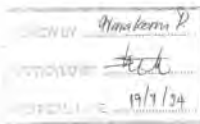
<sup>1</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

<sup>2</sup> Direction of standard

<sup>3</sup> Direction of Unit Under Calibration



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



Certificate Number

CL-011-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM**  
: Wind Direction Sensor  
**MANUFACTURER**  
: Novallme  
**MODEL/TYPE**  
: Sensor: WS-02F  
Data logger: 200-WS-25DL  
**SERIAL NUMBER**  
: Sensor: -  
Data logger: A4987  
**ID NUMBER**  
: RYG\_P50089  
**CONDITION AS-RECEIVED**  
**CUSTOMER**  
: Used item  
: AIS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**Calibration procedure:**  
The wind direction sensor was calibrated against  
Standard Rotary Encoder model: AS500759  
DMDA P8-S-UD in an close type section of Eiffel  
type wind tunnel with 400 cm² open cross-section  
area. The W1-CL-008 based on IEC 61400-12-1,  
Wind energy generation systems - Part 12-1:  
Power performance measurement 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: SN-0043-22

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

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

**ENVIRONMENTAL CONDITIONS:**  
Ambient condition in the laboratory are as follow:  
Temperature  
: 23.0 ± 3.0 °C  
Relative Humidity  
: 55.0 ± 15.0 %RH  
Atmospheric Pressure  
: 1010 ± 10 hPa

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

**CALIBRATION CONDITION**  
: Wind tunnel cross-section area<sup>1</sup> 300 cm²  
Win direction frontal area<sup>2</sup> 129 cm²  
Diameter of mounting pipe<sup>3</sup> mm  
Blockage ratio of test object<sup>4</sup> 0.141 [-]

**Preconditioning**  
: 24 hours at ambient conditions.  
**Measurement Condition**  
: The average values during measurement are (24.1) °C, (54.3) %RH and (1015.2) hPa.

**TABULATION OF RESULTS:**  
The table on next page give the measured values.

**Calibrated by:**  
☒ Mr. Sorawit Thirakulchai  
☐ Miss Atthasit Thirakulchai

Approved signature:

Mr. Pinyas Boonchaisan  
Calibration Department Manager

**Remarks:**  
<sup>1</sup> Nulling 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 "a" to "b"

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

Certificate Number

CL-011-66

Page 2 of 2 Pages

### MEASUREMENT RESULTS<sup>1</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 <sub>100</sub> Degree (°)	D <sub>100</sub> Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	0.59
	-45.000	41	-4	0.68
	-90.000	88	-2	0.74
	135.000	133	-2	0.58
5.03	180.000	180	0	0.74
	225.000	228	3	0.74
	270.000	273	3	0.68
	315.000	316	1	0.74

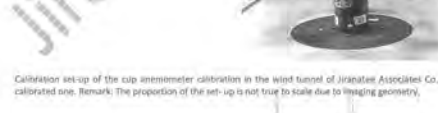
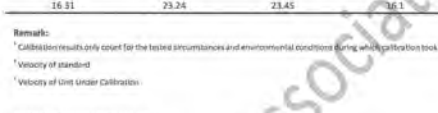
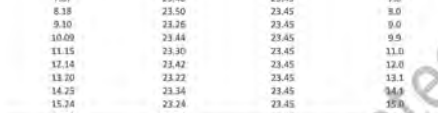
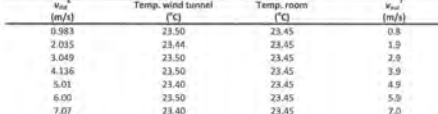
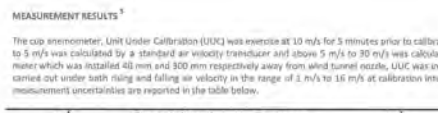
**Remark:**

<sup>1</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

<sup>2</sup> Direction of standard

<sup>3</sup> Direction of Unit Under Calibration

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



Certificate Number

CL-011-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

**MEASUREMENT ITEM**  
: Cup anemometer  
**MANUFACTURER**  
: Novallme  
**MODEL/TYPE**  
: Sensor: WS-02F  
Data logger: 200-WS-25DL  
**SERIAL NUMBER**  
: Sensor: -  
Data logger: A4987  
**ID NUMBER**  
: RYG\_P50089  
**CONDITION AS-RECEIVED**  
**CUSTOMER**  
: Used item  
: AIS laboratory group (Thailand) Co., Ltd.  
104 Phatthanakan Rd, Khwaeng Suan Luang,  
Khet Suan Luang, Bangkok 10250 Thailand.

**Calibration procedure:**  
The cup anemometer was calibrated against  
Standard air velocity transducer model: H45582  
and pitot tube with precision differential pressure  
meter model: DMM250 in an close type section of  
Eiffel-type wind tunnel with 300 cm² cross test  
section area. The W1-CL-008 based on IEC 61400-  
12-1, Wind energy generation systems - Part 12-1:  
Power performance measurement of electricity  
producing wind turbines, March 2017 was used as  
a calibration guideline.

**Traceability:**  
This certificate provides a traceability of the  
measurement to recognized the national  
standards, and to realization of the international  
system of units (SI) through the NIMT (National  
Metrology Institute of Thailand) via Certificate  
Number: MW-0052-21 and MW-0068-22

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

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

**ENVIRONMENTAL CONDITIONS:**  
Ambient condition in the laboratory are as follow:  
Temperature  
: 23.0 ± 3.0 °C  
Relative Humidity  
: 55.0 ± 15.0 %RH  
Atmospheric Pressure  
: 1010 ± 10 hPa

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

**CALIBRATION CONDITIONS**  
: Wind tunnel cross-section area<sup>1</sup> 300 cm²  
Win direction frontal area<sup>2</sup> 100 cm²  
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 (23.5) °C, (52.8) %RH and (1014.1) hPa.

**TABULATION OF RESULTS:**  
The table on next page give the measured values.

**Calibrated by:**  
☒ Mr. Sorawit Thirakulchai  
☐ Miss Atthasit Thirakulchai

Approved signature:

Mr. Pinyas Boonchaisan  
Calibration Department Manager

**Remarks:**  
<sup>1</sup> Nulling 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 "a" to "b"

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

Certificate Number

CL-011-66

Page 2 of 2 Pages

### MEASUREMENT RESULTS<sup>1</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 0.3 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 100 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 3 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 <sub>ref</sub> (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V <sub>meas</sub> (m/s)	Error (m/s)	U (k=2) (m/s)
0.383	23.50	23.45	0.8	-0.2	0.17
2.055	23.44	23.45	1.9	-0.1	0.16
3.049	23.50	23.45	2.9	-0.2	0.19
4.136	23.50	23.45	3.9	-0.2	0.20
5.01	23.40	23.45	4.9	-0.1	0.18
6.00	23.50	23.45	5.9	-0.1	0.19
7.07	23.40	23.45	7.0	-0.1	0.19
8.18	23.50	23.45	8.0	-0.3	0.19
9.30	23.25	23.45	9.0	-0.1	0.20
10.09	23.44	23.45	9.9	-0.1	0.21
11.15	23.30	23.45	11.0	-0.1	0.21
12.14	23.42	23.45	12.0	-0.1	0.25
13.10	23.22	23.45	13.1	-0.1	0.26
14.25	23.34	23.45	14.9	-0.1	0.24
15.24	23.24	23.45	15.0	-0.3	0.26
16.31	23.24	23.45	16.1	-0.2	0.24

**Remark:**

<sup>1</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

<sup>2</sup> Velocity of standard

<sup>3</sup> Velocity of Unit Under Calibration

**PHOTO OF CALIBRATION SET-UP**



Calibration set-up of the cup anemometer in the wind tunnel of Jiranatee Associates Co., Ltd. The cup anemometer sensor 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\*\*\*





JIRANATEE ASSOCIATES CO., LTD.

Jirantee Associates Co., Ltd.  
43/14-15, 43/15-16,  
Pattana 7, 7/1, Rd. Wattana, Bangkok,  
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Tel: +662-0580012  
Mobile: +662-0580012  
E-mail: jnac.calibration@jiranatee.com  
Web site: www.jiranatee.com

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

Air speed measurement laboratory  
Calibration services department



Certificate Number

CL-018-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

### MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

### 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

Effel-type wind tunnel of Jiranatee Associates Co., Ltd.

### CALIBRATION CONDITIONS

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

### Preconditioning

Measurement Condition

### TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☒ Mr. Sorwatt Thirakul  
☐ Miss Jitraporn Lertsomphol

### Remarks:

\* Valid cross-section area of the wind tunnel  
\* Specified cross-section area of the tested object include mounting pipe  
\* Diameter of mounting pipe  
\* Ratio "to 1"

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

Page 2 of 2 Pages

### MEASUREMENT RESULTS<sup>1</sup>

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

$V_{std}$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$V_{UUC}$ (m/s)	Error (m/s)	$U$ (k=2) (m/s)
0.983	23.60	23.55	0.8	-0.2	0.15
2.038	23.50	23.55	1.8	-0.2	0.16
3.044	23.50	23.55	2.9	-0.2	0.18
4.147	23.58	23.55	3.9	-0.3	0.19
5.00	23.50	23.55	4.9	-0.1	0.18
5.98	23.62	23.55	5.9	-0.1	0.18
7.04	23.28	23.55	7.0	-0.1	0.18
8.16	23.56	23.55	8.0	-0.2	0.19
9.10	23.26	23.55	9.0	-0.1	0.19
10.07	23.50	23.55	10.0	-0.1	0.19
11.13	23.10	23.55	11.0	-0.2	0.20
12.13	23.50	23.55	12.1	-0.1	0.20
13.21	23.12	23.55	13.1	-0.1	0.22
14.25	23.36	23.55	14.0	-0.2	0.27
15.24	23.10	23.55	15.3	-0.2	0.28
16.29	23.20	23.55	16.0	-0.3	0.24

### Remarks:

<sup>1</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

<sup>2</sup> Velocity of standard

<sup>3</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\*\*\*  
JIRANATEE ASSOCIATES CO., LTD.



JIRANATEE ASSOCIATES CO., LTD.

Jirantee Associates Co., Ltd.  
43/14-15, 43/15-16,  
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Tel: +662-0580012  
Mobile: +662-0580012  
E-mail: jnac.calibration@jiranatee.com  
Web site: www.jiranatee.com

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

Air speed measurement laboratory  
Calibration services department

Certificate Number

CL-016-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

### MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

### 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

Effel-type wind tunnel of Jiranatee Associates Co., Ltd.

### CALIBRATION CONDITION

Wind tunnel cross-section area : 900 cm<sup>2</sup>  
Win direction frontal area : 120 cm<sup>2</sup>  
Diameter of mounting pipe : mm  
Blockage ratio of test object : 0.143 [-]

### Preconditioning

Measurement Condition

### TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☒ Mr. Sorwatt Thirakul  
☐ Miss Jitraporn Lertsomphol

### Remarks:

\* Valid cross-section area of the wind tunnel  
\* Specified cross-section area of the tested object include mounting pipe  
\* Diameter of mounting pipe  
\* Ratio "to 1"

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

Certificate Number

CL-016-66

Page 2 of 2 Pages

### MEASUREMENT RESULTS<sup>1</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 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 (°)
		0	0	0.58
	45.000	41	-4	0.58
	90.000	87	-3	0.58
5.00	135.000	135	0	0.65
	180.000	182	2	0.74
	225.000	230	5	0.88
	270.001	275	5	0.58
	315.000	320	5	0.58

### Remarks:

<sup>1</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

<sup>2</sup> Direction of standard

<sup>3</sup> Direction of Unit Under Calibration



\*\*\*End of Certificate of Calibration\*\*\*  
JIRANATEE ASSOCIATES CO., LTD.



JIRANATEE ASSOCIATES CO., LTD.

Jirantee Associates Co., Ltd.  
43/14-15, 10/25-26  
Petchkasem 2/21, Rd. Wattana, Bangkok,  
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E-mail: jrac-calibration@jiranatee.com  
Web site: www.jiranatee.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC-TSI-ITS 17025  
CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department.



Certificate Number

CL-019-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

### MEASUREMENT ITEM MANUFACTURER MODEL/TYPE

Cup anemometer  
Novalyra  
Sensor: WS-02F  
Data logger: 200-WS-2SLB

### SERIAL NUMBER

Sensor: -  
Data logger: AS374  
RYS\_F50412

### ID NUMBER CONDITION AS-RECEIVED CUSTOMER

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

### RECEIVED DATE MEASUREMENT DATE ISSUE DATE

27 Jan 2023  
10 Feb 2023  
10 Feb 2023

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature:  $23.0 \pm 1.0$  °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: 500 cm<sup>2</sup>  
Win direction frontal area: 100 cm<sup>2</sup>  
Diameter of measuring pipe: - mm  
Blockage ratio of test object: 0.111 [-]

### Preconditioning Measurement Condition

24 hours at ambient conditions.  
The average values during measurement are (23.5) °C, (49.7) %RH and (1010.3) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:  
[ ] Mr. Soravit Thachakul  
[ ] Miss Jittragoon Lertsitongkul



Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

Remark:  
1. Actual cross-section area of the wind tunnel  
2. Projected cross-section area of the tested object include mounting pipe  
3. Diameter of measuring pipe  
4. Ratio 1/10

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

Certificate Number

CL-019-66

Page 2 of 2 Pages

### MEASUREMENT RESULTS<sup>1</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 (5 m/s to 5 m/s) was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

$V_{ref}$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$V_{UUC}$ (m/s)	Error (m/s)	$U$ (k=2) (m/s)
0.981	23.52	23.50	0.8	-0.2	0.15
2.039	23.46	23.50	1.8	-0.2	0.16
3.040	23.50	23.50	2.9	-0.2	0.17
4.144	23.56	23.50	3.8	-0.2	0.20
5.00	23.38	23.50	4.8	-0.2	0.19
5.98	23.56	23.50	5.8	-0.2	0.17
7.05	23.26	23.50	6.9	-0.2	0.18
8.15	23.50	23.50	7.9	-0.2	0.19
9.09	23.30	23.50	8.9	-0.2	0.18
10.09	23.50	23.50	9.9	-0.2	0.20
11.14	23.24	23.50	11.0	-0.2	0.21
12.13	23.36	23.50	12.0	-0.2	0.21
13.18	23.32	23.50	13.0	-0.2	0.21
14.26	23.18	23.50	14.0	-0.2	0.22
15.21	23.30	23.50	15.0	-0.3	0.24
16.28	23.12	23.50	16.1	-0.2	0.24

### Remark:

<sup>1</sup> Calibration results only valid for the tested circumstances and environmental conditions during which calibration took place.

<sup>2</sup> Velocity of standard

<sup>3</sup> Velocity of Unit Under Calibration

### PHOTO OF CALIBRATION SET-UP



Calibration setup 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\*\*\*  
JIRANATEE ASSOCIATES CO., LTD.



JIRANATEE ASSOCIATES CO., LTD.

Jirantee Associates Co., Ltd.  
43/14-15, 10/25-26  
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Tel: +6628280812  
Mobile: +6628280813  
E-mail: jrac-calibration@jiranatee.com  
Web site: www.jiranatee.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC-TSI-ITS 17025  
CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department.

Certificate Number

CL-017-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

### MEASUREMENT ITEM MANUFACTURER MODEL/TYPE

Wind Direction Sensor  
Novalyra  
Sensor: WS-02F  
Data logger: 200-WS-2SLB

### SERIAL NUMBER

Sensor: -  
Data logger: AS374  
RYS\_F50412

### ID NUMBER CONDITION AS-RECEIVED CUSTOMER

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

### RECEIVED DATE MEASUREMENT DATE ISSUE DATE

27 Jan 2023  
10 Feb 2023  
10 Feb 2023

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature:  $23.0 \pm 1.0$  °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: 500 cm<sup>2</sup>  
Win direction frontal area: 129 cm<sup>2</sup>  
Diameter of measuring pipe: - mm  
Blockage ratio of test object: 0.143 [-]

### Preconditioning Measurement Condition

24 hours at ambient conditions.  
The average values during measurement are (23.3) °C, (50.6) %RH and (1011.8) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:  
[ ] Mr. Soravit Thachakul  
[ ] Miss Jittragoon Lertsitongkul



Approved signatory:

Mr. Parinya Booncharoen  
Calibration Department Manager

Remark:  
1. Actual cross-section area of the wind tunnel  
2. Projected cross-section area of the tested object include mounting pipe  
3. Diameter of measuring pipe  
4. Ratio 1/10

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

Certificate Number

CL-017-66

Page 2 of 2 Pages

### MEASUREMENT RESULTS<sup>1</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	$D'_{45}$ Degree (°)	$D'_{135}$ Degree (°)	Error Degree (°)	$U$ (k=2) Degree (°)
	0.000	0	0	0.33
	45.000	41	-4	0.58
	90.000	87	-3	0.74
4.98	135.001	132	-3	0.74
	180.000	178	-2	0.74
	225.000	227	2	0.58
	270.000	274	4	0.58
	315.000	320	5	0.58

### Remark:

<sup>1</sup> Calibration results only valid for the tested circumstances and environmental conditions during which calibration took place.

<sup>2</sup> Direction of standard

<sup>3</sup> Direction of Unit Under Calibration



\*\*\*End of Certificate of Calibration\*\*\*  
JIRANATEE ASSOCIATES CO., LTD.

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACC22023  
Pages : 1 of 3

## Calibration Certificate

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

Condition As Found : GOOD

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

Location :  
Ambient Temperature : ( 23.0 ± 3 ) °C  
Pressure : ( 101.3 ± 3 ) kPa  
Relative Humidity : ( 50.0 ± 20 ) %

Received Date : 22 AUGUST 2022  
Calibration Date : 31 AUGUST 2022  
Date of Issue : 02 SEPTEMBER 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchur*  
( 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.

QF-TS12-04-04-020664

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACC22023  
Job No. : VC65AC0077  
Pages : 2 of 3

Calibration Procedure : CP-AC-03

## Calibration Method :

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

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

## Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL_BP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL_BP_03/0265	09-Feb-23
Digital Multimeter	33461A	MY60024273	EEL_BP_05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23
Audio Analyzer	AVR-3360A	V744B6069	EF-0010-22	07-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACC22023  
Job No. : VC65AC0077  
Pages : 3 of 3

## Result of calibration :

### 1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	94.04	0.04	0.14	0.40

### 2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1001.5	0.1	0.1	1.0

### 3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
1.70	0.10	3.0

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

End of Calibration Certificate

QF-TS12-04-04-020664

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL22154  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00734218 / 146937 / 34368  
ID No. : RYG\_FS0031

Condition As Found : GOOD

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

Location :  
Ambient Temperature : ( 23.0 ± 3 ) °C  
Pressure : ( 101.3 ± 3 ) kPa  
Relative Humidity : ( 50.0 ± 20 ) %

Received Date : 17 JUNE 2022  
Calibration Date : 20-22 JUNE 2022  
Date of Issue : 27 JUNE 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by :

*T. Petchur*  
( 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.

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL22154  
Job No. : VC65AC0068  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

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

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

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

## Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL_BP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL_BP_03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL_BP_05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

T. Petcha

## Continuation of Calibration Certificate

Cert. No. : ACL22154  
Job No. : VC65AC0068  
Pages : 3 of 8

## Summary of Measurement Result :

Parameter	Pass	Fail	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	-	-	-	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

QF-TS12-04-04-020664

T. Petcha

## Continuation of Calibration Certificate

Cert. No. : ACL22154  
Job No. : VC65AC0068  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
20.1

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.4
Flat	23.1

## 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	-1.5	-1.5	-1.4	±5.0

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T. Petcha

## Continuation of Calibration Certificate

Cert. No. : ACL22154  
Job No. : VC65AC0068  
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	-0.1	-0.1	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	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	0.1	0.1	±5.0

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

Frequency 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

QF-TS12-04-04-020664

T. Petcha

## Continuation of Calibration Certificate

Cert. No. : ACL22154  
Job No. : VC65AC0068  
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	132.9	-0.1	±1.1
132.0	131.9	-0.1	±1.1
131.0	130.9	-0.1	±1.1
129.0	128.9	-0.1	±1.1
124.0	123.9	-0.1	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	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	27.0	0.0	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.9	-0.1	±1.1

QF-TS12-04-04-020664

T. Petchur

## Continuation of Calibration Certificate

Cert. No. : ACL22154  
Job No. : VC65AC0068  
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)
Auto	94.0	94.0	0.0	±1.1

## 9. Tone burst response

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

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.7	-0.7	±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	-
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

QF-TS12-04-04-020664

T. Petchur

## Continuation of Calibration Certificate

Cert. No. : ACL22154  
Job No. : VC65AC0068  
Pages : 8 of 8

## 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	137.0	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

QF-TS12-04-04-020664

T. Petchur

451-451/1 Sirinthorn Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND.  
Tel: 0-2435-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL22239  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42A/ Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00623393 / 198640 / 26421  
ID No. : 7-8 0 31 1115

Condition As Found : GOOD

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

Location :  
Ambient Temperature : ( 23.0 ± 3 ) °C  
Pressure : ( 101.3 ± 3 ) kPa  
Relative Humidity : ( 50.0 ± 20 ) %

Received Date : 07 OCTOBER 2022  
Calibration Date : 20-21 OCTOBER 2022  
Date of Issue : 21 OCTOBER 2022

Calibrated by : Nuthakorn Pisutpaisan

Approved by :

T. Petchur  
( 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.

QF-TS12-04-04-020664



## Continuation of Calibration Certificate

Cert. No. : ACL22239  
Job No. : VC65AC0089  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).  
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

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

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP_03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP_05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL22239  
Job No. : VC65AC0089  
Pages : 3 of 8

## Summary of Measurement Result :

Parameter	Pass	Fail	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	-	-	-	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

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL22239  
Job No. : VC65AC0089  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
14.6

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

Frequency Weighting	Measured value (dB)
A-weight	11.2
C-weight	17.5
Flat	23.3

## 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	0.3	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.0	0.0	0.0	±5.0

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL22239  
Job No. : VC65AC0089  
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	0.0	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	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

Frequency 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

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL22239  
Job No. : VC65AC0089  
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	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	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	26.0	0.0	±1.1
25.0	25.0	0.0	±1.1

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## Continuation of Calibration Certificate

Cert. No. : ACL22239  
Job No. : VC65AC0089  
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)
Auto	94.0	94.0	0.0	±1.1

## 9. Tone burst response

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

## 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	133.0	133.0	0.0	-
One	136.4	135.6	-0.8	±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	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL22239  
Job No. : VC65AC0089  
Pages : 8 of 8

## 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	137.0	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

QF-TS12-04-04-020664

451-451/1 Sirinthorn Rd., Bangbunru, Bangkok Bangkok 10700 THAILAND  
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL22182  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No.: 00873109 / 171842 / 73485  
ID No.: RYG\_FS0384

Condition As Found : GOOD

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

Location : -  
Ambient Temperature : ( 23.0 ± 3 ) °C  
Pressure : ( 101.3 ± 3 ) kPa  
Relative Humidity : ( 50.0 ± 20 ) %

Received Date : 22 AUGUST 2022  
Calibration Date : 26-31 AUGUST 2022  
Date of Issue : 02 SEPTEMBER 2022

Calibrated by : Nalihakorn Pisutpaisan

Approved by :

T. Petchuraj  
( Thanakul Petchuraj )

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.

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL22182  
Job No. : VC65AC0077  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).  
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

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

## Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0263	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL22182  
Job No. : VC65AC0077  
Pages : 3 of 8

## Summary of Measurement Result :

Parameter	Pass	Fail	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	✓	—	0.4	0.7
4. Electrical signal tests of frequency weightings				
For 10 Hz to 4 kHz	✓	—	0.3	0.6
For > 4 kHz to 10 kHz	✓	—	0.3	0.7
For > 10 kHz to 20 kHz	—	—	—	1.0
5. Frequency and time weightings at 1 kHz	✓	—	0.2	0.2
6. Long - term stability	✓	—	0.1	0.1
7. Level linearity on the reference level range	✓	—	0.2	0.3
8. Level linearity including the level range control	✓	—	0.2	0.3
9. Tone burst response	✓	—	0.2	0.3
10. Peak C sound level	✓	—	0.2	0.35
11. Overload indication	✓	—	0.2	0.25
12. High level stability	✓	—	0.1	0.1

QF-TS12-04-04-020664

T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL22182  
Job No. : VC65AC0077  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
16.5

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

Frequency Weighting	Measured value (dB)
A - weight	11.2
C - weight	17.6
Flat	23.3

## 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	0.5	0.5	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-2.4	-2.4	-2.4	±5.0

QF-TS12-04-04-020664

T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL22182  
Job No. : VC65AC0077  
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	-0.1	-0.1	-0.1	±2.0
125	0.0	0.0	-0.1	±1.5
250	-0.1	-0.1	-0.1	±1.5
500	-0.1	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	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	—
C - weight	94.0	0.0	± 0.2
Flat	94.0	0.0	± 0.2

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

Frequency 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

QF-TS12-04-04-020664

T. Petch



## Continuation of Calibration Certificate

Cert. No. : ACL22182  
Job No. : VC65AC0077  
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	137.1	0.1	±1.1
136.0	136.1	0.1	±1.1
135.0	135.1	0.1	±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	129.1	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	109.1	0.1	±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	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	28.0	0.0	±1.1
27.0	27.0	0.0	±1.1
26.0	26.0	0.0	±1.1
25.0	24.9	-0.1	±1.1

QF-TS12-04-04-020664

T. Petchur

## Continuation of Calibration Certificate

Cert. No. : ACL22182  
Job No. : VC65AC0077  
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)
Auto	94.0	94.0	0.0	±1.1

## 9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±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	-
Positive half cycle	135.4	125.1	-10.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

QF-TS12-04-04-020664

T. Petchur

## Continuation of Calibration Certificate

Cert. No. : ACL22182  
Job No. : VC65AC0077  
Pages : 8 of 8

## 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

QF-TS12-04-04-020664

T. Petchur

451-451/1 Sirinthorn Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND  
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACC23005  
Pages : 1 of 3

## Calibration Certificate

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

Condition As Found : GOOD

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

Location :  
Ambient Temperature : ( 23.0 ± 3 ) °C  
Pressure : ( 101.3 ± 3 ) kPa  
Relative Humidity : ( 50.0 ± 20 ) %

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

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petchur  
( 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.

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACC23005  
Job No. : VC66AC0024  
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

This equipment was calibrated by based on IEC-60942-2003 Standard.  
The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference microphone.

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

QP-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACC23005  
Job No. : VC66AC0024  
Pages : 3 of 3

Result of calibration :

1. Sound pressure level

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

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value ( % )	Uncertainty ( % )	Tolerance limit ( % )
1000	1000.0	0.0	0.1	1.0

3. Total distortion

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

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

End of Calibration Certificate

QP-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD.  
CALIBRATION LABORATORY

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



Cert. No. : ACL23079  
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00296516 / 180412 / 88182  
ID No. : RYG\_FS0433

Condition As Found : GOOD

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

Location :  
Ambient Temperature : ( 23.0 ± 3 ) °C  
Pressure : ( 101.3 ± 3 ) kPa  
Relative Humidity : ( 50.0 ± 20 ) %

Received Date : 24 JANUARY 2023  
Calibration Date : 25-26 JANUARY 2023  
Date of Issue : 27 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur  
( Thanakul Petchur )

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.

QP-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23079  
Job No. : VC66AC0031  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).  
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

QP-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL23079  
Job No. : VC66AC0031  
Pages : 3 of 8

## Summary of Measurement Result :

Parameter	Pass	Fail	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	-	-	-	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

QF-TS12-04-04-020664

7. Patch

## Continuation of Calibration Certificate

Cert. No. : ACL23079  
Job No. : VC66AC0031  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

Reference Acoustic Signal ( dB )	Measured Value ( dB )	Deviation ( dB )	Acceptance Limit ( dB )
93.9 (93.95)	93.9	0.0	±0.3

## 2. Self-generated noise

## 2.1 Normal test

Measured Value ( dB )
14.8

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

Frequency Weighting	Measured value ( dB )
A - weight	11.6
C - weight	17.5
Flat	23.3

## 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	0.0	0.1	0.1	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	0.4	0.5	0.4	± 5.0

QF-TS12-04-04-020664

7. Patch

## Continuation of Calibration Certificate

Cert. No. : ACL23079  
Job No. : VC66AC0031  
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	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

Frequency 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

QF-TS12-04-04-020664

7. Patch

## Continuation of Calibration Certificate

Cert. No. : ACL23079  
Job No. : VC66AC0031  
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	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.8	-0.2	± 1.1
29.0	28.8	-0.2	± 1.1
28.0	27.8	-0.2	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.8	-0.2	± 1.1
25.0	24.8	-0.2	± 1.1

QF-TS12-04-04-020664

7. Patch

## Continuation of Calibration Certificate

Cert. No. : ACL23079  
Job No. : VC66AC0031  
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)
Auto	94.0	94.0	0.0	±1.1

## 9. Tone burst response

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

## 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	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±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	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

QP-TS12-04-04-020664

T. Petchurui

## Continuation of Calibration Certificate

Cert. No. : ACL23079  
Job No. : VC66AC0031  
Pages : 8 of 8

## 11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle	0.2	±1.5
89.5	89.7		

## 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

QP-TS12-04-04-020664

T. Petchurui

SITHIPORN ASSOCIATES CO.,LTD.  
CALIBRATION LABORATORY451-451/1 Sirinthorn Rd.,Bangbunru, Bangplud Bangkok 10700 THAILAND.  
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:center@sitthiporn.com http://www.sitthiporn.comCert. No. : ACL23081  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No.: 00296518 / 66239 / 34375  
ID No.: RYG\_FS0431

Condition As Found : GOOD

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

Location :  
Ambient Temperature : ( 23.0 ± 3 ) °C  
Pressure : ( 101.3 ± 3 ) kPa  
Relative Humidity : ( 50.0 ± 20 ) %

Received Date : 24 JANUARY 2023  
Calibration Date : 25-26 JANUARY 2023  
Date of Issue : 27 JANUARY 2023

Calibrated by : Nathikorn Pisutpaisan

Approved by :

T. Petchurui  
( Thanakul Petchurui )

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.

QP-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL23081  
Job No. : VC66AC0031  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).  
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.  
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

## Condition of this result of calibration :

## 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP_04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP_03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP_05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

QP-TS12-04-04-020664

T. Petchurui

## Continuation of Calibration Certificate

Cert. No. : ACL23081  
Job No. : VC66AC0031  
Pages : 3 of 8

## Summary of Measurement Result :

Parameter	Pass	Fail	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	-	-	-	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

QF-TS12-04-04-020664

T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23081  
Job No. : VC66AC0031  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

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

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
21.7

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

Frequency Weighting	Measured value (dB)
A - weight	13.1
C - weight	19.0
Flat	24.7

## 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	0.0	0.0	0.0	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-0.4	-0.3	-0.3	± 5.0

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T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23081  
Job No. : VC66AC0031  
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	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

Frequency 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

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T. Petch

## Continuation of Calibration Certificate

Cert. No. : ACL23081  
Job No. : VC66AC0031  
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	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.8	-0.2	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.8	-0.2	± 1.1

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T. Petch



Cert. No. : ACL23081  
Job No. : VC66AC0031  
Pages : 7 of 8

## 8. Level linearity including the level range control

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

## 9. Tone burst response

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

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, 1 repeat (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.8	-0.6	±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	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

QF-TS12-04-04-020664

T. Petchurui

Cert. No. : ACL23081  
Job No. : VC66AC0031  
Pages : 8 of 8

## 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

QF-TS12-04-04-020664

T. Petchurui

SITHIPORN ASSOCIATES CO.,LTD.  
CALIBRATION LABORATORY451-451/1 Sirinthorn Rd., Bangbunru, Bangkok 10700 THAILAND  
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23043  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No.: 00900072 / 188465 / 01734  
ID No.: RYG\_FS0493

Condition As Found : GOOD

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

Location :  
Ambient Temperature : ( 23.0 ± 3 ) °C  
Pressure : ( 101.3 ± 3 ) kPa  
Relative Humidity : ( 50.0 ± 20 ) %

Received Date : 06 JANUARY 2023  
Calibration Date : 13-18 JANUARY 2023  
Date of Issue : 19 JANUARY 2023

Calibrated by : Natchakorn Pisutpaisan

Approved by :

T. Petchurui  
( Thanakul Petchurui )

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QF-TS12-04-04-020664

Cert. No. : ACL23043  
Job No. : VC66AC0024  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM). The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

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

## Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP_03/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP_03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP_05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAJ	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand),

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

QF-TS12-04-04-020664

T. Petchurui

## Continuation of Calibration Certificate

Cert. No. : ACL23043  
Job No. : VC66AC0024  
Pages : 3 of 8

## Summary of Measurement Result :

Parameter	Pass	Fail	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	-	-	-	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

QF-TS12-04-04-020664

P. R. A.

## Continuation of Calibration Certificate

Cert. No. : ACL23043  
Job No. : VC66AC0024  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
14.2

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

Frequency Weighting	Measured value (dB)
A - weight	10.8
C - weight	17.2
Flat	22.9

## 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)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.3	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.0	-0.9	-0.9	±5.0

QF-TS12-04-04-020664

P. R. A.

## Continuation of Calibration Certificate

Cert. No. : ACL23043  
Job No. : VC66AC0024  
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	-0.1	-0.1	-0.1	±2.0
125	-0.1	0.0	-0.1	±1.5
250	0.0	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	0.1	0.1	±5.0

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

Frequency 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

QF-TS12-04-04-020664

P. R. A.

## Continuation of Calibration Certificate

Cert. No. : ACL23043  
Job No. : VC66AC0024  
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	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	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	28.9	-0.1	± 1.1
28.0	28.0	0.0	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

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P. R. A.

## Continuation of Calibration Certificate

Cert. No. : ACL23043  
Job No. : VC66AC0024  
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)
Auto	94.0	94.0	0.0	±1.0

## 9. Tone burst response

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

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.4	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	-
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

QF-TS12-04-04-020664

T. Petchur

## Continuation of Calibration Certificate

Cert. No. : ACL23043  
Job No. : VC66AC0024  
Pages : 8 of 8

## 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	137.0	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

QF-TS12-04-04-020664

T. Petchur

SITHIPORN ASSOCIATES CO.,LTD.  
CALIBRATION LABORATORY451-451/1 Sirinthorn Rd, Bangburm, Bangplud Bangkok 10700 THAILAND.  
Tel:0-2435-8800 Fax:0-2435-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comNSC-TS12-TS 17025  
CALIBRATION 0304  
Cert. No. : ACL23042  
Pages : 1 of 8

## Calibration Certificate

Equipment : SOUND LEVEL METER  
Manufacturer : RION  
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24  
Serial No. : 00900071 / 188464 / 01733  
ID No. : RYG\_FS0492

Condition As Found : GOOD

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

Location :  
Ambient Temperature : ( 23.0 ± 3 ) °C  
Pressure : ( 101.3 ± 3 ) kPa  
Relative Humidity : ( 50.0 ± 20 ) %

Received Date : 06 JANUARY 2023  
Calibration Date : 13-18 JANUARY 2023  
Date of Issue : 19 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur  
( 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.

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL23042  
Job No. : VC66AC0024  
Pages : 2 of 8

Calibration Procedure : CP-AC-01

## Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).  
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.  
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

## Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL-BP_04/0263	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL-BP_03/0263	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL-BP_03/0263	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

T. Petchur



## Continuation of Calibration Certificate

Cert. No. : ACL23042  
Job No. : VC66AC0024  
Pages : 3 of 8

## Summary of Measurement Result :

Parameter	Pass	Fail	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	-	-	-	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

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL23042  
Job No. : VC66AC0024  
Pages : 4 of 8

## Result of calibration :

## 1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

## 2. Self-generated noise

## 2.1 Normal test

Measured Value (dB)
14.6

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.9
Flat	23.9

## 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)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.2	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.3	0.4	0.4	±5.0

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL23042  
Job No. : VC66AC0024  
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)			Acceptance Limits
	Flat	C-weight	A-weight	
63	0.0	0.0	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

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

## 5.2 Time weighting at 1 kHz

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

## 6. Long - term stability

Frequency 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

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL23042  
Job No. : VC66AC0024  
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	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	49.0	0.0	± 1.1
44.0	43.9	-0.1	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.8	-0.2	± 1.1
26.0	25.8	-0.2	± 1.1
25.0	24.8	-0.2	± 1.1

QF-TS12-04-04-020664

## Continuation of Calibration Certificate

Cert. No. : ACL23042  
Job No. : VC66AC0024  
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)
Auto	94.0	94.0	0.0	±1.1

## 9. Tone burst response

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

## 10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±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	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

QF-TS12-04-04-020664

B.T.W

## Continuation of Calibration Certificate

Cert. No. : ACL23042  
Job No. : VC66AC0024  
Pages : 8 of 8

## 11. Overload indication

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

## 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

QF-TS12-04-04-020664

P.T.A

METTLER TOLEDO

Certificate Number CPH-0167-22

Calibration Certificate  
Seven2Go™ pH/mV meter S2

## Customer

Company ALS LABORATORY GROUP (THAILAND)  
Address 81610 Moo 5, T. Atanumkue, A. Khukhsong  
(BAVONG 21140)  
Customer ID number 361666073  
Customer representative -

## Instrument

Type Seven2Go™ pH/mV S2 Instrument Serial Number 0221115914  
Internal identification Firmware version 1.01

## Technical specifications

Measuring Range -1999.9 - 1999.9 mV ± 20 pH  
Resolution 1 mV 0.01 pH  
Limit of Error ± 1.0 mV ± 0.01 pH  
Temperature range MTC ± 100 °C  
Temperature range ATC ± 100 °C  
Resolution 0.1 °C  
Limit of Error ± 0.5 °C

## Procedure Statement

METTLER TOLEDO Seven2Go Service Manual Section 9 (Doc. No. 36732011) will be used as referring documentation to actual and verify the instrument parameter in the "Type" and "Serial number" section. The measurement results of this certification were obtained at ambient conditions.

REVIEW BY	Tavasit
APPROVED BY	Sep/s
NEXT CAL DATE	26 July 2023

METTLER TOLEDO

Certificate Number CPH-0167-22

## Certification Tools

Certified digital voltmeter Manufacturer HEWLETT PACKARD / 34401A  
Type 34401A  
Serial number US26931181  
Certificate number E110294186  
Date of Certification October 9, 2021

Certified Temperature detectors Manufacturer METTLER-TOLEDO  
Type B1302410  
Serial number A327  
Certificate number 53871  
Date of Certification April 27, 2022

Designation	Nominal value	Certified value
NTC 30 kΩ, 0 °C	34.380 kΩ	34.3814 kΩ
NTC 30 kΩ, 25 °C	30.000 kΩ	30.0022 kΩ
NTC 30 kΩ, 50 °C	15.989 kΩ	15.9920 kΩ
NTC 20 kΩ, 75 °C	4.525 kΩ	4.52564 kΩ
NTC 20 kΩ, 100 °C	2.022 kΩ	2.02259 kΩ

Certificate Number CPH-0167-22

## Certification Measurements

pH/mV Sensor Input

Designation	Certified value	Measured value	Max. Tolerance	Pass/Fail
-1800 mV	-1800.0 mV	-1800 mV	1 mV	Pass
-1000 mV	-1000.0 mV	-1000 mV	1 mV	Pass
-500 mV	-500.0 mV	-500 mV	1 mV	Pass
-180 mV	-180.0 mV	-180 mV	1 mV	Pass
0 mV	0.0 mV	0 mV	1 mV	Pass
180 mV	180.0 mV	180 mV	1 mV	Pass
500 mV	500.0 mV	500 mV	1 mV	Pass
1000 mV	1000.0 mV	1000 mV	1 mV	Pass
1800 mV	1800.0 mV	1800 mV	1 mV	Pass

Temperature Sensor Input

Designation	Nominal value	Measured value	Max. Tolerance	Pass/Fail
NTC 30 KΩ, 0 °C	30.1 °C	30.1 °C	±0.5 °C	Pass
NTC 30 KΩ, 25 °C	25.0 °C	25.1 °C	±0.5 °C	Pass
NTC 30 KΩ, 50 °C	50.0 °C	50.1 °C	±0.5 °C	Pass
NTC 30 KΩ, 75 °C	75.0 °C	75.1 °C	±0.5 °C	Pass
NTC 30 KΩ, 100 °C	100.0 °C	100.0 °C	±0.5 °C	Pass

## Summary of Certification

Certification of instrument

Passed

The instrument referred to in this certificate has fulfilled the criteria of this certificate. This is indicated by the notation Passed in the column items.

Remarks

Certification of this calibration was performed by

Name: Preecha Manonayarat

Function: Service Technician

Company: METTLER TOLEDO

Date: Aug 27, 2022

Signature: 

## Performance Test

Attachment to Certificate No. CPH-0167-22

pH Electrode

Type: InLab Expert Go-ISM S/N: 2103765

## Certified standards used

Standard 1:	Type	pH Buffer	Manufacturer	METTLER TOLEDO	Exp. date	Jun-24
		Nominal value: pH ( 25.00 °C):	4.01		Lot No.	1H158G
Standard 2:	Type	pH Buffer	Manufacturer	METTLER TOLEDO	Exp. date	Jun-24
		Nominal value: pH ( 25.00 °C):	7.00		Lot No.	1H013D
Standard 3:	Type	pH Buffer	Manufacturer	METTLER TOLEDO	Exp. date	May-24
		Nominal value: pH ( 25.00 °C):	9.20		Lot No.	1H138A
Standard 4:	Type	Redox Solution	Manufacturer	METTLER TOLEDO	Exp. date	-
		Nominal value: pH ( 25.00 °C):	-		Lot No.	-

## Adjustment

Set Calibration Buffer		B2 (25 °C) 2.00, 4.01, 7.00, 9.21, 11.00							
Select Calibration Mode		3-Point calibration		2-Point calibration		2-Point calibration			
3-Point Calibration		°C		pH		°C		pH	
Cell 1		ATC 25.4 4.01		ATC 25.0		-- ATC 25.0		--	
Cell 2		ATC 25.3 7.00		ATC 25.0		-- ATC 25.0		--	
Offset (mV)		3							
Slope % (or mV/pH)		99.9							
Cell 3		ATC 25.4 9.21		--		--		--	
Slope % (or mV/pH)		99.0							

## Measurements

Before adjustment				After adjustment					
Buffer Values		Measured	Difference	Buffer Values		Measured	Difference		
pH	°C	pH	pH	pH	°C	pH	pH		
4.01	25.4	ATC	3.96	-0.05	4.01	25.4	ATC	4.01	0.00
7.00	25.3	ATC	6.95	-0.05	7.00	25.4	ATC	6.99	-0.01
9.20	25.4	ATC	9.13	-0.07	9.20	25.4	ATC	9.21	0.01

Redox Measurement Result: - mV

Note: The difference result of calibrated electrode should be within  $\pm 0.05$  pH.

Remarks:

Place: Chemical room

Calibration Date: July 27, 2022

Service Specialist: Preecha Manonayarat

Signature: 

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
334/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL: 0-2717-0000-21 FAX: 0-2719-8884



Cert.No.: 22CH1733

Page.: 1 of 3

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Mettler Toledo  
Model : SevenExcellence  
Serial No. : B834291445  
ID No. : RYG\_EN0152  
Condition As-Received: Used Item  
Received Date : 21 December 2022  
Calibration Date : 22 December 2022  
Reference : 2212-0602DSC-1  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
Rayong Branch  
618/10 Moo 5 T.Maenam Khu.  
A.Pluakdaeng, Rayong 21140, Thailand

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

Calibrated by : Warakorn Lemgagrakul

Approved by :   
Approved Signatory

(/ ) Malee Butkruea  
( ) Sathip Meangmai  
( ) Warakorn Lemgagrakul

Issue Date : 26 December 2022

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 & Equipment Calibration and Testing Services.

Cert.No.: 22CH1733  
Page.: 2 of 3

## Condition of this calibration result

1. Reference Standard Instrument : -

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023
2) Ref. Standard Thermometer	4982054	110RC044	2211308	27 Oct 2023

This certification is traceable to the International System of Unit maintained at:-  
- Traceable to National Institute of Metrology (Thailand), NIMT

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	826588	09 July 2024
pH 6.987	CPA chem	823322	20 June 2023
pH 10.008	CPA chem	826590	09 July 2023

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

## Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input		Actual Reading		Uncertainty of Measurement (±mV)	Coverage factor k
		pH	mV	mV	pH		
pH Meter	4.000		177.48	177.3	4.000	0.058	2.00
S/N: B834291445	7.000		0.00	-0.1	7.000	0.058	2.00
	10.000		-177.48	-177.5	10.000	0.058	2.00



Cert.No.: 22CH1733  
Page.: 3 of 3

#### Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement ( $\pm$ )	Coverage factor k
pH Electrode S/N: 1475518	4.008	4.011	185.2	0.0052	2.06
	6.887	6.990	10.4	0.0088	2.00
	10.008	10.014	-166.5	0.0072	2.00

#### Function : Temperature Measurement

(\*) Without adjustment

This equipment was connected with Temperature Probe:

- Model : InLab Expert Pro-ISM

- Serial No. : 1475518

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	24.9	-0.101	0.13	2.00

Remark : UUC\* = Unit Under Calibration

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

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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 Calibration

Certificate No.: 22E4098  
Page.: 1 of 2

Equipment : pH Meter  
Manufacturer: Mettler Toledo  
Model : SevenExcellence  
Serial No.: B534291445  
ID No.: RYG\_EN0152

Condition As-Received: Used Item  
Received Date: 21 December 2022  
Calibration Date: 23 December 2022

Reference: 2212-0802DSC

Ambient Temperature: ( 23  $\pm$  2 ) °C

Relative Humidity: ( 50  $\pm$  10 ) %

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

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

Procedure used: Calibration were conducted using In-house calibration Procedure CP-E17 According to direct measurement method with Multi-Product Calibrator.

#### Condition of this result of calibration

1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5500A	6315011	22E1431	05 May 2023

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

3. This 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 at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by: Wulcharaporn Wongchulakram  
Issue Date: 26 December 2022

Approved Signatory:

Phalinee Prabpaipal  
Nuntawat Khanchai  
Ponthipha Taneyakul

B 0304803



Cert. No.: 22E4098  
Page.: 2 of 2

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

Function: DC voltage measurement

Range: 2000

mV

Standard Value	UUC* Reading	Error	Uncertainty
( mV )	( mV )	( mV )	( $\pm$ $\mu$ V )
-200.0000	-200.0	0.0	72
-150.0000	-150.0	0.0	69
-100.0000	-100.0	0.0	65
-50.0000	-50.0	0.0	62
0.0000	0.0	0.0	58
50.0000	50.0	0.0	62
100.0000	100.0	0.0	65
150.0000	150.0	0.0	69
200.0000	199.9	-0.1	72

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.

-000-

a 1140616



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.: 22TW34  
Page.: 1 of 2

Equipment : DO Meter  
Manufacturer : YSI  
Model : 5000-115V  
Serial No. : 15E102796  
ID No. : RYG\_EN0032

Received Date : 11 February 2022

Test Date : 14 February 2022

Reference : 2202-0404DSC-4

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

Laboratory Condition : Temperature ( 25  $\pm$  5 ) °C  
Humidity ( 50  $\pm$  20 ) %

Test Procedure : In-house method : CP-CH9  
by Comparison Technique with Azide Modification Method

Tested by : Waialak Sirithuan

Approved by:

Saithip  
Approved Signatory

( ) Maloe Butkrusa  
( ) Saithip Meangmai  
( ) Warakorn Lemagatrakul

Issue Date : 18 February 2022

REVIEW BY	N. Bannat
APPROVED BY	D. An
NEXT CAL. DATE	15/8/23

B 0281285



Cert.No.: 22TW34  
Page: 2 of 2

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)
8.02	8.02	0.0084

This report was certified only for the instrument we tested. It is allowable to use for study the system efficiency. The environmental impact control and present to organization it may concerned. Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced other in full, without written approval of the laboratory.

-o0o-

Saithip

a 1094744



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334/4 PATTANAKARN ROAD NO. 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3089-27 FAX 0-2719-9484



Cert. No.: 22LM12  
Page: 1 of 2

## Certificate of Calibration

Equipment : DO Meter with Sensor  
Manufacturer : YSI  
Model : 5000-115V  
Serial No. : 15E102796  
ID No. : RYG\_EN0032  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)  
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng,  
Rayong 21140, Thailand  
Location : TPA On Site Calibration Laboratory  
Received Order : 11 February 2022  
Calibrated Date : 21 February 2022  
Ambient Temperature : (26 ± 10) °C  
Relative Humidity : (50 ± 30) %  
AC Line Voltage : (220 ± 22) V  
Calibrated by : Kunchit Promrat  
Approved by :   
( ) Pornthippa Tameyakul  
(✓) Malee Butkruea  
( ) Suwit Imjai  
Issue Date : 21 February 2022

The Uncertainties are for a confidence probability of approximately 95%

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A 0038008



Equipment : DO Meter with Sensor  
Condition As-Received : Used Item  
Reference : 2202-0404DSC-5  
Procedure Used :-

Cert. No.: 22LM12  
Page: 2 of 2

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:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Digital Thermometer	1523	2188080	2111273	22 Nov 2022

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

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

Result of Calibration :- ( \* ) Without Adjustment

Function : Temperature measurement.

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

Calibration Point ( °C )	Immersion Depth ( mm )	Standard Temperature ( °C )	UUC* Reading ( °C )	Error ( °C )	Uncertainty ( ± °C )	Coverage Factor k
20.00	45	20.001	19.88	-0.121	0.15	2.00

UUC\* : Unit Under Calibration

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

-o0o-

Malee

a 1095714



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TEL. 0-2717-3089-27 FAX 0-2719-9484



Cert. No.: 22TM317  
Page: 1 of 3

## Certificate of Calibration

Equipment : Low Temp. Incubator  
Manufacturer : Memmert  
Model : IPP750  
Serial No. : V818.0084  
ID No. : RYG\_EN0154  
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.  
(Rayong Branch)  
616/10 Moo 5 T. Maenam Khu,  
A. Pluakdaeng, Rayong 21140, Thailand  
BOD Room  
Location :  
Received Order : 22 April 2022  
Calibration Date : 22 April 2022  
Ambient Temperature : (26 ± 10) °C  
Relative Humidity : (50 ± 30) %  
Calibrated by : Man Pattanapongpaiboon  
Approved by :   
( ) Pornthippa Tameyakul  
(✓) Malee Butkruea  
( ) Suwit Imjai

REVIEW BY	
APPROVED BY	
NEXT CAL. DATE	29/10/23

Issue Date : 3 May 2022

The Uncertainties are for a confidence probability of approximately 95%

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A 0040735



Equipment: Low Temp. Incubator  
Condition As-Received: Used Item  
Reference: 2204-0146OC-1  
Procedure Used :-

Cert. No.: 22TM317  
Page: 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement  
The temperature scale used was based on ITS-90.

#### Condition of this result of calibration

##### 1. Reference standard instrument:-

Instrument Model Serial No. Cert. No. Due Date  
1) Data Acquisition 34970A MY44031769 21LM12 02 Sep 2022

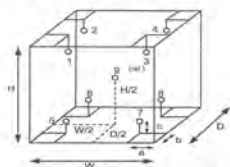
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close



#### Probe Installation Details : Dimension of Chamber :

a = 10 cm D = 0.50 m  
b = 10 cm W = 1.0 m  
c = 10 cm H = 1.2 m  
Capacity = 0.75 m<sup>3</sup>

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	25	25
REL. Humid. ( % )	54	58
AC Supply ( Volt )	221	223

Position :	Ref. Std. ID No.:
1	9RTD-2/1
2	9RTD-2/2
3	9RTD-2/3
4	9RTD-2/4
5	9RTD-2/5
6	9RTD-2/6
7	9RTD-2/7
8	9RTD-2/8
9 (ref.)	9RTD-2/9

Mulu

a 1106485



Equipment: Low Temp. Incubator  
Condition As-Received: Used Item  
Reference: 2204-0146OC-1  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 22TM317  
Page: 3 of 3

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor k
20.0	20.0	20.0	0.022	0.20	0.22	0.30	2

Measured Temperature ( °C )								
Point ( °C )	Position							
20.0	1	2	3	4	5	6	7	8 9 (ref.)
	20.209	20.174	20.199	20.110	20.075	20.062	20.027	20.099 20.030

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 %.

-000-

Mulu

a 1106484



## Certificate of Calibration

Equipment: SPECTROPHOTOMETER  
Model: DR6000  
Serial No. (or ID.): 1627645 (RYG\_EN0037)  
Manufacturer: HACH  
Condition: In Condition

Certificate No.: C06220464  
Issued Date: 27 September 2022  
Job No.: KSPR2212224  
Page: 1 of 3

Customer: ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)  
618/10 Moo 5 T.Maenam Khu,  
A.Pluakdaeng, Rayong 21140, Thailand.

REVIEW BY: *IV. B. J. J.*  
APPROVED BY: *D. J. J.*  
NEXT CAL DATE: 27.13.24

Environment Condition: Temperature 23.1 °C ±  
Humidity 65.4 %RH ± 3.2 %RH

Calibration Place: ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) ( Wet Chemistry )  
618/10 Moo 5 T.Maenam Khu,  
A.Pluakdaeng, Rayong 21140, Thailand.

Calibration By: Mr. Chaturaphon Fothong

Calibration Date: 27 September 2022

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. 91418 and 91435  
The standard for Photometric Certificate No. 91441 and 101088  
The standard for Stray light Certificate No. 101041 and 101040  
The standard for Spectral resolution Certificate No. 101037

(Mr. Chaturaphon Fothong)  
Person in charge

(Mr. Thakerngviat Pongnangern)  
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 in the expanded uncertainty which is observed 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.

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CALFM-C06-15-30-Jul-2022



Certificate No.: C06220464 Page 2 of 3

#### Calibration Results: Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of 84d at 2 nm and UUC at 2 nm

Standard Wavelength	Unit Under Calibration	Correction	Uncertainty
418.81	418.4	0.21	0.14
536.86	536.7	-0.04	0.14
637.98	638.3	-0.32	0.14
748.46	748.8	-0.32	0.14
807.05	807.4	-0.37	0.13

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5905	0.563	-0.0028	0.0045
	0.7334	0.737	-0.0036	0.0045
	1.0534	1.057	-0.0036	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.5603	0.563	-0.0027	0.0045
	0.7178	0.720	-0.0021	0.0045
	1.0312	1.034	-0.0028	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.5024	0.506	-0.0036	0.0045
	0.6693	0.672	-0.0027	0.0045
	0.9604	0.964	-0.0036	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5168	0.518	-0.0022	0.0045
	0.8903	0.891	-0.0007	0.0045
	0.9904	0.992	-0.0016	0.0045
580 nm	0.0000	0.000	0.0000	0.0045
	0.5525	0.554	-0.0015	0.0045
	0.7175	0.718	-0.0005	0.0045
	1.0301	1.031	-0.0009	0.0045
835 nm	0.0000	0.000	0.0000	0.0045
	0.5367	0.538	-0.0013	0.0045
	0.6847	0.685	-0.0003	0.0045
	0.9823	0.983	-0.0007	0.0045

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CALFM-C06-15-30-Jul-2022



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
	0.7423	0.744	-0.0017	0.0083
257 nm	0.0000	0.000	0.0000	0.0080
	0.6609	0.661	-0.0001	0.0084
313 nm	0.0000	0.000	0.0000	0.0080
	0.2686	0.262	-0.0025	0.0080
350 nm	0.0000	0.000	0.0000	0.0080
	0.6381	0.638	0.0001	0.0080
Stray light *				
Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%)	Absorbance (A)	
260.67 +/- 0.11 nm	260.7	2.1	1.678	
391.94 +/- 0.11 nm	391.9	1.7	1.776	
Spectral Resolution *				
Nominal Concentration 0.02 % v/v	Peak	Trough	Ratio	SBW
Standard Wavelength (nm)	268.80	266.63	1.39	2.00
UUC: Wavelength (nm)	268.2	266.1		
Std Absorbance (A)	0.4810	0.3176		
Absorbance (A)	0.373	0.268		

\* Calibration Marked \* No TISI Accredited \* In this Certificate have been included for completeness.

The End of Certificate

DKSH Technology Limited  
25/25 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพฯ 10110  
Phone: +66 2543 7000 Email: info@dksh.com Website: www.dksh.com

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CAL-FM-006-13-20 Jul 2022

## ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2212224

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR6000

หมายเลขเครื่อง: 1627845

ตรวจสอบ (รับ)		ตรวจสอบ (ส่ง)		หมายเหตุ
27 Sep 2022	ผลการตรวจเช็ค	27 Sep 2022	ผลการตรวจเช็ค	
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ	
General				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์ของเครื่อง	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิตช์ เปิด - ปิด เครื่อง (On-Off Switch)	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	
Spectrophotometer				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	6. แบตเตอรี่สำรอง (Battery Backup) >= 2.5 VDC	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. ควบคุมเลือกความยาวคลื่น (Wavelength Control)	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input checked="" type="checkbox"/>	886.1 น้ 886.1 nm
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. ช่ วงวัดหลายตัวอย่าง (Carousel Module)	<input checked="" type="checkbox"/>	
pH Meter and Conductivity Meter				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด (Electrode and Connection Cable)	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	13. ระดับสารละลายใน Electrode (Level KCl)	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	14. ฝาปิดกันปลาย Electrode (Dust Protection Hood)	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	15. ขาตั้งอิเล็กโทรด (Stand)	<input checked="" type="checkbox"/>	
Turbidimeter				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	16. ค่าความทึบที่ว่าง (No Sample)	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	17. ระดับการรบกวนของแสง (>= 2.5 ไม่นเกิน 3.0)	<input checked="" type="checkbox"/>	
Automatic titrator				
<input checked="" type="checkbox"/>	<input type="checkbox"/>	18. สภาพ Piston Burettes	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	19. Function Rinsing and Dosing	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	20. ระบบท่อสายนำและชุดอุปกรณ์ประกอบ	<input checked="" type="checkbox"/>	

เซ็นเซอร์อุณหภูมิ:

Mr. Chutaphon Fothong  
Service EngineerDKSH Technology Limited  
25/25 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพฯ 10110  
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CAL-FM-R31-03-20 Jul 2022

RYG\_EN0002

Sartorius (Thailand) Co., Ltd.  
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310  
Tel: +66 2543 8561-6 Email: service.thailand@sartorius.com

SARTORIUS

REVIEW BY: [Signature]  
APPROVED BY: [Signature]  
NEXT CAL DATE: 01/03/24

## Certificate of Calibration

Model Number : MSE224S-100-DU Certificate No. : 23BCI0112  
Description : Analytical Balance Issued Date : Friday, March 03, 2023  
Serial Number : 0026207038 Reference No. : 204833  
ID No. : RYG\_EN0002  
Manufacturer : Sartorius Page No. : 1 of 2

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

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

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

Matrological data : Capacity : 220 g Readability : 0.0001 g  
Ambients Conditions : Temperature : 23.6 °C ± 5.0 °C Humidity : 60.0 % RH ± 10.0 % RH Pressure : ±

Reasons for calibration : ☐ New installation ☐ Service / Required ☒ Re-calibration / Maintenance ☐ Equipment Condition: ☒ Good Operator ☐ Fail

Measurement Method : UKAS Publication Ref : Lab 14  
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came from list of Sartorius Metrological Specifications.

## Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2/YCS011-522-00	SPC-RT	C02212565	14-Sep-2023
MHB-362SD	Humidity/Barometer/Temp. Luton MHB-362SD	DKSH	C19220444	5-Sep-2023

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

M. Chonchai Inthana (Technical Manager)



SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310  
Tel: +66 2543 8561-6 Fax: +66 2543 4367, e-mail: service.thailand@sartorius.com

SARTORIUS

## Certificate of Calibration

Model Number : MSE224S-100-DU Certificate No. : 23BCI0112  
Description : Analytical Balance Issued Date : Friday, March 03, 2023  
Serial Number : 0026207038 Reference No. : 204833  
ID No. : RYG\_EN0002  
Manufacturer : Sartorius Page No. : 2 of 2

## Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)		
The repeatability is the ability of a weighing instrument to display nearly identical readings 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 measure repeatability quantitatively.			The off-center loading error is yielded by the difference between the reading 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 R110).		
Nominal Value : (Low Load)	20.0000	199.9999	Nominal value :	100	g
20 g	20.0000	200.0000	Tolerance	0.0004	g
Tolerance	0.0001 g	200.0000	Difference		
	20.0000	199.9999	1	-	
Nominal Value : (High Load)	20.0000	199.9999	2	-0.0002	
200 g	19.9999	200.0000	3	-0.0002	
Tolerance	0.0001 g	200.0000	4	0.0001	
	20.0000	199.9999	5	0.0002	
	20.0000	200.0000	6	-	
Standard Deviation			End of Report.		
0.00003					

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

Tolerance 0.0002 g					
Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)	
0.01	0.0100	0.0100	0.0000	0.00014	
0.05	0.0500	0.0500	0.0000	0.00014	
0.1	0.1000	0.1000	0.0000	0.00014	
0.5	0.5000	0.5000	0.0000	0.00014	
1	1.0000	1.0000	0.0000	0.00014	
5	5.0000	5.0000	0.0000	0.00014	
10	10.0000	10.0001	0.0001	0.00014	
20	20.0000	20.0000	0.0000	0.00024	
50	50.0000	50.0000	0.0000	0.00015	
100	100.0000	99.9999	-0.0001	0.00019	
200	200.0000	200.0000	0.0000	0.00032	

SOP FM 33 03 February 2022



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG BANGKOK 10250  
TEL. 0-2717-3099-27 FAX. 0-2719-9484



Cert. No.: 22TM1517  
Page : 1 of 3

## Certificate of Calibration

Equipment : Hot Air Oven  
Manufacturer : Memmert  
Model : UFE 500  
Serial No. : G511.1572  
ID No. : RYG\_EN0010  
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 : 20 October 2022  
Calibration Date : 20 October 2022  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Man Pattanapongpaiboon  
Approved by :   
( ) Pornthippa Tameyakul  
( ) Malee Butkruea  
( ) Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services & Equipment Calibration and Testing Services.

A 0046908



Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2210-0376OC-2  
Procedure Used :-

Cert. No.: 22TM1517  
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	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34972A	MY48023932	22LM97	29 Jul 2023

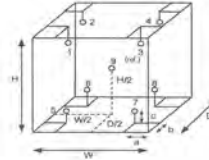
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close



Probe Installation Details :		Dimension of Chamber :	
a = 5.0 cm	D = 0.40 m	W = 0.56 m	
b = 5.0 cm	H = 0.48 m	Capacity = 0.11 m <sup>3</sup>	
c = 5.0 cm			

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	25	25
REL.Humid. ( % )	54	56
AC Supply ( Volt )	223	225

Ref. Std. ID No.: @ Calibration Point		
Position :	( 180 ) °C	( 104 ) °C
1	21-16TC-01	20-16RTD-01
2	21-16TC-02	20-16RTD-02
3	21-16TC-03	20-16RTD-03
4	21-16TC-04	20-16RTD-04
5	21-16TC-05	22-16RTD-05
6	21-16TC-06	20-16RTD-06
7	21-16TC-07	20-16RTD-07
8	21-16TC-08	22-16RTD-08
9 (ref.)	21-16TC-09	22-16RTD-09

a 1132465



Equipment : Hot Air Oven  
Condition As-Received : Used Item  
Reference : 2210-0376OC-2  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Close

Cert. No.: 22TM1517  
Page : 3 of 3

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor k
104.0	104.0	104.0	0.076	0.52	0.60	0.42	2
180.0	180.0	180.0	0.13	0.88	1.2	1.1	2

Calibration Point ( °C )	Measured Temperature ( °C )								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.766	103.734	103.723	103.800	104.215	104.131	104.132	103.740	103.747
180.0	179.723	179.359	179.439	179.489	180.361	180.114	180.131	180.243	179.805

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 %.

-odo-

a 1132465



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG BANGKOK 10250  
TEL. 0-2717-3099-27 FAX. 0-2719-9484



Cert. No.: 22TM1492  
Page : 1 of 3

## Certificate of Calibration

Equipment : Hot Air Oven  
Manufacturer : Memmert  
Model : UM 400  
Serial No. : b495.0899  
ID No. : RYG\_EN0006  
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 : 20 October 2022  
Calibration Date : 20 October 2022  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Praecha Hiahb  
Approved by :   
( ) Pornthippa Tameyakul  
( ) Malee Butkruea  
( ) Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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A 0046905



a 1132471

## Certificate of Calibration



Equipment : Water Bath  
 Condition As-Received : Used Item  
 Reference : 2210-0376OC-4  
 Result of Calibration :- ( \* ) Without Adjustment  
 Function of UUC\* : Temperature Source

Cert. No.: 22TM1491  
 Page : 3 of 3

Calibration point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Average* Standard Reading ( °C )				
			Position				
			1	2	3	4	5 (ref.)
85.0	85.0	85.0	84.527	84.563	84.628	84.516	84.580

Calibration point ( °C )	Uniformity ( °C )	Stability ( ± °C )	Uncertainty ( ± °C )	Coverage Factor k
85.0	0.12	0.081	0.18	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 %.

-060-

a 1132470

Equipment: Block Digestion Unit  
 Model: KT-20s  
 Serial No. (or ID.): 5720210009/5770200073  
 Manufacturer: Gerhardt  
 Condition: In Condition

Certificate No.: C29230010  
 Issued Date: 16 March 2023  
 Job No.: KSFR2304362  
 Page: 1 of 4  
 Digestion Block: 20 holes.

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

Environment Condition: Temperature: 25 °C ± 0.5 °C  
 Humidity: 85 %RH ± 3.7 %RH  
 Voltage: 231 VAC ± 3.1 VAC

REVIEW BY *[Signature]*  
 APPROVED BY *[Signature]*  
 NEXT CAL. DATE 15/03/24

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. Nakanin Ruemros  
 Calibration Date: 15 March 2023

The Method used: In house method, base on by comparison with standard

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through N.M. Technical Center Laboratory (NTL) Certificate No.: TC22/0080

(Mr. Nakanin Ruemros)  
 Person in charge

(Mr. Udon Srichana)  
 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, submitted or sampled. This report must not be reproduced except in full without approval of DKSH Technology Limited.

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Certificate No.: C29230010

Page: 2 of 4

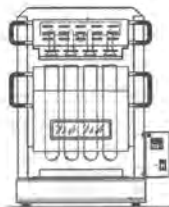
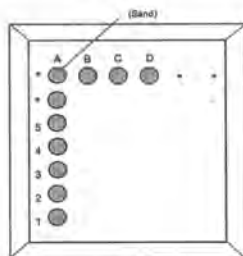


Fig. 1.: Front view



Location of standard

Fig. 2.: Digestion block

## Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the Digestion block.

Measured Temperature: The average reading of working standard at any positions at location.

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CAL-FM-C29-67-20 Jul 2023

Certificate No.: C29230010

Page: 3 of 4

Calibration Results:  
Before adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	380	380	380	375.1	-4.9	1.5
A2				374.3	-5.7	1.5
A3				374.8	-5.4	1.5
A4				376.3	-3.7	1.5
A5				373.2	-6.8	1.5
B1				374.4	-5.6	1.5
B2				374.3	-5.7	1.5
B3				374.8	-5.4	1.5
B4				375.2	-4.8	1.5
B5				375.1	-4.9	1.5
C1				373.5	-6.5	1.5
C2				372.8	-7.2	1.5
C3				372.1	-7.9	1.5
C4				372.2	-7.8	1.5
C5				374.5	-5.5	1.5
D1				374.7	-5.3	1.5
D2				375.3	-4.7	1.5
D3				375.5	-4.5	1.5
D4				375.8	-4.2	1.5
D5				375.1	-4.9	1.5

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### Calibration Results: After adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of IUUC. (°C)	Uncertainty (± °C)
A1	380	380	380	379.0	-1.0	1.5
A2				378.7	-1.3	1.5
A3				379.4	-0.6	1.5
A4				379.2	-0.8	1.5
A5				379.2	-0.8	1.5
B1				379.8	-0.2	1.5
B2				379.2	-0.8	1.5
B3				379.5	-0.5	1.5
B4				379.9	-1.1	1.5
B5				379.1	-0.9	1.5
C1				379.1	-0.9	1.5
C2				377.7	-2.3	1.5
C3				376.4	-1.6	1.5
C4				378.2	-1.8	1.5
C5				379.0	-2.0	1.5
D1				379.5	-0.5	1.5
D2				378.7	-1.3	1.5
D3				379.7	-0.3	1.5
D4				379.5	-0.5	1.5
D5				379.4	-0.6	1.5

The End of Certificate

### ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: KSPR2304362

ชนิดเครื่องมือ: Block Digestion Unit

รุ่น: KT-20s

หมายเลขเครื่อง: 5720210009/5770200073

ตรวจสอบ (รับ)		รายการตรวจสอบ	ตรวจสอบ (ส่ง)		หมายเหตุ
15 Mar 2023			15 Mar 2023		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
<i>General</i>					
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. สายไฟ	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. การทำงาน Main Switch	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. การทำงาน Selector Key	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. การแสดง Display	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. สภาพ Hole	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	6. สภาพหน้าปัด	<input type="checkbox"/>	<input type="checkbox"/>	ไม่มี
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. สภาพตัวเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. สภาวะแวดล้อม ณ สถานที่ตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

ขอแนะนำ :

Mr. Nakin Ruenros  
Service Engineer