

ภาคผนวก ง

เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Stack	Carbon Monoxide	Console Control Unit	BKK_FS0468	10-Jul-24	10-Jan-25	6
Stack	Carbon Monoxide	Pitot Tube	BKK_FS0473	10-Jul-24	10-Jan-25	6
Stack	Carbon Monoxide	Flue gas Analyzer	RYG_FS0465	22-Feb-24	21-Feb-25	12
Stack	Carbon Monoxide	CO Analyzer	RYG_EN0034	13-Dec-23	13-Dec-24	12
Stack	Oxides of Nitrogen	Console Control Unit	BKK_FS0468	10-Jul-24	10-Jan-25	6
Stack	Oxides of Nitrogen	Pitot Tube	BKK_FS0473	10-Jul-24	10-Jan-25	6
Stack	Oxides of Nitrogen	Flue gas Analyzer	RYG_FS0465	22-Feb-24	21-Feb-25	12
Stack	Oxides of Nitrogen	Vacuum Gauge	BKK_FS0479	20-Aug-24	20-Feb-26	18
Stack	Oxides of Nitrogen	SPECTROPHOTOMETER	RYG_EN0037	18-Sep-23	18-Mar-25	18
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0468	10-Jul-24	10-Jan-25	6
Stack	Total Suspended Particulate	Pitot Tube	BKK_FS0473	10-Jul-24	10-Jan-25	6
Stack	Total Suspended Particulate	Flue gas Analyzer	RYG_FS0465	22-Feb-24	21-Feb-25	12
Stack	Total Suspended Particulate	Digital Balance	RYG_EN0003	22-Feb-24	22-Feb-25	12
Ambient	Total Suspended Particulate	High Volume	RYG_FS0291	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0174	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0396	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RYG_EN0001	22-Feb-24	22-Feb-25	12
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RYG_FS0453	3-Jul-24	3-Jan-25	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RYG_FS0533	3-Jul-24	3-Jan-25	6
Ambient	Nitrogen Dioxide	NO ₂ Analyzer	RYG_FS0535	3-Jul-24	3-Jan-25	6
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0544	21-Jul-23	21-Jan-25	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0143	20-Aug-24	20-Feb-26	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0141	20-Aug-24	20-Feb-26	18
Noise	Leq 24 hrs	Sound Calibrator	RYG_FS0496	26-Jan-24	25-Jan-25	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0301	12-Jan-24	11-Jan-25	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0029	11-Jul-24	11-Jul-25	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0030	25-Jan-24	24-Jan-25	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0213	28-Feb-24	27-Feb-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0384	19-Oct-23	19-Oct-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0386	19-Oct-23	19-Oct-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0389	5-Jan-24	4-Jan-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0432	22-Feb-24	21-Feb-25	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0213	28-Feb-24	27-Feb-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0029	11-Jul-24	11-Jul-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0031	30-Aug-24	30-Aug-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0304	30-Aug-24	30-Aug-25	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0381	9-Oct-24	9-Oct-25	12
Workplace	Total Dust	Field Rotameter	RYG_FS0197	1-Jul-24	1-Oct-24	3
Workplace	Total Dust	DRYCAL FLOWMETER	BKK_FS1346	29-Jan-24	28-Jan-25	12
Workplace	Total Dust	Digital Balance	RYG_EN0004	22-Feb-24	22-Feb-25	12
Workplace	Styrene	Field Rotameter	RYG_FS0655	2-Jul-24	2-Oct-24	3
Workplace	Styrene	DRYCAL FLOWMETER	BKK_FS1346	29-Jan-24	28-Jan-25	12
Workplace	Styrene	GC-MSD	BKK_EN0410	10-May-24	10-Nov-25	18
Workplace	Total Hydrocarbon	Total Hydrocarbon Analyzer	RYG_EN0038	25-Jul-24	25-Jul-25	12
Rayong Lab	Cyanide	SPECTROPHOTOMETER	RYG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Formaldehyde	SPECTROPHOTOMETER	RYG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Phenols compounds	SPECTROPHOTOMETER	RYG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	pH at 25 °C	pH Meter	RYG_EN0152	14-Dec-23	14-Jun-25	18
Rayong Lab	Calcium Hardness	Chamber (Cold Room)	RYG_EN0184	11-Jun-24	11-Dec-25	18
Rayong Lab	Color (at Original pH)	Spectrophotometer	RYG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Color (at pH 7.0)	Spectrophotometer	RYG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Sulfide	Chamber (Cold Room)	RYG_EN0184	11-Jun-24	11-Dec-25	18
Rayong Lab	BOD	DO meter with Sensor	RYG_EN0032	24-Jul-23	24-Jan-25	18
Rayong Lab	BOD	Incubator	RYG_EN0154	1-Nov-24	1-May-26	18
Rayong Lab	BOD	Burette	RYG_EN0216	24-Sep-24	24-Sep-25	12
Rayong Lab	COD	Spectrophotometer	RYG_EN0037	18-Sep-23	18-Mar-25	18
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RYG_EN0010	21-Mar-24	21-Sep-25	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RYG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RYG_EN0010	21-Mar-24	21-Sep-25	18



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Rayong Lab	Conductivity	Conductivity meter	RYG_EN0029	4-Sep-23	4-Mar-25	18
Rayong Lab	Oil & Grease	Electronic Balance	RYG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Oil & Grease	Hot Air Oven	RYG_EN0213	21-Mar-24	21-Mar-25	12
Rayong Lab	Oil & Grease	Water Bath	RYG_EN0061	21-Mar-24	21-Sep-25	18
Rayong Lab	Temperature	pH meter	RYG_FS0596	1-Jul-24	1-Jul-25	12
Rayong Lab	Total Kjeldahl Nitrogen	Block Digestion Unit	RYG_EN0188	11-Mar-24	11-Sep-25	18
Rayong Lab	Total Kjeldahl Nitrogen	pH Meter	RYG_EN0152	14-Dec-23	14-Jun-25	18
Rayong Lab	Total Petroleum Hydrocarbon	Electronic Balance	RYG_EN0002	22-Feb-24	22-Feb-25	12
Rayong Lab	Total Petroleum Hydrocarbon	Hot Air Oven	RYG_EN0213	21-Mar-24	21-Mar-25	12
Rayong Lab	Total Petroleum Hydrocarbon	Water Bath	RYG_EN0061	21-Mar-24	21-Sep-25	18
Water Lab	Organochlorine Pesticide	GC MSMS	BKK_EN0284	21-Nov-24	21-May-26	18
Water Lab	Hexavalent Chromium	Spectrophotometer	BKK_EN0018	13-Sep-24	13-Sep-25	12
Water Lab	Barium	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Barium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Barium	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Lead	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Lead	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Lead	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Manganese	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Manganese	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Manganese	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Copper	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Copper	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Copper	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Nickel	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Nickel	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Nickel	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Arsenic	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Arsenic	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Arsenic	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Selenium	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Selenium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Selenium	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Cadmium	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Cadmium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Cadmium	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Zinc	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Zinc	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Zinc	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Trivalent Chromium	ICP-MS	BKK_EL0026	12-Dec-23	13-Jun-25	18
Water Lab	Trivalent Chromium	Hot Block	BKK_EL0054	22-Sep-23	22-Mar-25	18
Water Lab	Trivalent Chromium	Chamber (Cooling Room)	BKK_EN0167	6-Dec-23	6-Jun-25	18
Water Lab	Mercury	Mercury Analyzer	BKK_EL0128	6-Dec-24	6-Dec-25	12
Water Lab	Total Organic carbon	TOC Analyzer	BKK_EN0066	26-Jun-24	26-Jun-25	12



CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 10-Jul-24
Next Cal. Date : 10-Jan-25
Barometric Pressure (mmHg) : 749.1
Relative Humidity (%) : 46.2
Temperature (°C) : 33.8

Reference Dry Gas Meter Data

Calibration No. : C-100724-BKK_F50468
Dry Gas Meter ID : BKK_F50468
Serial No. : 1302005
Model No. : XC-572-V
Reference Dry Gas Meter ID : BKK_F51122
Serial No. : A203240
Correction Factor (Y) : 0.9824
Next Calibration Date : 7-Nov-24

Console Control Meter Data

ΔH (mm H ₂ O)	Θ Miles	Reference Dry Gas Meter Calibration						Console Control Drygas Meter						Dry Gas Meter Core Factor	Office Calibration Factor	ΔH ₀	
		V ₁ (Liters)			T ₁ (°C)			V ₂ (Liters)			T ₂ (°C)						Avg. Im (°C)
		Final	Initial	Total	Final	Initial	Total	Final	Initial	Total	Final	Initial	Total				
15	11.90	150.00	0.00	150.00	20.0	56750.0	148.00	29.0	29.0	0.9842	43.8072						
25	8.80	150.00	0.00	150.00	31.0	56707.0	147.00	32.0	32.0	1.0033	40.9791						
50	6.30	150.00	0.00	150.00	31.0	56728.0	146.00	32.0	32.0	0.9841	41.0531						
80	4.94	150.00	0.00	150.00	31.0	56737.0	147.00	32.0	32.0	0.979	40.3865						
120	4.10	150.00	0.00	150.00	31.0	56750.0	147.00	33.0	33.0	0.973	41.6033						
										Avg	41.5890						

Y Rate of reading of reference to dry gas meter; tolerance for individual values ± 0.02 from average.

ΔH₀ Office pressure differential that equates to 21.24 in of air @ 25°C and 760 mm of mercury; tolerance for individual values ± 5.08 from average.

Procedure: 40 CFR 60 APP A, METH, SEC 5.3.8.7

Calibrated by: Saksit Phaisanphut

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

Approved by: Nattapon Jengwareewong

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

FORM NO. F-06-027 REVISION NO. 2 ISSUE DATE: 30 Jun 20

Stopwatch ID No. : RYG_FS0540
Model : F808
Serial No. : E18051
Calibration Date : 4 Jul 24
Certificate No. : E-2407022

Dry Gas Meter No. : BKK_FS0468
Model : XC-572-V
Serial No. : 1302005

Run No	Time Actual (m:ss.ms)	Time Reading (m:ss)	Diff. (ms)	Diff. (min)
1	5:00:04	5:00	3	0.00005
2	5:00:06	5:00	8	0.00013
3	5:00:07	5:00	7	0.00012
4	5:00:08	5:00	8	0.00013
5	5:00:06	5:00	6	0.00010
6	5:00:06	5:00	6	0.00010
7	5:00:06	5:00	6	0.00010
8	5:00:08	5:00	8	0.00013
9	5:00:07	5:00	7	0.00012
10	5:00:07	5:00	7	0.00012
Average				0.00011
SD				0.00003

Calibrate by: Saksit Phaisanphut
Mr. Saksit Phaisanphut
RYG Field Service Scientist (4)

Approved by: Nattapon Jengwareewong
Mr. Nattapon Jengwareewong
RYG Field Service Specialist (1)

Next Calibrate : 13 Nov 24					
Location	Reference Temperature °C	Digital Temperature °C	Error °C	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass
	100	101	1	±3	Pass
	150	150	0	±3	Pass
	200	201	1	±3	Pass
Probe	250	251	1	±3	Pass
	300	301	1	±3	Pass
	500	501	1	±3	Pass
	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Oven	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Filter	100	101	1	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Exit	0	0	0	±3	Pass
	10	10	0	±3	Pass
	20	20	0	±3	Pass
Meter	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	49	-1	±3	Pass
AUX	0	0	0	±3	Pass
	25	25	0	±3	Pass
	50	50	0	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนของการวัด

Calibrated by: Saksit Phaisanphut
(Mr. Saksit Phaisanphut)
RYG Field Service Scientist (4)

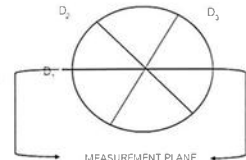
Approved by: Nattapon Jengwareewong
(Mr. Nattapon Jengwareewong)
RYG Field Service Specialist (1)

FORM NO. F-06-027 REVISION NO. 2 ISSUE DATE: 16/2/23

	D ₁	D ₂	D ₃	ΔD	D _{avg}
1	0.305	0.300	0.305	0.005	0.303
2	0.455	0.455	0.455	0.000	0.455
3	0.604	0.602	0.601	0.003	0.602
4	0.760	0.765	0.770	0.010	0.765
5	0.935	0.945	0.935	0.010	0.938
6	1.095	1.098	1.092	0.006	1.095
7	1.260	1.260	1.260	0.000	1.260
8	1.605	1.600	1.610	0.010	1.605

Where :

- D₁, D₂, D₃ : Three different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm.
- ΔD : Maximum distance between any two diameters, must be ≤ 0.100 mm.
- D_{avg} : (D₁ + D₂ + D₃) / 3



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

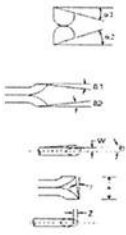
Approved by: Nattapon Jengwareewong
(Mr. Nattapon Jengwareewong)
RYG Field Services Specialist

FORM NO. F-06-027 REVISION NO. 2 ISSUE DATE: 16/2/23



Type S Pitot Tube Calibration

Date Calibration 10-Jul-24 Due Date 10-Jan-25
Pitot ID BKK_FS0473 Inclinator ID BKK_FS1131
Pitot SN - Vernier ID RYG_FS0539



Parameter	Value	Allowable Range	Check
α_1	2.5	$-10^\circ < \alpha_1 < +10^\circ$	OK
α_2	1.4	$-10^\circ < \alpha_2 < +10^\circ$	OK
β_1	-0.8	$-5^\circ < \beta_1 < +5^\circ$	OK
β_2	-0.4	$-5^\circ < \beta_2 < +5^\circ$	OK
γ	0.3	-	-
θ	0.2	-	-
$Z = A \tan \gamma$	0.005	$Z \leq 0.125"$	OK
$W = A \tan \theta$	0.003	$W \leq 0.031"$	OK
Dt	0.310	0.188" to 0.375"	OK
A/2Dt	1.484	$1.05 \leq A/2Dt \leq 1.5$	OK
A	0.92	$2.1Dt \leq A \leq 3Dt$	OK

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

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

Approved By: Nattapol Jengwareewong
(Mr. Nattapol Jengwareewong)
RYG Field Services Specialist (1)

FORM NO. F-08-124 REVISION NO. 0 ISSUE DATE: 25/12/23



Calibration Certificate



Certificate No: G 670124
Date of issue : 22-Feb-24

Instrument description : Fuel Gas Analyzer
Instrument model : Tests 310
Control unit serial no. :
Instrument serial no. : G2150565
ID no. or control no. : RYG_FS0465
Manufacturer : Testo SE & Co. KGaA
Probe description :
Probe model :
Probe serial no. :
Customer name : ALS LABORATORY GROUP (THAILAND) CO., LTD.
Customer address : 104 Phatthanakan 40, Phatthanakan Road, Khwaeng Phatthanakan, Khet Suan Luang, Bangkok, 10250 Thailand

REVIEW BY: Nattapol Jengwareewong
APPROVED BY: Saksit Phalsanphut
NEXT CAL DATE: 21/2/25

Total pages of certificate : 2 Pages
Receiving no. : L 240604
Receiving date : 19-Feb-24
Parameter of calibration : Gas Calibration (Oxygen 2.50, 10.04, 21.02 % vol, Carbon Monoxide 80, 14, 302, 1003 ppm)
Nitric Oxide 30.01, 151.5, 322.5 ppm, Sulphur Dioxide 50.36, 100.8, 600.8 ppm)
Used :
Condition of UUC :
Ambient condition : All of the Measurement were carried out the stabilized laboratory
Temperature : 23 \pm 5 $^\circ$ C
Humidity : 55 \pm 15 %RH
Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Tsongasonghong, La-sa, Bangkok 10210

Calibration procedure no. : This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no. WI-CL-26-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 valid only for the use under test Environmental condition.
This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory.
Calibration certificate without signature and seal not valid and The results relate only to the items tested and marked.
This calibration certificate documents are traceability to national standards, which realize measurement according to the International System of Units (SI).
Date of calibration : 22-Feb-24

Kwanthai Khamdang
Mr. Kwanthai Khamdang
Calibration Technician

Nongluck Wengroee
Mrs. Nongluck Wengroee
Technical Manager

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Issue Date 26/02/24

Entech Industrial Solution Co., Ltd.

17/121 Soi Ngamwongwan 47, Yaek 48, Tsongasonghong, La-sa, Bangkok 10210 THAILAND, Tel: 02-770-8864, Email: entech@entech.co.th, Fax: 02-0105590255081, www.entech.co.th



Calibration Certificate



Certificate No.: G 670124

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O2) 2.50 % Vol	2412/23	Linde	27 Aug 27
Oxygen (O2) 10.04 % Vol	CG-0193-21	Nmt	16-Nov-26
Oxygen (O2) 21.02 % Vol	CG-0041-22	Nmt	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nmt	14-Feb-27
Carbon monoxide (CO) 302 ppm	1915/23	Linde	16-Jun-25
Carbon monoxide (CO) 1003 ppm	2584/23	Linde	10-Sep-25
Nitric Oxide (NO) 30.01 ppm	CG-0014-23	Nmt	19-Feb-25
Nitric Oxide (NO) 151.5 ppm	0161/23	Linde	23-Jan-25
Nitric Oxide (NO) 322.5 ppm	1974/23	Linde	17-Jul-25
Sulphur Dioxide (SO2) 50.36 ppm	2004/23	Linde	17-Jul-25
Sulphur Dioxide (SO2) 100.8 ppm	3507/22	Linde	05-Nov-24
Sulphur Dioxide (SO2) 600.8 ppm	2603/23	Linde	17-Jul-25

Measured room conditions

Temperature : 22.7 $^\circ$ C Humidity : 60.2 %RH Pressure : 1011.8 mbar
Calibration conditions
Gas Temperature : 23 $^\circ$ C Flow rate : 500 ml/min Gas pressure : 1014.1 mbar

Calibration Results (Without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.50	2.44	-0.06	0.15
O2 (%Vol)	10.04	9.92	-0.12	0.20
O2 (%Vol)	21.02	21.11	0.09	0.30
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	302	303	1	6.0
CO (ppm)	1003	1003	0	12
NO (ppm)	30.01	29	-1.01	0.6
NO (ppm)	151.5	151	-0.5	8.0
NO (ppm)	322.5	321	-1.5	12
SO2 (ppm)	50.36	52	1.64	6.0
SO2 (ppm)	100.8	107	1.2	6.0
SO2 (ppm)	600.8	604	3.2	13

Remark : 1 cmol/mol = 1 %vol, 1 μ mol/mol = 1 ppm

End of Report

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Issue Date 26/02/24

Entech Industrial Solution Co., Ltd.

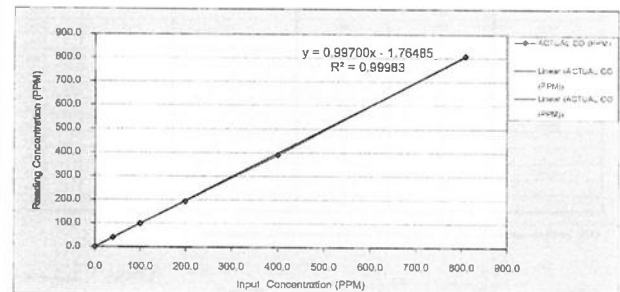
17/121 Soi Ngamwongwan 47, Yaek 48, Tsongasonghong, La-sa, Bangkok 10210 THAILAND, Tel: 02-770-8864, Email: entech@entech.co.th, Fax: 02-0105590255081, www.entech.co.th

MULTI-POINT CALIBRATION REPORT

CUSTOMER NAME : ALS Laboratory Group (Thailand) Co Ltd
EQUIPMENT NAME : CO Analyzer
MANUFACTURER : Teclayne - API MODEL : T300 SERIAL NO : 1215
STANDARD GAS CONCENTRATION (PPM) : 4512 CERTIFIED DATE : CC745169
CYLINDER PRESSURE (psig) : 503 CERTIFIED DATE : Mar 10, 2021
CERTIFIED BY : AIRGAS SPECIALTY GASES EXPIRED DATE : Mar 10, 2029

CALIBRATION RESULTS

POINT NO	CALIBRATION RESULTS			
	IDEAL (PPM)	ACTUAL CO (PPM)	ERROR CO (PPM)	% ERROR CO
ZERO	0.000	0.003	0.003	0.003
1	45.000	45.110	0.110	0.245
2	100.000	99.998	-0.002	-0.002
3	100.000	100.002	0.002	0.002
4	100.000	99.999	-0.001	-0.001
5	600.000	600.000	0.000	0.000
AVERAGE (%)				0.001



CALIBRATED BY : Kwanthai Khamdang DATE : 12 FEB 2024
ผู้ตรวจรับมาตรฐานคุณภาพ : คุณวราณี มณีจันทร์ โทรศัพท์ : 02-615-8107
เลขที่ 388 ถนนพหลโยธิน แขวงจันทราภิรมย์ เขตจันทบุรี 10000 โทรศัพท์ : 0-2515-8105 โทรสาร : 0-2515-8106 E-Mail : info@entech.co.th

TEST VALUES			
	API MODEL T300	BEFORE	AFTER
1. RANGE	1 - 1000 PPM	100.0	100.0
2. STABILITY	±1 PPM	0.01	0.01
3. CO MEASURE	20.0 ± 0.02 PPM	20.02	20.02
4. CO MEASURE	20.0 ± 0.02 PPM	20.02	20.02
5. CO MEASURE	20.0 ± 0.02 PPM	20.02	20.02
6. CO MEASURE	20.0 ± 0.02 PPM	20.02	20.02
7. CO MEASURE	20.0 ± 0.02 PPM	20.02	20.02
8. CO MEASURE	20.0 ± 0.02 PPM	20.02	20.02
9. CO MEASURE	20.0 ± 0.02 PPM	20.02	20.02
10. CO MEASURE	20.0 ± 0.02 PPM	20.02	20.02
11. CO MEASURE	20.0 ± 0.02 PPM	20.02	20.02
12. CO MEASURE	20.0 ± 0.02 PPM	20.02	20.02
13. CO MEASURE	20.0 ± 0.02 PPM	20.02	20.02
14. CO MEASURE	20.0 ± 0.02 PPM	20.02	20.02
15. CO MEASURE	20.0 ± 0.02 PPM	20.02	20.02
16. CO MEASURE	20.0 ± 0.02 PPM	20.02	20.02
17. CO MEASURE	20.0 ± 0.02 PPM	20.02	20.02
18. CO MEASURE	20.0 ± 0.02 PPM	20.02	20.02
19. CO MEASURE	20.0 ± 0.02 PPM	20.02	20.02

หมายเหตุ:

1. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

2. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

3. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

4. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

5. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

6. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

7. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

8. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

9. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

10. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

11. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

12. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

13. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

14. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

15. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

16. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

17. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

18. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

19. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

20. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

21. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

22. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

23. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

24. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

25. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

26. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

27. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

28. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

29. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

30. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

31. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

32. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

33. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

34. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

35. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

36. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

37. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

38. การสอบเทียบครั้งนี้เป็นการสอบเทียบตามข้อกำหนดของ ALG Laboratory Group (Thailand) Co.Ltd

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : DWYER
MODEL / TYPE : DPGA-00
SERIAL NO. : DVG06[BKK_FS0479]
CLID. NO. : 212300278
JOB CONTROL NO. : 240819087098
CALIBRATION SERVICE : ☒ IN-LABORATORY ☐ ON-SITE

REVIEW BY : *[Signature]*
APPROVED BY : *[Signature]*
NEXT CAL. DATE : 2022/12/15

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

DATE OF RECEIVED : 19 August 2024 DATE OF ISSUED : 22 August 2024

The report of calibration shall not be reproduced except in full without approval of the Calibration Laboratory Co., Ltd.

Calibrated By : Sinitpong Pimdee
Calibration Engineer

Approved By : Mongkol Yotsontorn
Authorized Signatory
22 August 2024



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

Certificate No. Q24087098

F3-011-0512-23

page 1 of 3



REPORT OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : DWYER
MODEL / TYPE : DPGA-00
SERIAL NO. : DVG06[BKK_FS0479]
DATE OF CALIBRATION : 20 August 2024

ENVIRONMENT CONDITIONS :

Temperature : (23 ± 2) °C

Relative Humidity : (55 ± 10) %RH

PROCEDURE USED :

The 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 Calibration and Pressure Module which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Document Process Calibration, Fluke Model 741H S/N: 8295020 with Pressure Module Model 700PDS S/N: 89401505.

TRACEABILITY :

The measurements are traceable to International System of Units (SI), through National Institute of Metrology (NIM) and Certificate No. MP-0040-24, Due Date 08 February 2025.

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 Gauge" (DKD R 6-1) which provides a level of confidence approximately 95%.

Certificate No. Q24087098

F3-011-0512-23

page 2 of 3



CONDITION OF CALIBRATION ITEM : RECEIVED IN GOOD OPERATIONAL CONDITION
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	STD Reading (kPa)		Conversion to mHg		Correction (mHg)	
	Up	Down	Up	Down	Up	Down
0.00	0.000	0.000	0.000	0.000	0.000	0.000
+10.00	+33.836	-33.836	+9.992	-9.992	+0.008	-0.008
+20.00	+67.666	-67.666	+19.983	-19.983	+0.017	-0.017
+30.00	+101.496	-101.496	+29.974	-29.974	+0.026	-0.026
+40.00	+135.326	-135.326	+39.965	-39.965	+0.035	-0.035
+50.00	+169.156	-169.156	+49.956	-49.956	+0.044	-0.044
+60.00	+202.986	-202.986	+59.947	-59.947	+0.053	-0.053
+70.00	+236.816	-236.816	+69.938	-69.938	+0.062	-0.062
+80.00	+270.646	-270.646	+79.929	-79.929	+0.071	-0.071
+90.00	+304.476	-304.476	+89.920	-89.920	+0.080	-0.080

Uncertainty of measurement : 0.053 mHg

Transmitting fluid : Air

Technical Note: Conversion factor 1 kPa = 0.2953002 mHg

Note: The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 012 Page 43 of 67

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

Certificate No. Q24087098

F3-011-0512-23

page 3 of 3





Certificate of Calibration

Equipment: SPECTROPHOTOMETER
Model: DR6000
Serial No. (or ID.): 1627845 (RYG_EN0037)
Manufacturer: HACH
Condition: In Condition

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

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

Environment Condition: Temperature 23.9 °C ± 0.2
Humidity 65.3 %RH ± 1.4

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

Calibration By: Mr. Nattapat Rungueang

Calibration Date: 18 September 2023

The Method used: In house method, CAL-WH-24, base on ASTM E 275-06 and ASTM E 387-04

Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Slama Scientific Limited.

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

(Mr. Nattapat Rungueang)
Person in charge

(Mr. Nitinun Srihawan)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Phra Prachin, Bangkok 10260
Phone: +66 2629 7300 Email: info@dksh.com Website: www.dksh.com/scientific-thailand

Delivering Growth - In Asia and Beyond.

CAL-FM-C06-15: 12 Sep 2022



Certificate No.: C06230441 Page 2 of 3

Calibration Results: Without Adjustment

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

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

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.2930	0.289	0.0040	0.0045
	0.5168	0.519	-0.0022	0.0045
	1.0298	1.029	0.0008	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.2867	0.283	0.0037	0.0045
	0.5073	0.509	-0.0017	0.0045
	1.0083	1.007	0.0013	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.2518	0.250	0.0016	0.0045
	0.4595	0.462	-0.0025	0.0045
	0.9334	0.933	0.0004	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.2461	0.245	0.0011	0.0045
	0.4652	0.466	-0.0008	0.0045
	0.9468	0.946	0.0008	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.2594	0.259	0.0004	0.0045
	0.5040	0.505	-0.0010	0.0045
	1.0032	1.002	0.0012	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.2579	0.257	0.0009	0.0045
	0.4971	0.497	0.0001	0.0045
	0.9720	0.971	0.0010	0.0045

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CAL-FM-C06-15: 12 Sep 2022



Certificate No.: C06230441 Page 3 of 3

Calibration Results: Without Adjustment

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

Stray light *

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

Spectral Resolution *

Nominal Concentration 0.02 % w/v	Peak	Trough	Ratio	SBW
Standard Wavelength (nm)	268.66	266.69	1.38	2.00
UUC: Wavelength (nm)	268.2	268.1		
Std Absorbance (A)	0.4566	0.2780		
Absorbance (A)	0.413	0.300		

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

The End of Certificate

DKSH Technology Limited
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Phone: +66 2629 7300 Email: info@dksh.com Website: www.dksh.com/scientific-thailand

Delivering Growth - In Asia and Beyond.

CAL-FM-C06-15: 12 Sep 2022



ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00005382

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR6000 หมายเลขเครื่อง: 1627845

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

เห็นด้วยและแนะนำ: *656.1nm=656.1nm

*486.0nm=485.5nm

Mr. Nattapat Rungueang
Service Engineer

DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Phra Prachin, Bangkok 10260
Phone: +66 2629 7300 Email: info@dksh.com Website: www.dksh.com/scientific-thailand

Delivering Growth - In Asia and Beyond.

CAL-FM-R31-03: 20 Jul 2022



SARTORIUS

Certificate of Calibration

REVIEW BY: Thawit
APPROVED BY: [Signature]
NEXT CAL. DATE: 01/02/2025

Model Number: MSU224S-100-DU Certificate No.: 24BCI0073
Description: Analytical Balance Issued Date: Friday, February 23, 2024
Serial Number: 0031709552 Reference No.: 229196
ID No.: RYG_EN0003
Manufacturer: Sartorius Page No.: 1 of 2

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

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

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

Metrological data:
Capacity: 220 g Readability: 0.0001 g
Reasons for calibration:
☐ New Installation ☐ Service / Repair ☒ Re-calibration/ Maintenance

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	TCS	M2308197S	23-Aug-2025
MHB-382SD	Humidity/Barometer/Temp. Lutron MHB-382SD	DKSH	C1923184S	23-Aug-2024

This certificate relate and apply this equipment only.

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SOP FM 33 03 February 2022

Mr. Chonchai Inthana (Technical Manager)



SARTORIUS

Certificate of Calibration

Model Number: MSU224S-100-DU Certificate No.: 24BCI0073
Description: Analytical Balance Issued Date: Friday, February 23, 2024
Serial Number: 0031709552 Reference No.: 229196
ID No.: RYG_EN0003
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 readouts under constant load conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.		The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/2 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R76).	
Nominal Value : (Low Load)	20.0000	200.0001	Nominal value : 100 9
20 g	20.0000	200.0000	Tolerance 0.0004 9
Tolerance	0.0001 g	0.0001	
Nominal Value : (High Load)	20.0000	200.0001	
200 g	19.9999	200.0001	
Tolerance	0.0001 g	0.0001	
Standard Deviation	0.00005	0.00005	

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	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00013
0.1	0.1000	0.1000	0.0000	0.00013
0.5	0.5000	0.5000	0.0000	0.00013
1	1.0000	1.0000	0.0000	0.00013
5	5.0000	5.0000	0.0000	0.00013
10	10.0000	10.0000	0.0000	0.00013
20	20.0000	20.0000	0.0000	0.00013
50	50.0000	50.0000	0.0000	0.00024
100	100.0000	99.9999	-0.0001	0.00018
200	200.0000	199.9999	-0.0001	0.00029

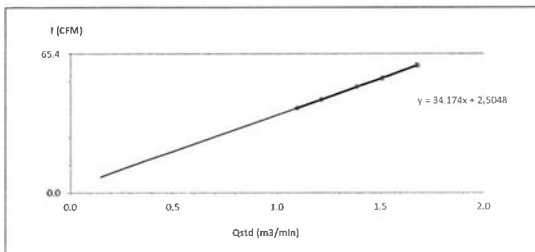
End of Report.

SOP FM 33 03 February 2022

High Volume Air Sampler Calibration Worksheet

Project Site: Siam Polystyrene Co., Ltd. Barometric Pressure (mm Hg): 755.8
Calibrate Location: โรงงานพลาสติกโพลีสไตรีน Temperature (°C): 31.3
Calibrate Date: 15-Sep-24 High Volume ID: RYG_FS0291
Calibration Sheet No.: C-150924-RYG_FS0291 High Volume Model: TE-5170D
Calibrator ID: RYG_FS0206 High Volume S/N: 5333
Calibrator Model: TE-5028A Calibrator Slope: 1.48469
Calibrator S/N: 1543 Calibrator Intercept: -0.02523

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.6	1.0970	40	Slope: 34.1741
2	3.2	1.2143	44	Intercept: 2.5048
3	4.2	1.3874	50	Correlation Coefficient: 0.9999
4	5.0	1.5115	54	
5	6.2	1.803	60	



Calibrated by: [Signature]
(Mr. Nontchai Uppathamp)
Field Scientist (2)

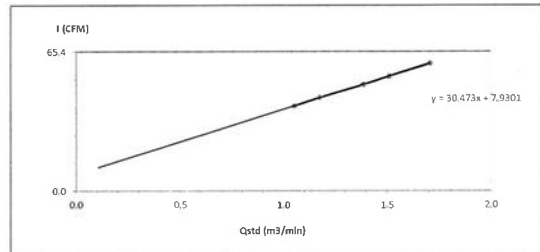
Approved by: [Signature]
(Mr. Noppong Juntarapan)
Enviro Field Coordinator Scientist (3)

FORM NO: F-06-073 REVISION NO.2 ISSUE DATE: 20/11/23

High Volume Air Sampler Calibration Worksheet

Project Site: Siam Styrene Monomer Co., Ltd. Barometric Pressure (mm Hg): 755.8
Calibrate Location: โรงงานพลาสติกโพลีสไตรีน Temperature (°C): 31.3
Calibrate Date: 15-Sep-24 High Volume ID: RYG_FS0174
Calibration Sheet No.: C-150924-RYG_FS0174 High Volume Model: TE-5170D
Calibrator ID: RYG_FS0206 High Volume S/N: 4800
Calibrator Model: TE-5028A Calibrator Slope: 1.48469
Calibrator S/N: 1543 Calibrator Intercept: -0.02523

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.4	1.0550	40	Slope: 30.4732
2	3.0	1.1765	44	Intercept: 7.9301
3	4.2	1.3874	50	Correlation Coefficient: 0.9998
4	5.0	1.5115	54	
5	6.4	1.7068	60	



Calibrated by: [Signature]
(Mr. Nontchai Uppathamp)
Field Scientist (2)

Approved by: [Signature]
(Mr. Noppong Juntarapan)
Enviro Field Coordinator Scientist (3)

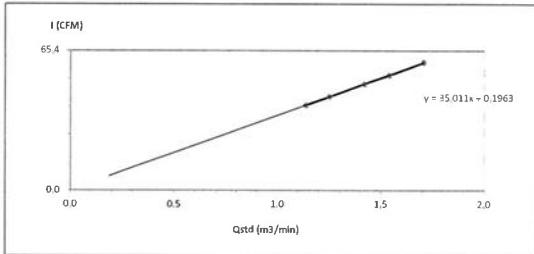
FORM NO: F-06-073 REVISION NO.2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Siam Styrene Monomer Co. Ltd. Barometric Pressure (mm Hg) : 755.8
Calibrate Location : บ้านนาหว้า Temperature (°C) : 31.3
Calibrate Date : 15-Sep-24 High Volume ID : RYG_F5036
Calibration Sheet No. : C-150924-RYG_F50296 High Volume Model : TE-5170D
Calibrator ID : RYG_F50206 High Volume S/N : 5698
Calibrator Model : TE-5028A Calibrator Slope : 1.48469
Calibrator S/N : 1543 Calibrator Intercept : -0.02523

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.8	1.1375	40	Slope: 35.0108
2	3.4	1.2508	44	Intercept: 0.1963
3	4.4	1.4195	50	Correlation Coefficient: 0.9999
4	5.2	1.5409	54	
5	6.4	1.7068	60	



Calibrated by Wijit
(Mr. Nontachai Uppathamp)
Field Scientist (2)

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

FORM NO. F 06-073 REVISION NO. 2 ISSUE DATE: 20/11/23

Sartorius (Thailand) Co., Ltd.
120 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8381-6, e-mail: service.thailand@sartorius.com



NSC-TIS-15 17025
CALIBRATION 0426

SARTORIUS

Certificate of Calibration

Model Number : LA130S-F Certificate No. : 24BC10068
Description : Analytical Balance Issued Date : Friday, February 23, 2024
Serial Number : 25409664 Reference No. : 228196
ID No. : RYG_EN0001
Manufacturer : Sartorius Page No. : 1 of 3
Customer Name : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

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

Calibrated By : Mr.Chonchai Inthana Calibration Procedure No. : This calibration was conducted by Using in-house calibration procedure number (WI-003)
Calibration Date : Thursday, February 22, 2024 Based on UKAS LAB 14 : 2019

Metrological data : Capacity : 150 g Readability : 0.0001 g
Ambients Conditions : Temperature : 23.6 °C ± 5.0 °C
Humidity : 54.0 % RH ± 10.0 % RH
Pressure : ±
Reasons for calibration : ☐ New Installation ☐ Service / Repaired ☒ Re-calibration/ Maintenance
Equipment Condition : ☒ Good Operate ☐ Fair

Measurement Method UKAS Publication Ref : Lab 14
The measurement uncertainty stated is the 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	TCS	M2308197S	23-Aug-2025
MHB-382SD	Humidity/Barometer/Temp. Lutron MHB-382SD	DKSH	C1923184S	23-Aug-2024

This certificate relate and apply this equipment only.

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Sartorius (Thailand) Co., Ltd.

SOP FM 33 03 February 2022

Mr.chonchai inthana(Technical Manager)



Sartorius (Thailand) Co., Ltd.
120 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8381-6 Fax: +66 2643 8387, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number : LA130S-F Certificate No. : 24BC10068
Description : Analytical Balance Issued Date : Friday, February 23, 2024
Serial Number : 25409664 Reference No. : 228196
ID No. : RYG_EN0001
Manufacturer : Sartorius Page No. : 2 of 2

Calibration Results : Without Adjustment

Repeatability

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

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

Eccentricity (Off-center loading error)

The off-center loading error is yielded by the difference between the readout of the load, Le 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and extension each of four notional measurement points (positions defined according to OIML R110).

Nominal value :	50	g
Tolerance	0.0004	g
	1	-
	2	-0.0001
	3	0.0001
	4	0.0002
	5	0.0000
	6	-

Linearity

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

Tolerance		0.0002 g		
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.0100	0.0100	0.0000	0.00020
0.05	0.0500	0.0500	0.0000	0.00021
0.1	0.1000	0.1000	0.0000	0.00021
0.5	0.5000	0.5000	0.0000	0.00021
1	1.0000	1.0000	0.0000	0.00021
2	2.0000	2.0000	0.0000	0.00021
5	5.0000	5.0000	0.0000	0.00021
10	10.0000	10.0001	0.0001	0.00024
20	20.0000	20.0001	0.0001	0.00021
100	100.0000	99.9999	-0.0001	0.00024

End of Report.

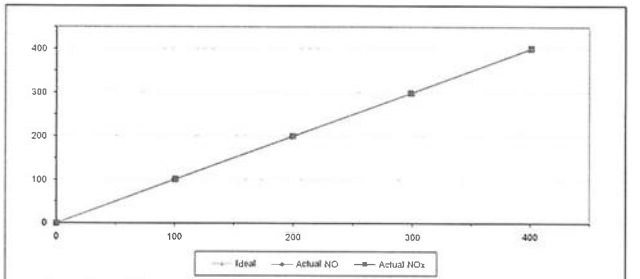
SOP FM 33 03 February 2022



MULTIPOINT CALIBRATION REPORT

Calibration Date : 3-Jul-24 Equipment Name : NOx Analyzer
Manufacturer : HORIBA Model : APNA-370
Serial No. : AWXG87CR Equipment ID : RYG_F50453
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	99.60	-0.40	-0.40	101.10	1.10	1.10
2	200.00	198.60	-1.40	-0.70	199.80	-0.20	-0.10
3	300.00	299.00	-1.00	-0.33	298.60	-1.40	-0.47
4	400.00	401.10	1.10	0.28	401.10	1.10	0.28
AVERAGE (%)				-0.21			0.18



Calibrated By

Approved By

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

(Mr.Sarayuht Jitranont)
Assistant General Manager

ALS Laboratory Group
FORM NO. F 06-056 REVISION NO. 1 ISSUE DATE: 02/04/12



JIRANATEE ASSOCIATES CO., LTD.

Jirantee Associate Co., Ltd.
45/21-21, 1275-35
Ratchaburi, 2211, P.O. Box 1, Bangkok,
Bangkok 10110, Thailand
Tel: +66 (0) 2688 0121
Fax: +66 (0) 2688 0122
E-mail: jirantee@jirantee.com
Web: www.jirantee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC-TS-15 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

Certificate Number

CWD 001-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Wind Direction Sensor

Novalline

Sensor: WS-001

Data logger: 110-WS-25DL-D

Sensor: WS0-A5662

Data logger: A5662

Used item

ALIS Laboratory group (Thailand) Co., Ltd.

104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,

Khet Suan Luang, Bangkok 10250 Thailand

Calibration procedure:

The wind direction sensor was calibrated against standard rotary encoder model J1900075 DWS4 P3.5 UO in an enclosed test area. The effective wind tunnel with 202 cm² cross section area. The wind speed based on IEC 61400-11, Wind energy generation systems, Part 12.1, Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of the measurement to recognized the national standards, and to recognition of the international system of units (SI) through the National Institute of Metrology of Thailand (NIMT) Certificate number: IM-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

MEASUREMENT DATE

ISSUE DATE

11 Jul 2023

21 Jul 2023

21 Jul 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature

23.0 ± 3.0 °C

Relative Humidity

55.0 ± 15.0 %RH

Atmospheric Pressure

1013 ± 10 hPa

PLACE OF CALIBRATION

Effect-type wind tunnel of Jirantee Associates Co., Ltd.

CALIBRATION CONDITION

Wind Tunnel cross-section area¹

900 cm²

Wind direction frontal area²

129 cm²

Diameter of mounting plate³

mm

Blockage ratio of test object⁴

0.143 [%]

Preconditioning

24 hours at ambient conditions

Measurement Condition:

7 average values during measurement are (23.8)°C, (43.0) %RH and (1011.6) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

Mr. Soravit Thacholud

Miss Jiraporn Lertsomprad



Approved signatory:

Mr. Parinya Booncharoen

Calibration Department Manager

Remarks:

¹ Net area of the wind tunnel

² In frontal cross section area of the tested object include mounting pipe

³ Diameter of mounting pipe

⁴ Ratio %

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

CWD-001-66

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

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 allist 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 _{ref} Degree (°)	D _{meas} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	45.000	41	-4	1.0
	90.000	87	-3	1.0
	135.000	132	-3	1.0
	180.000	180	0	1.0
	225.000	228	3	1.0
	270.000	273	3	1.0
	315.000	318	3	1.0
	360.000	359	-1	1.0

Remarks:

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

² Direction of standard

Direction of Unit Under Calibration



End of Certificate of Calibration



63/14-15,67/35-36, Soi Petchhaseem 7/71, Petchhaseem Rd,
Walthapra, Bangkokyay, Bangkok 10600 Thailand,
Tel: (66) 02-6680812#13 Fax: (66) 02-6680860 www.jirantee.com



CERTIFICATE OF CALIBRATION

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

Equipment Name: Data Logger with Temperature sensor

Manufacturer: Novalline

Model: 110-WS-25DL-D

Serial No.: A5662

ID No.: RYG_FSC544

Customer

Name: ALIS Laboratory group (Thailand) Co., Ltd.

Address: 104 Phatthanakan 40, Phatthanakan Rd.,

Khwaeng Suan Luang, Khet Suan Luang, Bangkok

10250 Thailand

Received date: 11 Jul 2023

Calibration date: 21 Jul 2023

Issue date: 21 Jul 2023

Reference Used During Calibration

1. Standard Temperature Probe Model: STS 100 A500

Serial No.: 687682-09, Due date: 28 Mar 2024

2. D Digital Temperature Indicator Model: DTI-1000-A MK

II Serial No.: 671407-00591, Due date: 22 July 2023

Calibration Condition:

Temperature: (23.3)°C

Relative Humidity: (55.1) %

Calibration Procedure

The temperature calibration was done by In-House comparison method as WICL-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: IT 0038-23, Certificate number: ER 0092-22

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

Calibrated by:

Mr. Soravit Thacholud

Miss Jiraporn Lertsomprad

Miss Rungpran Poonnimit



Approved Signatory:

Mr. Parinya Booncharoen

Calibration Department Manager

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63/14-15,67/35-36, Soi Petchhaseem 7/71, Petchhaseem Rd,
Walthapra, Bangkokyay, Bangkok 10600 Thailand,
Tel: (66) 02-6680812#13 Fax: (66) 02-6680860 www.jirantee.com



Certificate No.: CDT-037-66
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: T2320591.

Dimension: Diameter 12 mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.080	19.6	-0.5	0.099
70	25.094	24.6	-0.5	0.099
70	30.050	29.7	-0.3	0.14
70	35.043	34.5	-0.5	0.099
70	40.036	39.5	-0.5	0.14

UUC* = Unit Under Calibration

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

★ End of Certificate ★





63/14-15,67/35-36, Soi Petchkasem 7/71, Petchkasem Rd,
Walthapra, Bangkokyai, Bangkok 10600 Thailand.
Tel: (66) 02-860812413 Fax: (66) 02-8608060 www.jiranalee.com

CERTIFICATE OF CALIBRATION

Calibration No.: RH-01072023
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novalyx
Model/Type : 110-WS-25DL-D
Serial Number : A5662
ID No : RYO_F80544
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±1)%.

Measurement Method:
Unit Under Calibration (UUC) was calibrated by comparison method with standard chilled mirror hygrometer model: 1B60-3 in the humidity generator chamber to determine the errors.

Traceability:
This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the international system of units (SI) via MCS Calibration, Inc. Certificate number: 20926-001, Due date: Sep 26, 2024.

Measurement Date : Jul 21, 2023
Issued Date : Jul 21, 2023

Measurement Results:
This equipment was connected with indoor air quality probe and Displayed (UIF) on display, Model: HMP03, Serial num: T2320691.
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 (measured) (%RH)	Error (%RH)	Uncertainty ±(%RH)
20	20.07	16.3	-3.8	0.51
50	50.23	45.0	-5.2	0.51
80	80.23	73.5	-6.7	0.51

Performed by:
☐ Mr. Sarawit Thachetad
☒ Miss Jitraporn Lerthongthong
☐ Miss Ruangsang Phasommit



Approved Signature:
Mr. Paitiya 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.



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

Accredited measurement laboratory
Calibration services department



NSC-TIS-TIS 17025
CALIBRATION 0367

Certificate Number

CWS-030-67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novalyx
MODEL/TYPE : Sensor WS-420
Data logger: WS-25DL
SERIAL NUMBER : Sensor: WSD-A4562
Data logger: A4562
ID NUMBER : EKK_F50143
CONDITION AS RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE : 08 Aug 2024
MEASUREMENT DATE : 20 Aug 2024
ISSUE DATE : 20 Aug 2024

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1010.10 hPa

PLACE OF CALIBRATION : R18V type wind tunnel of Jiranalee Associates Co., Ltd.

CALIBRATION CONDITIONS:
Wind tunnel cross-section area^a : 900 cm²
Wind direction frontal area^b : 100 cm²
Diameter of mounting pipe^c : 1 mm
Blockage ratio of test object^d : 0.111 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.2)°C, (41.9) %RH and (1007.9) hPa.

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

Calibrated by:
Mr. Sarawit Thachetad
Miss Jitraporn Lerthongthong



Approved signature:
Mr. Paitiya Booncharoen
Calibration Department Manager

Remarks:
^a Roundness section area of the wind tunnel
^b Projected upstream area of the tested object include mounting pipe
^c Diameter of mounting pipe
^d Ratio (%)

Calibration procedure:
The Cup anemometer was calibrated against Standard Air velocity transducer model: 8455-82 and pilot tube with precision differential pressure meter model: 10942100 in an open jet section of R18V type wind tunnel with 900 cm² cross test section area. The WSD-A4562 sensor is used in the test section area. The WSD-A4562 sensor is used in the test section area. The WSD-A4562 sensor is used in the test section area.

Traceability:
This certificate provides a traceability of the measurement to the international system of units (SI) through the BIPM (Bureau International des Poids et Mesures) via Certificate number: 0007-24 and 0055-23.

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

REVIEW BY :
APPROVED BY :
NEXT CAL DATE : 20/12/26

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

CWS-030-67

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

The Cup anemometer, Unit Under Calibration (UUC) was exposed at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer which was installed 50 mm away from wind tunnel nozzle and installed 50 mm away from top of the test section and the standard air velocity 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section. UUC was mounted on a round vertical tube of the lower plate at center of test section. The calibration was carried out under still air and falling air velocity in the range of 1 m/s to 30 m/s at constant 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 _{std} (m/s)	Error (m/s)	U=2 (m/s)
0.999	23.98	24.20	0.9	-0.1	0.31
2.043	24.42	24.20	1.8	-0.2	0.31
2.982	23.80	24.20	2.9	-0.3	0.31
4.108	23.92	24.20	3.8	-0.9	0.31
4.97	23.62	24.20	4.9	-0.1	0.31
5.95	23.44	24.20	6.0	0.0	0.31
7.01	23.45	24.20	7.0	0.0	0.31
7.96	23.43	24.20	8.0	0.0	0.31
8.98	23.52	24.20	9.1	0.1	0.31
9.96	23.74	24.20	10.1	0.1	0.31
10.94	24.00	24.20	11.1	0.2	0.31
12.01	23.84	24.20	12.2	0.2	0.31
12.94	24.00	24.20	13.1	0.2	0.31
14.06	23.86	24.20	14.2	0.2	0.31
15.00	24.00	24.20	15.2	0.2	0.31
15.93	23.96	24.20	16.2	0.2	0.31

Remark:
¹ Calibration results only count for the tested circumstances and environmental conditions during which the calibration took place.
² Velocity of standard.
³ Velocity of Unit Under Calibration.

PHOTO OF CALIBRATION SET-UP



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



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Calibration services department



NSC-TIS-TIS 17025
CALIBRATION 0367

Certificate Number

CWS-030-67

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalyx
MODEL/TYPE : Sensor WS-420
Data logger: WS-25DL
SERIAL NUMBER : Sensor: WSD-A4562
Data logger: A4562
ID NUMBER : EKK_F50143
CONDITION AS RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand

RECEIVED DATE : 08 Aug 2024
MEASUREMENT DATE : 20 Aug 2024
ISSUE DATE : 20 Aug 2024

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1010.10 hPa

PLACE OF CALIBRATION : R18V type wind tunnel of Jiranalee Associates Co., Ltd.

CALIBRATION CONDITIONS:
Wind tunnel cross-section area^a : 900 cm²
Wind direction frontal area^b : 129 cm²
Diameter of mounting pipe^c : 1 mm
Blockage ratio of test object^d : 0.143 [-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.7)°C, (42.6) %RH and (1007.9) hPa.

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

Calibrated by:
Mr. Sarawit Thachetad
Miss Jitraporn Lerthongthong



Approved signature:
Mr. Paitiya Booncharoen
Calibration Department Manager

Remarks:
^a Roundness section area of the wind tunnel
^b Projected upstream area of the tested object include mounting pipe
^c Diameter of mounting pipe
^d Ratio (%)

Calibration procedure:
The wind direction sensor was calibrated against Standard Air velocity transducer model: 8455-82 and pilot tube with precision differential pressure meter model: 10942100 in an open jet section of R18V type wind tunnel with 900 cm² cross test section area. The WSD-A4562 sensor is used in the test section area. The WSD-A4562 sensor is used in the test section area.

Traceability:
This certificate provides a traceability of the measurement to the international system of units (SI) through the BIPM (Bureau International des Poids et Mesures) via Certificate number: 0007-24 and 0055-23.

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

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

CND-029-67

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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 counter-clockwise 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 ₁₀₀ Degree (°)	D ₁₀₀ Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.01	45.000	41	-4	0.80
	50.000	87	-3	0.80
	135.000	132	-3	0.80
	180.000	181	-1	0.80
	225.000	229	4	0.80
	270.000	275	5	0.80
	315.000	320	5	0.80
	360.000	359	-1	0.80

Remarks:

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

² Direction of standard.

³ Direction of Unit Under Calibration.

End of Certificate of Calibration



JIRANATEE ASSOCIATES CO., LTD.

Jirantee Associates Co., Ltd.
40/21-23, 40/24-25
Petchayon 7/21, Pr. Anusorn, Bangkok,
Bangkok 10600, Thailand
Tel: 02-050512
Fax: 02-050513
E-mail: info@jiranatee.com
Web site: www.jiranatee.com

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

Air speed measurement laboratory
Calibration services department



Certificate Number

CNS-029-67

CERTIFICATE OF CALIBRATION

Page 2 of 2 Pages

MEASUREMENT ITEM

Cup anemometer

MANUFACTURER

Novamex

MODEL/TYPE

Sensor: WS-02F

SERIAL NUMBER

Data logger: WS-25DL

ID NUMBER

Data logger: A4481

CONDITION AS-RECEIVED

1. Used item

CUSTOMER

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

RECEIVED DATE

18 Aug 2024

MEASUREMENT DATE

20 Aug 2024

ISSUE DATE

20 Aug 2024

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 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITIONS

Wind tunnel cross-section area¹: 300 cm²
Wind direction frontal area²: 300 cm²
Diameter of mounting pipe³: 6 mm
Blockage ratio of test object⁴: 0.111 [-]

Preconditioning

24 hours at ambient conditions

Measurement Condition

The average values during measurement are (23.9) °C, (42.7) %RH and (1005.0) hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

21 Mr. Sanyas Thirapitak
21 Mrs. Sanyas Thirapitak

Remarks:

¹ Nominal cross-section area of the wind tunnel.
² Projected cross-section area of the tested object include mounting pipe.
³ Diameter of mounting pipe.
⁴ Ratio of test object.

Calibration procedure:

The Cup anemometer was calibrated against standard air velocity transducer model: A455-32 of 0.5 m/s full scale with precision differential pressure meter model: DP42500 in air flow test-section of Dilif-type wind tunnel with 500 mm cross test section area. The WS-02F007 basic: A45 61405 12.1 Wind energy generation system: Part 12.1 Power performance measurements of electricity generating wind turbines, March 2017 was used as a calibration procedure.

Traceability:

The certificate provides a traceability of the measurement to recognize the national standards, and to realization of the International system of units (SI) through the NMIs (National Metrology Institute of Thailand) via Certificate Number: MW-0007-24 and MW-0035-23.

Uncertainty of Measurement:

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

Approved signature:

Mr. Sanyas Thirapitak
Calibration Department Manager

REVIEW BY:

Mr. Sanyas Thirapitak

APPROVED BY:

20/8/26

NEXT CAL. DATE:

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

CNS-029-67

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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 which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section and the standard air velocity 5 m/s to 40 m/s was calibrated by a pitot tube with precision differential pressure meter which was installed 50 mm away from wind tunnel nozzle and installed 40 mm away from top of the test section. UUC was mounted on a round vertical tube at the lower plate at center of test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V _{std} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{std} (m/s)	Error (m/s)	U (k=2) (m/s)
1.015	23.50	23.90	0.18	-0.2	0.31
2.041	24.28	23.90	1.8	-2.2	0.31
3.077	23.30	23.90	2.9	-0.1	0.31
4.108	23.34	23.90	3.8	-0.3	0.31
4.98	23.90	23.90	5.0	0.0	0.31
5.95	23.50	23.90	6.0	0.1	0.31
7.00	23.14	23.90	7.1	0.1	0.31
7.96	23.30	23.90	8.0	0.1	0.31
8.16	23.26	23.90	9.1	0.1	0.31
9.16	23.16	23.90	10.1	0.1	0.31
10.95	23.50	23.90	11.1	0.1	0.31
12.02	23.30	23.90	12.2	0.1	0.31
12.94	23.50	23.90	13.2	0.2	0.31
14.08	23.28	23.90	14.2	0.1	0.31
15.02	23.60	23.90	15.2	0.2	0.31
15.95	23.50	23.90	16.3	0.3	0.31

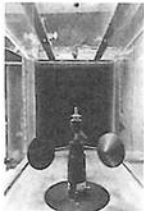
Remarks:

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

² Velocity of standard.

³ 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. Hence, the precision 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.
40/21-23, 40/24-25
Petchayon 7/21, Pr. Anusorn, Bangkok,
Bangkok 10600, Thailand
Tel: 02-050512
Fax: 02-050513
E-mail: info@jiranatee.com
Web site: www.jiranatee.com

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

Wind direction measurement laboratory
Calibration services department



Certificate Number

CND-029-67

CERTIFICATE OF CALIBRATION

Page 2 of 2 Pages

MEASUREMENT ITEM

Wind Direction Sensor

MANUFACTURER

Novamex

MODEL/TYPE

Sensor: WS-02F

SERIAL NUMBER

Data logger: WS-25DL

ID NUMBER

Data logger: A4481

CONDITION AS-RECEIVED

1. Used item

CUSTOMER

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

RECEIVED DATE

08 Aug 2024

MEASUREMENT DATE

20 Aug 2024

ISSUE DATE

20 Aug 2024

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 ± 10 hPa

PLACE OF CALIBRATION

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

CALIBRATION CONDITION

Wind tunnel cross-section area¹: 300 cm²
Wind direction frontal area²: 329 cm²
Diameter of mounting pipe³: 6 mm
Blockage ratio of test object⁴: 0.143 [-]

Preconditioning

24 hours at ambient conditions

Measurement Condition

The average values during measurement are (23.7) °C, (45.7) %RH and (1007.7) hPa

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

21 Mr. Sanyas Thirapitak
21 Mrs. Sanyas Thirapitak

Remarks:

¹ Nominal cross-section area of the wind tunnel.
² Projected cross-section area of the tested object include mounting pipe.
³ Diameter of mounting pipe.
⁴ Ratio of test object.

Calibration procedure:

The wind direction sensor was calibrated against standard rotary encoder model: A455-32 of 0.5 m/s full scale with precision differential pressure meter model: DP42500 in air flow test-section of Dilif-type wind tunnel with 500 mm cross test section area. The WS-02F007 basic: A45 61405 12.1 Wind energy generation system: Part 12.1 Power performance measurements of electricity generating wind turbines, March 2017 was used as a calibration procedure.

Traceability:

The certificate provides a traceability of the measurement to recognize the national standards, and to realization of the International system of units (SI) through the NMIs (National Metrology Institute of Thailand) via Certificate Number: MW-0007-24 and MW-0035-23.

Uncertainty of Measurement:

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

Approved signature:

Mr. Sanyas Thirapitak
Calibration Department Manager

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Certificate Number

CWD 029 67

Page 2 of 2 Pages

MEASUREMENT RESULTS²

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 counter-clockwise 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 ¹ m/s	D ₁₀₀ Degree (°)	D ₁₈₀ Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.01	45.000	41	-4	0.80
	90.000	87	-3	0.80
	135.000	134	-1	0.80
	180.000	182	2	0.80
	225.000	230	5	0.80
	270.000	275	5	0.80
	315.000	320	5	0.80
	360.000	359	-1	0.80

Remarks:

¹ Calibration results only valid for the stated circumstances and environmental conditions during which calibration took place.

² Direction of measurement

Direction of Unit under Calibration

End of Certificate of Calibration

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/1 Srintham Road, Bangbunru, Bangkok, 10700 Thailand
Tel: +66 2433 8331 Email: calibration@sithiporn.com

SITHIPORN
ASSOCIATES

Cert. No. : ACC24008
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 : 19 JANUARY 2024
Calibration Date : 26 JANUARY 2024
Date of Issue : 29 JANUARY 2024

Calibrated by : Natlakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/1 Srintham Road, Bangbunru, Bangkok, 10700 Thailand
Tel: +66 2433 8331 Email: calibration@sithiporn.com

SITHIPORN
ASSOCIATES

Cert. No. : ACC24008
Job No. : VC67AC0058
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

This equipment was calibrated by follow 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	EP-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL-BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL-BP 30/0267	13-FEB-24
Digital Multimeter	33461A	MY60024273	EEL-BP 31/0266	14-FEB-24
Programmable Attenuator	MA7-1070	62100114	EP-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAI	34560495	AA-3002-23	14-FEB-24
Audio Analyzer	AVR-3360A	V744B6069	EP-0012-23	10-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/1 Srintham Road, Bangbunru, Bangkok, 10700 Thailand
Tel: +66 2433 8331 Email: calibration@sithiporn.com

SITHIPORN
ASSOCIATES

Cert. No. : ACC24008
Job No. : VC67AC0058
Pages : 3 of 3

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Acceptance limit (dB)
94	93.58	-0.02	0.14	0.40

2. Frequency

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

3. Total distortion

Measured value (%)	Uncertainty (%)	Acceptance limit (%)
0.83	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

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/1 Sinitthorn Road, Bangbunru, Bangkok, 10700 Thailand
Tel : +66 2433 8331 Email : calibration@sithiporn.com

SITHIPORN
associates



Cert. No. : ACL24027
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 00472126 / 158778 / 88180
ID No. : RYG_FS0301

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 : 19 DECEMBER 2023
Calibration Date : 12 JANUARY 2024
Date of Issue : 16 JANUARY 2024

Calibrated by : Nathakorn Pisupaisan

Approved by : T. Petchu.
(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.

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/1 Sinitthorn Road, Bangbunru, Bangkok, 10700 Thailand
Tel : +66 2433 8331 Email : calibration@sithiporn.com

SITHIPORN
associates



Cert. No. : ACL24027
Job No. : VC67AC0044
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by follow on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For test 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-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EELBP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EELBP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EELBP 31/0266	14-FEB-24
Programmable Attenuator	MAF-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAJ	34560495	AA-3002-23	14-FEB-24

- This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
- This certificate is traceable to the international system of unit maintained at :
 - National Institute of Metrology (Thailand),
 - Thailand Institute of Scientific and Technological Research (TISTR).

T. Petchu.

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Cert. No. : ACL24027
Job No. : VC67AC0044
Pages : 3 of 8

Summary of Measurement Result :

Parameter	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	0.2	N/A
2. Self-generated noise	0.2	N/A
3. Acoustical signal tests of frequency weightings		
125 Hz	0.3	0.6
1000 Hz	0.3	0.6
8000 Hz	0.3	0.7
4. Electrical signal tests of frequency weightings		
For 10 Hz to 4 kHz	0.3	0.6
For > 4 kHz to 10 kHz	0.3	0.7
For > 10 kHz to 20 kHz	-	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

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Cert. No. : ACL24027
Job No. : VC67AC0044
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.98)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
18.8

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

Frequency Weighting	Measured value (dB)
A-weight	12.0
C-weight	18.4
Flat	24.2

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	0.7	0.8	0.9	± 1.5
1000	-0.2	-0.2	-0.2	± 1.0
8000	-2.5	-2.5	-2.5	± 5.0

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Cert. No. : ACL24027
Job No. : VC67AC0044
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	0.0	-0.1	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long-term stability

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

7. Reth.

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Cert. No. : ACL24027
Job No. : VC67AC0044
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	89.1	0.1	±1.1
84.0	84.1	0.1	±1.1
79.0	79.1	0.1	±1.1
74.0	74.1	0.1	±1.1
69.0	69.1	0.1	±1.1
64.0	64.0	0.0	±1.1
59.0	59.1	0.1	±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	29.1	0.1	±1.1
28.0	28.1	0.1	±1.1
27.0	27.1	0.1	±1.1
26.0	26.1	0.1	±1.1
25.0	25.1	0.1	±1.1

7. Reth.

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Cert. No. : ACL24027
Job No. : VC67AC0044
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, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.3	-1.1	±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	±2.0
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

7. Reth.

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Cert. No. : ACL24027
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Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.7	89.6	-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

7. Reth.

Cert. No. : ACL24228
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RJON
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 00734223 / 169439 / 72460
ID No. : RYG-TS0029

Condition As Found : GOOD

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

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

Received Date : 10 JULY 2024
Calibration Date : 11 JULY 2024
Date of Issue : 15 JULY 2024

Calibrated by : Nithakorn Pisutpaisan

Approved by :

T. Petchu
(Thanakul Petchurai)

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

Cert. No. : ACL24228
Job No. : VC67AC0127
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

For test 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-0009-24	05-FEB-25
Waveform Generator	33517B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EEL_BP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EEL_BP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EEL_BP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KA1	34560495	AA-3001-24	05-FEB-25

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

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

- 3.1 National Institute of Metrology (Thailand).
3.2 Thailand Institute of Scientific and Technological Research (TISTR).

Cert. No. : ACL24228
Job No. : VC67AC0127
Pages : 3 of 8

Summary of Measurement Result :

Parameter	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	0.2	N/A
2. Self-generated noise	0.2	N/A
3. Acoustical signal tests of frequency weightings		
125 Hz	0.3	0.6
1000 Hz	0.3	0.6
8000 Hz	0.3	0.7
4. Electrical signal tests of frequency weightings		
For 10 Hz to 4 kHz	0.3	0.6
For > 4 kHz to 10 kHz	0.3	0.7
For > 10 kHz to 20 kHz	-	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

Cert. No. : ACL24228
Job No. : VC67AC0127
Page : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.6

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

Frequency Weighting (dB)	Weighting (dB)
A-weight	9.9
C-weight	16.7
Flat	22.4

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-1.7	-1.6	-1.6	± 5.0

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Job No. : VC67AC0127
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighing 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	0.0	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	0.0	0.0	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long-term stability

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

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Cert. No. : ACL24228
Job No. : VC67AC0127
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	30.0	0.0	±1.1
29.0	29.0	0.0	±1.1
28.0	28.1	0.1	±1.1
27.0	27.0	0.0	±1.1
26.0	26.1	0.1	±1.1
25.0	25.1	0.1	±1.1

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Cert. No. : ACL24228
Job No. : VC67AC0127
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, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.3	-1.1	±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	±2.0
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

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Cert. No. : ACL24228
Job No. : VC67AC0127
Pages : 8 of 8

11. Overload indication

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

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Cert. No. : ACL24093
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NII-24
Serial No. : 00734225 / 145272 / 34370
ID No. : RYG_FS0030

Condition As Found : GOOD

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

Location : -
Ambient Temperature : (23,0 ± 3) °C
Pressure : (101,3 ± 3) kPa
Relative Humidity : (50,0 ± 20) %

Received Date : 19 JANUARY 2024
Calibration Date : 25-26 JANUARY 2024
Date of Issue : 29 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :
(Thanukul Petchurui)

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Cert. No. : ACL24093
Job No. : VC67AC0058
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL_BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL_BP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EEL_BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAJ	34560495	AA-3002-23	14-FEB-24

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

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

- 3.1 National Institute of Metrology (Thailand),
- 3.2 Thailand Institute of Scientific and Technological Research (TISTR).

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

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Cert. No. : ACL24093
Job No. : VC67AC0058
Pages : 3 of 8

Summary of Measurement Result :

Parameter	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	0.2	N/A
2. Self-generated noise	0.2	N/A
3. Acoustical signal tests of frequency weightings		
125 Hz	0.3	0.6
1000 Hz	0.3	0.6
8000 Hz	0.3	0.7
4. Electrical signal tests of frequency weightings		
For 10 Hz to 4 kHz	0.3	0.6
For > 4 kHz to 10 kHz	0.3	0.7
For > 10 kHz to 20 kHz	-	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

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Cert. No. : ACL24093
Job No. : VC67AC0058
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.98)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
21.4

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	23.6

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.1	-0.9	-0.9	± 5.0

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Job No. : VC67AC0058
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	0.0	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	0.0	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	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.0	0.0	± 0.2
C - weight	94.0	94.0	0.0	± 0.2
Flat	94.0	94.0	0.0	± 0.2

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

7. Petch

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Job No. : VC67AC0058
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
29.0	29.9	+0.1	± 1.1
24.0	24.9	+0.1	± 1.1
19.0	19.0	0.0	± 1.1
14.0	14.0	0.0	± 1.1
9.0	9.0	0.0	± 1.1
4.0	4.0	0.0	± 1.1
25.0	25.0	0.0	± 1.1

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Job No. : VC67AC0058
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, Lepenk (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	136.2	-0.2	±3.0

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

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Cert. No. : ACL24093
Job No. : VC67AC0058
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	89.8	0.2	±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

7. Petch



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0292 MTC No. EEL, BP, 83/0267

CALIBRATION CERTIFICATE

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

Instrument Calibrated : Ambient Environment
Description : Sound Calibrator Temperature : (23.0 ± 3.0) °C
Manufacturer : Rion Relative Humidity : (50 ± 15) %
Model : NC-74 Ambient Pressure : (101.325 ± 1.500) kPa

Serial No. : 34178121 (ID:RYG_150213)

Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037,

2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484,

3. Programmable Attenuator Tammawa TPA-303A S/N OF 2214,

4. Digital Multimeter Agilent 34401A S/N MY44005560,

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001,

6. Audio Analyzer Keithley 2015-P S/N 4106495,

7. Condenser Microphone B&K 4180 S/N 2889871.

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

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

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

Date of Receipt : 19 Feb, 2024

Date of Calibration : 28 Feb, 2024

1/2

The results are valid only for the items tested and are not valid for other items.

Attention: The Report/Certificate and parts of the results except in full are prohibited unless written permission is obtained from the Laboratory.

EEL-MTC-002 Rev.5

Head Office : 35 Moo 2 Tambon Khong Nue, Amphoe Khong Nue, Thailand
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E-mail: info@stihp.com



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0292 MTC No. EEL, BP, 83/0267

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

Nominal Output of Unit Under Test = 94 dB re 20 µPa at 1000 Hz

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

1. Sound Pressure Level

Standard Microphone	Measured Sound Pressure	Deviated value	Uncertainty	Tolerance limit
Type	Level (dB)	(dB)	(dB)	IEC60942:2003 Class I
1/2 inch Bruel&Kjaer 4180	94.01	0.01	± 0.10	± 0.40 dB

2. Frequency

Standard Microphone	Measured Frequency	Deviated value	Uncertainty	Tolerance limit
Type	(Hz)	(Hz)	(Hz)	IEC60942:2003 Class I
1/2 inch Bruel&Kjaer 4180	1003.1	3.1	± 1.5	± 1.0%

3. Total Distortion

Standard Microphone	Measured Total Distortion	Uncertainty	Tolerance limit
Type	(%)	(%)	IEC60942:2003 Class I
1/2 inch Bruel&Kjaer 4180	1.80	± 0.50	± 3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

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

Calibrated by : (Mr. Weerachai Deechaiyee)

Approved by : (Mr. Pongsak Khuyap)

Electrical and Electronic Standards Laboratory

Date of Calibration : 28 Feb, 2024

Industrial Metrology and Testing Service Centre

Date of Issue : 29 Feb, 2024

Ref: 2011267021900719001

End of Certificate

2/2

The results are valid only for the items tested and are not valid for other items.

Attention: The Report/Certificate and parts of the results except in full are prohibited unless written permission is obtained from the Laboratory.

EEL-MTC-002 Rev.5

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SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY451-451/1 Srinthorn 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. : ACL23324
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Pre-amplifier 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 ± 3.0) °C
Pressure : (101.3 ± 3.3) kPa
Relative Humidity : (50.0 ± 2.0) %

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

Calibrated by : Nathakorn Pisutpaisan

Approved by : (Thanakul Petchurai)

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

QF-TS12-04-04-020664

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL23324
Job No. : VC67AC0011
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL-BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL-BP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EEL-BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KA1	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23324
Job No. : VC67AC0011
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

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

QI-TS12-01-01-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23324
Job No. : VC67AC0011
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93,98)	93,9	0,0	±0,3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
16,8

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

Frequency Weighting	Measured value (dB)
A - weight	11,3
C - weight	17,5
Flat	23,1

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0,4	0,4	0,5	± 1,5
1000	0,0	0,0	0,0	± 1,0
8000	-1,2	-1,1	-1,1	±5,0

QI-TS12-01-01-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23324
Job No. : VC67AC0011
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	0,0	-0,1	±2,0
125	0,0	0,0	0,0	±1,5
250	0,0	0,0	0,0	±1,5
500	0,0	0,0	0,0	±1,5
1000	0,0	0,0	0,0	±1,0
2000	0,0	0,0	0,0	±2,0
4000	0,0	0,0	0,0	±3,0
8000	0,0	0,1	0,1	±5,0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94,0	94,0	0,0	± 0,2
C - weight	94,0	94,0	0,0	± 0,2
Flat	94,0	94,0	0,0	± 0,2

5.2 Time weighting at 1 kHz

Frequency Weighting	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94,0	94,0	0,0	± 0,1
Slow	94,0	94,0	0,0	± 0,1
Leq	94,0	94,0	0,0	± 0,1

6. Long - term stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94,0	94,0	0,0	± 0,3

QI-TS12-01-01-020661

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23324
Job No. : VC67AC0011
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	34,0	0,0	± 1,1
30,0	29,9	-0,1	± 1,1
29,0	28,9	-0,1	± 1,1
28,0	27,9	-0,1	± 1,1
27,0	26,9	-0,1	± 1,1
26,0	25,8	-0,2	± 1,1
25,0	24,9	-0,1	± 1,1

QI-TS12-01-01-020664

T. Petch

Continuation of Calibration Certificate

Cert. No. : ACL23324
Job No. : VC67AC0011
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 Weighing	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, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
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	±2.0
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. Petchu

Continuation of Calibration Certificate

Cert. No. : ACL23324
Job No. : VC67AC0011
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11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle	+0.1	±1.5
89.7	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

T. Petchu

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Cert. No. : ACL23325
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No. : 01073423 / 169513 / 73684
ID No. : RYG_PS0386

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHUWAENG 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 : 11 OCTOBER 2023
Calibration Date : 19-20 OCTOBER 2023
Date of Issue : 24 OCTOBER 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petchu
(Thanakul Petchurui)

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23325
Job No. : VC67AC0011
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM). The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For test 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-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EELBP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EELBP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EELBP 31/0266	14-FEB-24
Programmable Attenuator	MA7-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAJ	34560495	AA-3002-23	14-FEB-24

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

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

- 3.1 National Institute of Metrology (Thailand),
- 3.2 Thailand Institute of Scientific and Technological Research (TISTR).

QF-TS12-04-04-020664

T. Petchu

Continuation of Calibration Certificate

Cert. No. : ACL23325
Job No. : VC67AC0011
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

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

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P. B. K. N.

Continuation of Calibration Certificate

Cert. No. : ACL23325
Job No. : VC67AC0011
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.98)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.4

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	18.8
Flat	24.6

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	1.6	1.7	1.6	± 5.0

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P. B. K. N.

Continuation of Calibration Certificate

Cert. No. : ACL23325
Job No. : VC67AC0011
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QI-TS12-04-04-020664

P. B. K. N.

Continuation of Calibration Certificate

Cert. No. : ACL23325
Job No. : VC67AC0011
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	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.8	-0.2	± 1.1

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P. B. K. N.

Continuation of Calibration Certificate

Cert. No. : ACL23325
Job No. : VC67AC0011
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, T _b (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, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133,0	133,0	0,0	±3,0
One	136,4	136,1	-0,3	±3,0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133,0	133,0	0,0	±2,0
Positive half cycle	135,4	135,2	-0,2	±2,0
Negative half cycle	135,4	135,2	-0,2	±2,0

Q1-1512-04-04-02-06-4

T. Petchurai

Continuation of Calibration Certificate

Cert. No. : ACL23325
Job No. : VC67AC0011
Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle	Value (dB)	
89,6	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

Q1-1512-04-04-02-06-4

T. Petchurai

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Cert. No. : ACL24008
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 01173610 / 143485 / 22619
ID No.: RYG_FS0389

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTANAKAN 40, PHATTANAKAN ROAD,
KHAENG PHATTANAKAN, 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 : 19 DECEMBER 2023
Calibration Date : 05-08 JANUARY 2024
Date of Issue : 09 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petchurai
(Thanakul Petchurai)

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Cert. No. : ACL24008
Job No. : VC67AC0044
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by follow on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests in 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-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL-BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL-BP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EEL-BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KA1	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

T. Petchurai

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Cert. No. : ACL24008
Job No. : VC67AC0044
Pages : 3 of 8

Summary of Measurement Result :

Parameter	Uncertainty	Maximum-permitted
	(dB)	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

T. Petch.

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Cert. No. : ACL24008
Job No. : VC67AC0044
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.98)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
18.6

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

Frequency Weighting	Measured value (dB)
A-weight	16.2
C-weight	22.1
Flat	28.0

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.4	0.5	0.5	±1.5
1000	0.0	0.0	0.0	±1.0
8000	0.5	0.5	0.6	±5.0

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Cert. No. : ACL24008
Job No. : VC67AC0044
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	-0.1	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	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	94.0	94.0	0.0	±0.2
C-weight	94.0	94.0	0.0	±0.2
Flat	94.0	94.0	0.0	±0.2

5.2 Time weighting at 1 kHz

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

6. Long-term stability

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

T. Petch.

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Cert. No. : ACL24008
Job No. : VC67AC0044
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	89.1	0.1	±1.1
84.0	84.1	0.1	±1.1
79.0	79.1	0.1	±1.1
74.0	74.1	0.1	±1.1
69.0	69.1	0.1	±1.1
64.0	64.0	0.0	±1.1
59.0	59.1	0.1	±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	34.1	0.1	±1.1
30.0	30.1	0.1	±1.1
29.0	29.1	0.1	±1.1
28.0	28.2	0.2	±1.1
27.0	27.4	0.4	±1.1
26.0	26.3	0.3	±1.1
25.0	25.4	0.4	±1.1

T. Petch.

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451/4511 Sithiporn Road, Bangbunru, Bangkok, 10700 Thailand
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Cert. No. : ACL24008
Job No. : VC67AC0044
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, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
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	±2.0
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

7. Petch

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Job No. : VC67AC0044
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11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.7	89.6	-0.1	±1.5

12. High level stability

Frequency Weighting	S.L.M Display at initial (dB)	S.L.M 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

7. Petch



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL BP. 172/0167

CALIBRATION CERTIFICATE

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

Address : 104 Phatthanakan 40, Phatthanakan Rd., Kluwaeng Phatthanaka, Khet Suan Luang, Bangkok 10250

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

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NI-42

Serial No. : 00296515 (ID: RYG_FS0432)

Microphone : Type UC-52 No.179119

Preamplifier : Type NH-24 No.87526

Standards used :

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

Date of Receipt : 24 Jan. 2024

Date of Calibration : 22-28 Feb. 2024

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Petch

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0232

MTC No. EEL BP. 172/0167

9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.

10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.

11. Digital Multimeter Agilent 34401A S/N MY44005560.

12. Programmable Attenuator Tamagawa TPA 303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61673-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 22-28 Feb. 2024

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Fax : +66 2251 4022
Email : info@tistr.go.th

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation Before adjust After adjust value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
115.96	114.1	113.9	-0.1	1.0	0.30
					N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 123.6 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
19.1	0.10	N/A

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

Frequency (Hz)	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Weighting			
A-Weight	11.9	0.10	N/A
C-Weight	17.4	0.10	N/A
Flat	23.2	0.10	N/A

Date of Calibration 22-28 Feb. 2024

3-9

This report is valid only to the items tested and the conditions stated therein.

All sampling and testing methods and procedures used in this report are in accordance with the standards and specifications of the relevant standards and specifications.

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Fax. No. 0-2-251-6715
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Tel. No. 0-2-251-1122 (ext. 5219, 5225, 5237)
Fax. No. 0-2-251-9092
E-mail: tistr@tistr.go.th

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
125	0.1	0.2	0.2	0.6
1 000	-0.1	-0.1	-0.1	0.6
5 000	0.0	0.0	-0.1	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
63	-0.1	0.0	0.0	0.6
125	-0.1	0.0	0.0	0.6
250	-0.1	0.0	0.0	0.6
500	0.0	0.0	0.0	0.6
1 000	0.0	0.0	0.0	0.6
2 000	0.0	0.0	0.0	0.6
4 000	0.0	0.0	0.0	0.6
8 000	0.0	0.0	0.0	0.7

Date of Calibration 22-28 Feb. 2024

4-9

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5. Long-term stability

Time	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Weighting					
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.1	0.1	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Weighting					
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration 22-28 Feb. 2024

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This report is valid only to the items tested and the conditions stated therein.

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
137	137.1	0.1	1.1	0.30	0.3
136	136.1	0.1	1.1	0.30	0.3
135	135.1	0.1	1.1	0.30	0.3
133	133.1	0.1	1.1	0.30	0.3
132	132.1	0.1	1.1	0.30	0.3
131	131.1	0.1	1.1	0.30	0.3
130	130.1	0.1	1.1	0.30	0.3
129	129.1	0.1	1.1	0.30	0.3
124	124.0	0.0	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.1	0.1	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.1	0.1	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3

Date of Calibration 22-28 Feb. 2024

6-9

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All sampling and testing methods and procedures used in this report are in accordance with the standards and specifications of the relevant standards and specifications.

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Request No.21-67-0232

MTC No. EEL, BP, 172-0167

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

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
54	54,0	0,0	1,1	0,30	0,3
49	49,0	0,0	1,1	0,30	0,3
44	44,0	0,0	1,1	0,30	0,3
39	39,0	0,0	1,1	0,30	0,3
34	34,0	0,0	1,1	0,30	0,3
29	28,9	-0,1	1,1	0,30	0,3
28	28,0	0,0	1,1	0,30	0,3
27	27,0	0,0	1,1	0,30	0,3
26	26,0	0,0	1,1	0,30	0,3
25	25,0	0,0	1,1	0,30	0,3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
20-130	94,0	94,0	0,0	1,1	0,30	0,3

Date of Calibration 22-28 Feb, 2024

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The results quoted are to the items tested and calibrated as indicated.

Adopting the reported uncertainty and validity of the results except as fully and properly stated, unless written comments are obtained from the laboratory (TISTR).

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Request No.21-67-0232

MTC No. EEL, BP, 172-0167

8. Level linearity including the level range control

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

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
20-130	25	25,0	0,0	1,1	0,30	0,3

9. Tone burst response

Time Weighting	Duration, T ₀ (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	126,0	0,0	±1,0	0,20	0,3
	2	108,9	-0,1	+1,0, -2,5	0,20	0,3
	0,25	100,0	0,0	+1,5, -5,0	0,20	0,3
Slow	200	119,5	-0,1	±1,0	0,20	0,3
	2	100,0	0,0	+1,0, -5,0	0,20	0,3

Date of Calibration 22-28 Feb, 2024

8/9

The results quoted are to the items tested and calibrated as indicated.

Adopting the reported uncertainty and validity of the results except as fully and properly stated, unless written comments are obtained from the laboratory (TISTR).

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Request No.21-67-0232

MTC No. EEL, BP, 172-0167

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125,4	125,5	0,1	3,0	0,20	0,35
Positive half cycle	124,4	124,1	-0,3	2,0	0,20	0,35
Negative half cycle	124,4	124,1	-0,3	2,0	0,20	0,35

11. Overload indication

Measured value (dB)		Deviated	Acceptance limit	Uncertainty	Maximum-permitted uncertainty
Positive one-half cycle	Negative one-half cycle	value (dB)	class 2 (±dB)	(±dB)	of measurement (±dB)
135,4	135,4	0,0	1,5	0,55	0,25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129,0	0,0	0,3	0,10	0,1
End	129,0				

Calibrated by:
(Mr. Pannasit Phasingrui)

Approved by:
(Mr. Pannasit Phasingrui)
Director
Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration 22-28 Feb, 2024

Date of Issue 29 Feb, 2024

Ref: 2011267012400347002

End of Certificate

9/9

The results quoted are to the items tested and calibrated as indicated.

Adopting the reported uncertainty and validity of the results except as fully and properly stated, unless written comments are obtained from the laboratory (TISTR).

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Cert. No.: ACL24228

Pages: 1 of 8

Calibration Certificate

Equipment: SOUND LEVEL METER
Manufacturer: RION
Model: NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00734223 / 169439 / 72460
ID No.: RYG_P50029

Condition As Found: GOOD

Customer: ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTANAKAN 40, PHATTANAKAN ROAD,
KHWAENG PHATTANAKAN, 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: 10 JULY 2024
Calibration Date: 11 JULY 2024
Date of Issue: 15 JULY 2024

Calibrated by: Nathakorn Pisutpaisan

Approved by:
(Thanakul Petchurai)

REVIEW BY	
APPROVED BY	
NEXT CAL DATE	15/7/25

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.

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

451-451/1 Sinitthorn Road, Banglumru, Bangkok, 10700 Thailand
Tel : +66 2433 8331 Email : calibration@sithiporn.com



Cert. No. : ACL24228
Job No. : VC67AC0127
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	11LBP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EELBP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EELBP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAI	34560495	AA-3001-24	05-FEB-25

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

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

3.1 National Institute of Metrology (Thailand).

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

T. Petch

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Summary of Measurement Result :

Parameter	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	0.2	N/A
2. Self-generated noise	0.2	N/A
3. Acoustical signal tests of frequency weightings		
125 Hz	0.3	0.6
1000 Hz	0.3	0.6
8000 Hz	0.3	0.7
4. Electrical signal tests of frequency weightings		
For 10 Hz to 4 kHz	0.3	0.6
For > 4 kHz to 10 kHz	0.3	0.7
For > 10 kHz to 20 kHz	-	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

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Cert. No. : ACL24228
Job No. : VC67AC0127
Page : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.6

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

Frequency Weighting	Weighting (dB)
A-weight	9.9
C-weight	16.7
Flat	22.4

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
125	0.4	0.4	0.4	±1.5
1000	-0.1	-0.1	-0.1	±1.0
8000	-1.7	-1.6	-1.6	±5.0

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Cert. No. : ACL24228
Job No. : VC67AC0127
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4. Electrical signal tests of frequency weightings

Weighing network response with relative to 1 kHz.

Frequency (Hz)	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	0.0	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	0.0	0.0	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long-term stability

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

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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	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

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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, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.3	-1.1	±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	±2.0
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

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11. Overload indication

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

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Cert. No. : ACL24266
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-34
Serial No.: 00734218 / 146937 / 34368
ID No.: RYG_FS0031

Condition As Found : GOOD

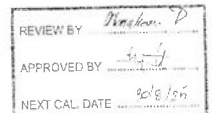
Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHUANG PHATTHANAKAN, KHUANG SUAN LUANG,
BANGKOK, 10250 THAILAND.

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

Received Date : 09 AUGUST 2024
Calibration Date : 30 AUGUST 2024
Date of Issue : 03 SEPTEMBER 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by : *T. Petchur*
(Thiamakul Petchurai)



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Cert. No. : ACL24266
Job No. : VC67AC0140
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by follow on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For test 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-0009-24	05-FEB-25
Waveform Generator	33511B	MY53202742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EELBP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EELBP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EELBP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KAJ	34560495	AA-3001-24	05-FEB-25

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

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

3.1 National Institute of Metrology (Thailand),

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

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Cert. No. : ACL24266
Job No. : VC67AC0140
Pages : 3 of 8

Summary of Measurement Result :

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

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Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
19.5

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

Frequency Weighting	Weighting (dB)
A-weight	11.6
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)	Flat	C-weight	A-weight	Acceptance Limits
125	0.5	0.6	0.6	±1.5
1000	0.0	0.0	0.0	±1.0
8000	+1.1	+1.1	+1.1	±5.0

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

5.2 Time weighting at 1 kHz

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

6. Long-term stability

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

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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	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 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	29.1	0.1	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

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8. Level linearity including the level range control

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

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	30.0	29.8	-0.2	±1.1

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 : -5.0
	2	8	117.0	117.0	0.0	1.0 : -2.5
	200	800	134.0	134.0	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	128.1	0.1	±1.0

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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	±3.0
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	±2.0
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

11. Overload indication

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

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Cert. No. : ACL24264
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NII-24
Serial No. : 00472132 / 169445 / 72466
ID No. : RYG_IS0304

Condition As Found : GOOD

Customer : A.I.S LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTANAKAN 40, PHATTANAKAN ROAD,
KHWAENG PHATTANAKAN, 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 : 09 AUGUST 2024
Calibration Date : 30 AUGUST 2024
Date of Issue : 03 SEPTEMBER 2024

Calibrated by : Nuthakorn Pisutpaisan

Approved by : *T. Petchur*
(Thanakul Petchurui)

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Cert. No. : ACL24264
Job No. : VC67AC0140
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-24	05-FEB-25
Waveform Generator	33511B	MY52302742	EF-0007-24	05-FEB-25
Digital Multimeter	33461A	MY53220104	EELBP 21/0267	13-FEB-25
Digital Multimeter	33461A	MY53220076	EELBP 20/0267	15-FEB-25
Digital Multimeter	34461A	MY60024273	EELBP 22/0267	15-FEB-25
Programmable Attenuator	MAT-1070	62100114	EF-0008-24	05-FEB-25
Condenser Microphone	4180	2977900	AA-1001-24	12-FEB-25
Measuring Amplifier	NA-42KA1	34560495	AA-3001-24	05-FEB-25

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

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

3.1 National Institute of Metrology (Thailand).

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

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Pages : 3 of 8

Summary of Measurement Results :

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

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Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Nominal test

Measured Value (dB)
16.6

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

Frequency Weighting	Weighting (dB)
A-weight	11.6
C-weight	18.0
Flat	23.4

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.4	0.4	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-0.8	-0.7	-0.8	± 5.0

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Cert. No. : ACL24264
Job No. : VC67AC0140
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	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	0.0	0.0	+0.1	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long-term stability

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

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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	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 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	24.9	-0.1	± 1.1

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Job No. : VC67AC0140
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8. Level linearity including the level range control

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

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	30.0	29.8	-0.2	± 1.1

9. Tone burst response

Time Weighting	Tone burst duration, Th (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

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10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	± 3.0
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	133.1	0.1	± 2.0
Positive half cycle	135.4	135.3	-0.1	± 2.0
Negative half cycle	135.4	135.3	-0.1	± 2.0

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.5	89.8	0.3	±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

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Cert. No. : ACL24304
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 00873057 / 171591 / 73333
ID No.: RYG_FS0381

Condition As Found : GOOD

Customer : AJS LABORATORY GROUP (THAILAND) CO., LTD.
104 PIATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PIATTHANAKAN, 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 : 23 SEPTEMBER 2024
Calibration Date : 09 OCTOBER 2024
Date of Issue : 09 OCTOBER 2024

Calibrated by : Nathakorn Pisutpaissan

Approved by :

T. Petchu
(Thanakul Petchurai)

REVIEW BY	<i>Nathakorn Pisutpaissan</i>
APPROVED BY	<i>T. Petchu</i>
NEXT CAL DATE	9/10/25

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.

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Cert. No. : ACL24304
Job No. : VC67AC0164
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Calibration Procedure : CP-AC-01

Calibration Method :

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

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand),

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

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Summary of Measurement Result :

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

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Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
16.7

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

Frequency Weighting	Weighting (dB)
A-weight	13.4
C-weight	15.3
Flat	25.0

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 94 dB

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.4	0.4	±1.5
1000	0.1	0.1	0.1	±1.0
8000	1.1	1.2	1.2	±5.0

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4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±2.0
125	0.1	0.1	0.1	±1.5
250	0.1	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±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	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	94.0	94.0	0.0	±0.2
C-weight	94.0	94.0	0.0	±0.2
Flat	94.0	94.0	0.0	±0.2

5.2 Time weighting at 1 kHz

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

6. Long-term stability

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

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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	30.1	0.1	±1.1
29.0	29.0	0.0	±1.1
28.0	28.1	0.1	±1.1
27.0	27.1	0.1	±1.1
26.0	26.2	0.2	±1.1
25.0	25.2	0.2	±1.1

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Job No. : VC67AC0164
Pages : 7 of 8

8. Level linearity including the level range control

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

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	30.0	30.1	0.1	±1.1

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	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	98.0	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

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10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±3.0
One	136.4	135.9	-0.5	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.1	0.1	±2.0
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

11. Overload indication

Measured value (dB)	Deviated Value	Acceptance Limits
Positive one-half cycle	Negative one-half cycle	(dB) (dB)
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

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ROTA METER CALIBRATION RESULT JULY 2024

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R ²)
BKK_FS0577	01 Jul 24	Y = 1.0001x + 0.0433	1.0000
BKK_FS0584	01 Jul 24	Y = 1.0056x - 2.7974	1.0000
BKK_FS0585	02 Jul 24	Y = 1.0315x + 3.0033	0.9998
BKK_FS0587	02 Jul 24	Y = 1.0294x + 0.71	1.0000
BKK_FS0588	01 Jul 24	Y = 0.8751x + 9.8452	0.9999
BKK_FS0581	01 Jul 24	Y = 1.0035x - 8.2303	1.0000
BKK_FS0592	02 Jul 24	Y = 1.002x + 14.273	1.0000
BKK_FS0594	02 Jul 24	Y = 1.0003x + 7.0095	1.0000
BKK_FS0595	01 Jul 24	Y = 1.0871x - 114.97	0.9985
BKK_FS1004	02 Jul 24	Y = 0.9826x + 13.51	0.9999
BKK_FS1005	02 Jul 24	Y = 1.0217x - 0.5933	0.9997
BKK_FS1006	02 Jul 24	Y = 1.149x - 1.0422	0.9981
BKK_FS1007	02 Jul 24	Y = 1.1116x + 3.3558	0.9994
BKK_FS1008	02 Jul 24	Y = 1.1273x - 0.4837	0.9999
BKK_FS1009	01 Jul 24	Y = 1.1044x - 0.8245	1.0000
BKK_FS1017	02 Jul 24	Y = 1.0488x + 2.2027	0.9998
BKK_FS1018	02 Jul 24	Y = 1.0173x - 0.1967	0.9999
BKK_FS1019	02 Jul 24	Y = 1.0022x + 5.619	1.0000
BKK_FS1026	01 Jul 24	Y = 1.072x - 2.4954	1.0000
BKK_FS1027	01 Jul 24	Y = 1.0104x - 4.4788	0.9999
BKK_FS1028	01 Jul 24	Y = 1.0009x - 3.7755	1.0000
BKK_FS1029	01 Jul 24	Y = 1.1118x - 4.4431	0.9985
BKK_FS1030	01 Jul 24	Y = 1.0159x - 6.395	1.0000
BKK_FS1031	01 Jul 24	Y = 0.8973x - 5.3371	0.9999
BKK_FS1039	02 Jul 24	Y = 0.9992x + 6.8833	0.9992
BKK_FS1040	01 Jul 24	Y = 1.0034x - 2.5343	1.0000
BKK_FS1041	02 Jul 24	Y = 1.0511x + 1.1272	0.9996
BKK_FS1042	02 Jul 24	Y = 1.0016x + 10.387	0.9995
BKK_FS1043	01 Jul 24	Y = 0.9965x + 9.3743	1.0000
BKK_FS1044	02 Jul 24	Y = 1.1237x - 0.4231	0.9981
BKK_FS1200	01 Jul 24	Y = 1.0397x - 0.1016	0.9994
BKK_FS1201	01 Jul 24	Y = 0.9871x + 5.0931	0.9988
BKK_FS1202	01 Jul 24	Y = 0.7978x + 301.39	0.9334
PHK_FS0027	02 Jul 24	Y = 1.0722x + 3.4395	0.9988
PHK_FS0028	02 Jul 24	Y = 1.0254x + 1.04	1.0000
PHK_FS0029	02 Jul 24	Y = 0.999x + 12.73	1.0000
RYG_FS0197	01 Jul 24	Y = 1.0045x + 10.291	1.0000
RYG_FS0198	01 Jul 24	Y = 1.0056x + 1.8883	1.0000
RYG_FS0199	02 Jul 24	Y = 1.0029x + 3.2381	0.9990



ROTA METER CALIBRATION RESULT JULY 2024

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R ²)
RYG_FS0654	02 Jul 24	Y = 1.0421x + 1.4935	1.0000
RYG_FS0655	02 Jul 24	Y = 0.975x + 15.2	0.9994
RYG_FS0656	01 Jul 24	Y = 1.0042x + 7.1067	0.9999
RYG_FS0657	02 Jul 24	Y = 1.0337x + 1.8918	0.9998
RYG_FS0658	02 Jul 24	Y = 0.9921x + 10.87	0.9996
RYG_FS0659	01 Jul 24	Y = 1.0022x + 8.4152	1.0000
SGK_FS0135	02 Jul 24	Y = 1.0193x + 3.6833	0.9999
SGK_FS0136	02 Jul 24	Y = 1.0217x + 1.63	1.0000
SGK_FS0138	02 Jul 24	Y = 1.055x + 4.5833	0.9999
SGK_FS0139	02 Jul 24	Y = 1.0154x + 3.74	0.9998
SGK_FS0140	02 Jul 24	Y = 1.0008x + 13.353	1.0000
SGK_FS0141	02 Jul 24	Y = 1.1185x + 1.4867	0.9998
SGK_FS0142	02 Jul 24	Y = 1.0211x + 1.39	1.0000
SGK_FS0143	02 Jul 24	Y = 1.0045x + 5.6981	1.0000

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

Approved By : Sarayu Jittranont
(Mr. Sarayu Jittranont)
Assistant General Manager



Certificate of Calibration

Customer

Name : ALS Laboratory Group Thailand Co., Ltd.
Address : 101 Soi Phatthana 40, Phatthana Road, Suan Luang, Bangkok
10250

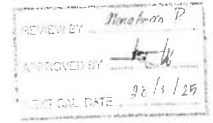
Certificate No : 24-ATM-018 Rev.1

Request No : Req-2024-0013

Unit Under Calibration Details

Measurement Item : Air Flow Meter
Manufacturer : Bus
Model : Defender 510-L
Serial Number : 200845
ID : BKK_FS1346
Location of Calibration : LAB-AIR VELOCITY METER
Calibration Environment and Details
Temperature : 23.0°C ± 3.0°C
Humidity : 55%RH ± 20%RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 1 January 2024
Calibration Date : 20 January 2024

Sensor Model :
Sensor Serial Number :



Calibration Procedure : In house method CIP-A1-M-01 by Comparison technique with Standard Primary Flow Calibration

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Calibration 3 Low flow	18501010006	Snowdyne	12 July 2024
Air Flow Meter	Calibration 3 Standard flow	19031010007	Snowdyne	12 July 2024
Temperature meter	GT 11	90000057	Quchem	27 February 2024
Pressure meter	CPG7400	41000KD-651007	1PA	9 November 2024

Traceability :

This Certificate is traceable to SI Unit through Snowdyne ACLA Accreditation No. 3943-01

Note :

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

This Certificate was issued to replace in Calibration Certificate No. 24-ATM-018

Calibration By : B/C

Mr. Suppabon Lungsit
Service Calibration Engineer

Approved By : M/S

Mr. Paet Muttavon
Calibration Engineer Supervisor

Issue Date : 1 February 2024

The results stated only for the items calibrated. These results shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

File:008-ATM-01 Rev 01 issue date 25/01/24



Certificate No : 24-ATM-018 Rev.1

Request No : Req-2024-0043

Result of Calibration : Without Adjustment

Temperature (°C)	Pressure (kPa)	STD (ml/min)	UUC (ml/min)	Error (ml/min)	Uncertainty (ml/min)
25.00	101.66	20	20.148	0.1	1.3
25.00	101.67	100	99.409	-0.6	2.8
24.90	101.63	199	197.48	-1.5	5.6
25.00	101.61	300	298.15	-1.8	8.4
24.90	101.60	399	400.13	1	11
25.00	101.59	499	479.82	-2.0	16.8

Note : STD = Standard UUC = Unit Under Calibration
UUC Reference Condition : At atmospheric pressure and room temperature condition
Flow Rate was corrected for non-standard operating condition by using equation

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

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

* Indicates non accredited

End of Certificate



BKK_FS0614



Calibration Certificate

Certificate No. 610563

Sold To:

Product 200-S10M Defender 510 Medium Flow

Serial No. 151114

Cal. Date 21-May-2024

All calibrations are performed in accordance with ISO 17025 at Mesa Laboratories, Inc., 12100 W. 6th Ave., Lakewood, CO 80226, an ISO 17025:2017 accredited laboratory through NVLAP. This report shall not be reproduced except in full without the written approval of the laboratory. Results only relate to the items calibrated. This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

As Received Calibration Data

Technician	Derek Dellape		Lab. Pressure	614.2 mmHg
			Lab. Temperature	24.3 °C
Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Received
0 ccm	4504.81 ccm	-100.0%	1.00%	Out of Tolerance
0 ccm	1000.98 ccm	+100.0%	1.00%	Out of Tolerance
0 ccm	249.55 ccm	-100.0%	1.00%	Out of Tolerance

Mesa Laboratories Standards Used

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

Marked P
21/5/24



As Shipped Calibration Data

Certificate No	610563	Lab, Pressure	617 mmHg	
Technician	Derek Delape	Lab, Temperature	24.6 °C	
Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
4482.47 ccm	4493.49 ccm	-0.25%	1.00%	In Tolerance
997.25 ccm	996.83 ccm	0.04%	1.00%	In Tolerance
248.51 ccm	248.67 ccm	-0.06%	1.00%	In Tolerance

Mesa Laboratories Standards Used

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

Calibration Notes

The expanded uncertainty of flow has a coverage factor of $k = 2$ for a confidence interval of approximately 95%. Flow testing is in accordance with our test number MP-00672 with an expanded uncertainty of 0.27% using high-purity nitrogen or filtered laboratory air. Traceability to the International System of Units (SI) is verified by accreditation to ISO/IEC 17025 by NVLAP under NVLAP Code 200661-0.

Technician Notes:

By: _____ Approved By: _____

Troy Thacker

Derek Dellape
Production Assembler II

Troy Thacker
Quality Engineer

Mesa Laboratories, Inc. certifies that the above instrument meets or exceeds published specifications, and that the calibration results in this certificate were obtained using equipment capable of producing results that are traceable through NIST to the International System of Units (SI). Calibration results are in compliance with ISO/IEC 17025:2017. Calibration process has a Test Uncertainty Ratio (TUR) of 4.1 or greater. Any Pass/Fail determination is made without taking measurement uncertainty into account and is based on UUT performance against required tolerance only.

Mesa Laboratories Inc. 12100 W 6th Ave, Lakewood, CO 80228 USA
(303) 987-6390 www.mesalabs.com Symbol "MLAB" on live NASDAQ

Certificate of Calibration

Customer: ALS Laboratory Group Thailand Co., Ltd.
Name: 104 Soi Phatthanasak 40, Phatthanasak Road, Suan Luang, Bangkok
Address: 10250
Certificate No : 24-AFM-033
Request No : Req-2024-0241

Unit Under Calibration Details

Measurement Item: Primary Flow Calibrator
Manufacturer: Huss
Model: Defender 510 L
Serial Number: 130027
ID: RYG_ES0208
Sensor Model: _____
Sensor Serial Number: _____

Location of Calibration: LAB 4 AIR VELOCITY METER

Calibration Environment and Details

Temperature: $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$
Humidity: $55\% \text{RH} \pm 20\% \text{RH}$
Barometric Pressure: $\pm 1013 \text{ hPa} \pm 10 \text{ hPa}$
Received Date: 31 January 2024
Calibration Date: 13 February 2024

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

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Calibrator 3 Low Flow	18501010006	Sensodyne	12 July 2024
Air Flow Meter	Calibrator 3 Standard flow	19031011003	Sensodyne	12 July 2024
Temperature meter	GT 11	090000057	Queborn	27 February 2024
Pressure meter	CPG2300	41000KDU-651802	TPA	9 November 2024

Traceability :

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

Note :

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

Calibration By: *by*
Mr Noppadon Luangut
Service Calibration Engineer

Approved By: *Mr P*
Mr Pien Muthavorn
Calibration Engineer Supervisor
Issue Date : 13 February 2024

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

Certificate No : 24-AFM-033
Request No : Req-2024-0241

Result of Calibration : Without Adjustment

Temperature	Pressure	STD	UUC	Error	Uncertainty
(°C)	(kPa)	(cc/min)	(cc/min)	(cc/min)	(cc/min)
24.50	101.26	20	19.968	0.0	1.3
24.20	101.25	100	100.50	-0.5	2.8
24.00	101.31	200	199.13	-0.9	5.6
23.90	101.42	300	303.56	-2.6	8.4
24.10	101.41	400	401.57	-4	11
24.10	101.49	450	453.81	-3.8	7.0

Note: STD = Standard UUC = Unit Under Calibration
UUC Reference Condition : At atmosphere pressure and room temperature condition
Flow Rate was corrected for non-standard operating condition by using equation

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

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

* Indicates non accredited

End of Certificate

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

Certificate of Calibration

Customer: ALS Laboratory Group Thailand Co., Ltd.
Name: 104 Soi Phatthanasak 40, Phatthanasak Road, Suan Luang, Bangkok
Address: 10250
Certificate No : 24-AFM-032
Request No : Req-2024-0240

Unit Under Calibration Details

Measurement Item: Primary Flow Calibrator
Manufacturer: Huss
Model: Defender 510-M
Serial Number: 129918
ID: RYG_J50209
Sensor Model: _____
Sensor Serial Number: _____

Location of Calibration: LAB 4 AIR VELOCITY METER

Calibration Environment and Details

Temperature: $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$
Humidity: $55\% \text{RH} \pm 20\% \text{RH}$
Barometric Pressure: $\pm 1013 \text{ hPa} \pm 10 \text{ hPa}$
Received Date: 31 January 2024
Calibration Date: 13 February 2024

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

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Calibrator 3 Low Flow	18501010006	Sensodyne	12 July 2024
Air Flow Meter	Calibrator 3 Standard flow	19031011003	Sensodyne	12 July 2024
Temperature meter	GT 11	090000057	Queborn	27 February 2024
Pressure meter	CPG2300	41000KDU-651802	TPA	9 November 2024

Traceability :

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

Note :

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

Calibration By: *by*
Mr Noppadon Luangut
Service Calibration Engineer

Approved By: *Mr P*
Mr Pien Muthavorn
Calibration Engineer Supervisor
Issue Date : 13 February 2024

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.

Certificate No : 24-AM-032
Request No : Req/2024-0240

Result of Calibration : Without Adjustment

Temperature (°C)	Pressure (kPa)	STD (cc/min)	UUC (cc/min)	Error (cc/min)	Uncertainty (cc/min)
23.80	101.89	95	100.13	5.1	2.8
23.90	101.71	801	513.93	12.9	7.2
24.18	101.62	1006	1019.8	13	14
24.00	101.81	1997	2023.0	26	29
24.10	101.87	2999	3035.5	37	45
24.60	102.00	3914	3991.8	48	59
24.60	102.08	4739	4790.5	52	72

Note : STD : Standard UUC : Unit Under Calibration
- UUC Reference Condition : At atmospheric pressure and room temperature condition
Flow Rate was corrected for non-standard operating condition by using equation

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

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

* Indicates non accredited

End of Certificate

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.
FM-708-AFM-01 Rev 01 Issue date 25/01/24

Certificate of Calibration

Certificate No : 24-AFM-174
Request No : Req/2024-1861

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

Unit Under Calibration Details

Measurement Item : Air Flow Meter
Manufacturer : MesaLabs
Model : 510-M
Serial Number : 268345
ID : BKK-FS1747
Location of Calibration : LAB 4 AIR VELOCITY METER
Calibration Environment and Details
Temperature : 23 °C ± 0.1 °C
Humidity : 55 % RH ± 20 % RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 22 August 2024
Calibration Date : 28 August 2024

Calibration Procedure

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

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Calibrator 3 Low flow	1550101006	Sensodyne	6 August 2025
Air Flow Meter	Calibrator 3 Standard flow	19334011003	Sensodyne	2 August 2025
Temperature meter	GT 11	08060957	Orieltem	8 March 2025
Pressure meter	CPG2400	416063100-653302	TEPA	9 November 2024

Traceability :
This Certificate is traceable to SI Unit through Sensodyne A2LA Accreditation No. 3043.01
Note :
The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor $k=2$, providing a level of confidence approximately 95 %

Calibration By : Mr. Noppadol Luangrat
Service Calibration Engineer
Approved By : Mr. Pachi Mahavorn
Calibration Engineer Supervisor
Issue Date : 28 August 2024

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.
FM-708-AFM-01 Rev 04 Issue date 17/05/24

Certificate No : 24-AFM-174
Request No : Req/2024-1861

Result of Calibration : Without Adjustment

Temperature (°C)	Pressure (kPa)	STD (cc/min)	UUC (cc/min)	Error (cc/min)	Uncertainty (cc/min)	MPE (cc/min)	Result
22.30	100.57	100	99.526	-0.5	2.8	1	N/A
22.40	100.61	499	500.48	1.5	7.8	5	N/A
22.80	100.56	1004	1004.8	1	15	10	N/A
22.60	100.54	2008	2003.3	-5	29	20	N/A
22.80	100.62	3004	3032.1	28	45	30	N/A
23.20	100.71	4032	4022.4	-10	60	40	N/A
23.40	100.73	5060	5056.4	-4	79	51	N/A

Note : STD : Standard UUC : Unit Under Calibration
- UUC Reference Condition : At atmospheric pressure and room temperature condition
Flow Rate was corrected for non-standard operating condition by using equation

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

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

* Indicates non accredited

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

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

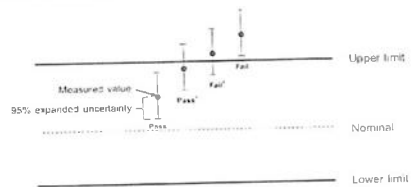
The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.
FM-708-AFM-01 Rev 04 Issue date 17/05/24

Certificate No : 24-AFM-174
Request No : Req/2024-1861

Decision Rule for Statements of Conformity

The accepted decision rule employed for the statements of conformity to each calibration result will be applied using IEC 61359-3:2019, Clause 6.3 on the Reporting of Compliance with Specifications as follows (upper and lower limits)

- Pass - The measurement result plus the expanded uncertainty with a 95% coverage probability were within the limit.
Pass¹ - The measurement result was within the limit. However, a portion of the expanded uncertainty of the measurement is 95% outside the limit.
Fail¹ - The measurement result was on the limit. However, a portion of the expanded uncertainty of measurement is 95% within the limit.
Fail - The measurement result plus the expanded uncertainty with a 95% coverage probability were outside the limit.



End of Certificate

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.
FM-708-AFM-01 Rev 04 Issue date 17/05/24

INNOVATIVE INSTRUMENT CALIBRATION LAB

INNOVATIVE INSTRUMENT CO., LTD HEAD OFFICE

7 THAMMONGKOL SORENTANAKORN II TAMBON BANGKAKHUE

AMPHOE BANGPHUET SAMUT PRAKANG PROVINCE 10140 THAILAND

TEL : 0800 2116 7100 FAX : 0800 2116 7140

INNOVATIVE

Instrument Calibration Laboratory

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Certificate of Calibration

Certificate No : 24-AFM-177

Customer

ALS Laboratory Group Thailand Co., Ltd

Name

Request No : Req-2024-1862

Address

104 Nij Phatthanarak 40, Phatthanarak Road, Sam Lung, Bangkok 10250

Unit Under Calibration Details

Measurement Item

Air Flow Meter

Manufacturer

Bios

Model

Defence 5104

Serial Number

120026

ID

IRK-150619

Location of Calibration

LAB 4 AIR VELOCITY METER

Calibration Environment and Details

Temperature

23.70 ± 1.70

Humidity

55.76 RH ± 20.76 RH

Barometric Pressure

1012.10 kPa ± 10.10 kPa

Received Date

22 August 2024

Calibration Date

9 September 2024

Calibration Procedure

In-house method CP-AFM(01) by Comparative technique with Standard Primary Flow Calibrator

Accuracy

Peak Reading

Sensor Model

Sensor Serial Number

Instrument Status

Used

REVIEW BY

APPROVED BY

NEXT CAL. DATE

9/9/24

Reference Standard

Model

Serial Number

Traceable

Due Calibration

Air Flow Meter

Calibrator 3 Low flow

1850101006

Semalyne

9 August 2025

Air Flow Meter

Calibrator 3 Standard flow

19031011003

Semalyne

2 August 2025

Temperature meter

GT 11

08000057

Qreborn

1 March 2025

Pressure meter

CPC2400

410008DU651182

TFA

9 September 2024

Traceability

This Certificate is traceable to SI Unit through Semalyne A21 Accredited No. 3943.01

Note

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

Calibration By

Mr Noppadon Urrungorn

Service Calibration Engineer

Approved By

Mr. Paiton Mallavon

Calibration Engineer Supervisor

Issue Date

9 September 2024

The results relate only to the item calibrated. The certificate shall not be reproduced except in full without written approval of the Innovate Instrument Co., Ltd.

PM 705-AFM-01 Rev.04 Issue date 17/8/24

INNOVATIVE INSTRUMENT CALIBRATION LAB

INNOVATIVE INSTRUMENT CO., LTD HEAD OFFICE

7 THAMMONGKOL SORENTANAKORN II TAMBON BANGKAKHUE

AMPHOE BANGPHUET SAMUT PRAKANG PROVINCE 10140 THAILAND

TEL : 0800 2116 7100 FAX : 0800 2116 7140

INNOVATIVE

Instrument Calibration Laboratory

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Decision Rule for Statements of Conformity

The standard decision rule employed for the statements of conformity in each calibration pass will be applied using JJ M04:05/09:2019 Guidelines

NOTE: Reporting of compliance with Specifications will vary by type and quantity

Pass - The measurement result plus its expanded uncertainty with a 95% coverage probability was within the limit

Fail - The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement is 95% exceeds the limit

1st - The measurement result was outside the limit. However, a portion of the expanded uncertainty of measurement is 95% is within the limit

1st - The measurement result plus the expanded uncertainty with a 95% coverage probability was outside the limit

Measured value

95% expanded uncertainty

Upper limit

Nominal

Lower limit

End of Certificate

INNOVATIVE INSTRUMENT CALIBRATION LAB

INNOVATIVE INSTRUMENT CO., LTD HEAD OFFICE

7 THAMMONGKOL SORENTANAKORN II TAMBON BANGKAKHUE

AMPHOE BANGPHUET SAMUT PRAKANG PROVINCE 10140 THAILAND

TEL : 0800 2116 7100 FAX : 0800 2116 7140

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Instrument Calibration Laboratory

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Certificate No : 24-AFM-177

Request No : Req-2024-1862

Result of Calibration : Without Adjustment

Temperature

Pressure

STD

UUC

Error

Uncertainty

MPE

Result

24.70

100.92

20

20.192

0.2

1.3

0.2

N/A

24.70

100.96

100

99.923

-0.1

2.8

1.0

N/A

24.70

100.94

201

200.7

-0.3

5.6

2.0

N/A

24.70

100.97

209

200.1

-2.1

8.4

3.0

N/A

24.70

100.99

403

399.1

-4

11

4.0

N/A

24.69

101.05

452

477.6

-4.1

6.9

4.8

N/A

Note

STD : Standard

UUC : Unit Under Calibration

UUC Reference Condition = At atmospheric pressure and room temperature condition

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

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

where : Q = Flow Rate

P = Absolute Pressure

T = Absolute Temperature

Meas = Measurement Condition

ref = Standard Condition

* Indicates not accredited

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

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

The results relate only to the item calibrated. The certificate shall not be reproduced except in full without written approval of the Innovate Instrument Co., Ltd.

PM 705-AFM-01 Rev.04 Issue date 17/8/24

INNOVATIVE INSTRUMENT CALIBRATION LAB

INNOVATIVE INSTRUMENT CO., LTD HEAD OFFICE

7 THAMMONGKOL SORENTANAKORN II TAMBON BANGKAKHUE

AMPHOE BANGPHUET SAMUT PRAKANG PROVINCE 10140 THAILAND

TEL : 0800 2116 7100 FAX : 0800 2116 7140

INNOVATIVE

Instrument Calibration Laboratory

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ILAC-MRA

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ANAB

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Decision Rule for Statements of Conformity

The standard decision rule employed for the statements of conformity in each calibration pass will be applied using JJ M04:05/09:2019 Guidelines

NOTE: Reporting of compliance with Specifications will vary by type and quantity

Pass - The measurement result plus its expanded uncertainty with a 95% coverage probability was within the limit

Fail - The measurement result was within the limit. However, a portion of the expanded uncertainty of measurement is 95% exceeds the limit

1st - The measurement result was outside the limit. However, a portion of the expanded uncertainty of measurement is 95% is within the limit

1st - The measurement result plus the expanded uncertainty with a 95% coverage probability was outside the limit

Measured value

95% expanded uncertainty

Upper limit

Nominal

Lower limit

End of Certificate

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaywang, Huaywang, Bangkok 10310
Tel: +66 2643 8351-8, e-mail: service.thailand@sartorius.com



NSC-TS1515 17025
CALIBRATION 0426

Certificate of Calibration

REVIEW BY: *Thirawat*
APPROVED BY: *Dul*
NEXT CAL. DATE: 09/09/2025

Model Number : MSE125P-100-DU
Description : Semi-micro Balance
Serial Number : 0033108893
ID No. : RYG-EN0004
Manufacturer : Sartorius
Certificate No. : 24BCI0071
Issued Date : Friday, February 23, 2024
Reference No. : 229186
Page No. : 1 of 3

Customer Name : ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
618/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd (Balance Room)
618/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

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

Calibration Procedure No. : This calibration was conducted by Using in-house calibration procedure number (WI-003)
Based on UKAS LAB 14 : 2016

Metrological data :
Capacity : 60.120 g Readability : 0.00001/0.0001 g
Reasons for calibration
☐ New Installation ☐ Service / Repair ☒ Re-Calibration/ Maintenance
Ambients Conditions:
Temperature : 24.0 °C ± 5.0 °C
Humidity : 60.0 % RH ± 10.0 % RH
Pressure : ±
Equipment Condition: ☒ Good Operate ☐ 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.

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2 YCS011-522-00	TCS	M23081975	23-Aug-2025
MHB-382SD	Humidity/Barometer/Temp. Lutron MHB-382SD	DKSH	C19231845	23-Aug-2024

This certificate relate and apply this equipment only.
This certificate may not be reproduced other than in full except with the prior written approval of the Verification Operation Division
Sartorius (Thailand) Co., Ltd.
SOP FM 33 03 February 2022
Mr.Chonchai Inthana(Technical Manager)

Certificate of Calibration

Model Number : MSE125P-100-DU
Description : Semi-micro Balance
Serial Number : 0033108993
ID No. : RYG_EN0004
Manufacturer : Sartorius
Certificate No. : 24BCI0071
Issued Date : Friday, February 23, 2024
Reference No. : 229196
Page No. : 2 of 3

Calibration Results : Without Adjustment

Repeatability		Eccentricity (Off-center loading error)	
The repeatability is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.		The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R78).	
Nominal Value : (Low Load)	5.00003	50.00003	
5 g	5.00001	50.00003	
Tolerance	5.00003	50.00002	
0.000015 g	5.00002	50.00003	
	5.00001	50.00003	
Nominal Value : (High Load)	5.00002	50.00003	
50 g	5.00001	50.00003	
Tolerance	5.00001	50.00002	
0.000015 g	5.00002	50.00003	
	5.00002	50.00002	
Standard Deviation	0.000008	0.000005	

Linearity		Eccentricity (Off-center loading error)	
The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.		The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R78).	
Tolerance	0.00004 g	50.00003	
Nominal Value	Conventional Mass Value	Displayed Value	Deviation
(g)	(g)	(g)	(g)
0.01	0.01000	0.01000	0.00000
0.1	0.10000	0.10000	0.00000
1	1.00000	1.00000	0.00000
2	2.00002	2.00002	0.00000
5	5.00002	5.00003	0.00001
10	10.00002	10.00004	0.00002
20	20.00002	20.00002	0.00000
30	30.00004	30.00003	-0.00001
40	40.00005	40.00003	-0.00002
50	50.00002	50.00001	-0.00001
Uncertainty			
(g)			(g)
0.01			0.000024
0.1			0.000025
1			0.000027
2			0.000028
5			0.000031
10			0.000036
20			0.000049
30			0.000089
40			0.000089
50			0.000089

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Certificate of Calibration

Model Number : MSE125P-100-DU
Description : Semi-micro Balance
Serial Number : 0033108993
ID No. : RYG_EN0004
Manufacturer : Sartorius
Certificate No. : 24BCI0071
Issued Date : Friday, February 23, 2024
Reference No. : 229196
Page No. : 3 of 3

Calibration Results : Without Adjustment

Repeatability		Eccentricity (Off-center loading error)	
The repeatability is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.		The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R78).	
Nominal Value : (Low Load)	100.0000	50.00003	
100 g	100.0000	50.00002	
Tolerance	100.0000	50.00003	
0.000015 g	100.0000	50.00003	
	100.0000	50.00003	
Nominal Value : (High Load)	100.0000	50.00003	
100 g	100.0000	50.00003	
Tolerance	100.0000	50.00002	
0.000015 g	100.0000	50.00003	
	100.0000	50.00002	
Standard Deviation	0.00003	0.000005	

Linearity		Eccentricity (Off-center loading error)	
The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.		The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R78).	
Tolerance	0.0001 g	50.00003	
Nominal Value	Conventional Mass Value	Displayed Value	Deviation
(g)	(g)	(g)	(g)
65	65.0000	65.0000	0.0000
70	70.0000	70.0000	0.0000
75	75.0001	75.0000	-0.0001
80	80.0001	80.0000	-0.0001
85	85.0001	85.0001	0.0000
90	90.0001	90.0001	0.0000
95	95.0001	95.0001	0.0000
100	100.0000	100.0000	0.0000
110	110.0000	110.0000	0.0000
120	120.0000	120.0000	0.0000
Uncertainty			
(g)			(g)
65			0.00015
70			0.00015
75			0.00015
80			0.00016
85			0.00018
90			0.00017
95			0.00019
100			0.00024
110			0.00026
120			0.00026

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Certificate of System Qualification

GC-QQ + GCMS-QQ

System ID	GM-12
Organization Name	ALS Laboratory Group (Thailand) Co Ltd
Organization Location	104 Phatnanakan 40 Phatnanakan Rd Bangkok 10250
Date	May 10, 2024 2:18:55 PM
EOP Name	AgilentRecommended AgilentRecommended
EOP Revision	GC-Q2-S2, GCMS-Q2-S4
Overall Qualification Status	Pass
CDS Logon Verification - GC	Pass
Logon	Pass
Overall CDS Logon Verification - GC Test Status	Pass
System Inspection and Basic Safety and Operation	Pass
Name	8890
Setpoint Status	Pass
Overall System Inspection and Basic Safety and Operation Test Status	Pass
Inlet Pressure Accuracy	Pass
Name	8890
From	SSL
Setpoint Status	Pass
Setpoint	25.0 psi
Actual	25.0 psi
Accuracy	0.0 psi
Agilent Recommended	±1.2 psi
Date	May 10, 2024 2:18:55 PM
System ID	GM-12

Overall Inlet Pressure Accuracy Test Status

Pass	
GC Oven Temperature Accuracy	
Name	8890
Setpoint Status	Pass
Zone	Oven
Temperature	230.0 229.1 °C
Accuracy	-0.9 °C
Agilent Recommended	±1.0 °C setpoint in K (±5.0 °C)
Setpoint Status	Pass
Zone	Oven
Temperature	100.0 101.1 °C
Accuracy	1.1 °C
Agilent Recommended	±1.0 °C setpoint in K (±3.7 °C)
Overall GC Oven Temperature Accuracy Test Status	Pass
GC Oven Temperature Stability	
Name	8890
Setpoint Status	Pass
Temperature	100.0 100.9 °C
Stability	0.0 °C
Agilent Recommended	±0.5 °C
Overall GC Oven Temperature Stability Test Status	Pass
Date	May 10, 2024 2:18:55 PM
System ID	GM-12

Log Amp

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

Overall Log Amp Test Status

Pass

RFPA

Tested Combination1 Front SSL / External SQ
Name: 5977C
Setpoint Status: Pass
Attenuation: 1050 mV Drift After Five Minutes: 4 mV RFPA Voltage: 482 mV
Agilent Recommended: ≥ -100 and ≤ 100 ≤ 1100

Overall RFPA Test Status

Pass

Tune EI

Tested Combination1 Front SSL / External SQ
Name: 5977C
Setpoint Status: Pass
Filament: 1
Setpoint Status: Pass
Filament: 2

Overall Tune EI Test Status

Pass

Scouting Run

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

Tested Combination1 Front SSL / External SQ
Injection Tower
Name: 7693A
Source: EI - Extractor
Setpoint Status: Completed
Injection Volume on Column: 1.0 μ L
Overall Scouting Run Status: Completed

Instrument Detection Limit

Tested Combination1 Front SSL / External SQ
Injection Tower
Name: 7693A
Source: EI - Extractor
Setpoint Status: Pass
Injection Volume on Column: 1.0 μ L
Area: 0.72 %
Minimum RSD: 0.01 %
Agilent Recommended: ≤ 5.00 %
Status: Pass
Retention Time: 0.01 %
Instrument Detection Limit: 2.41164 fg
Agilent Recommended: ≤ 16.82500 fg
Status: Pass

Overall Instrument Detection Limit Test Status

Pass

Mass Ratio Precision

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

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

Injection Volume on Column: 1.0 μ L

Area Mass 1
Abundance's
RSD: 0.71 %
Agilent Recommended: ≤ 5.00 %
Status: Pass
Mass Ratio
0.19 %
Agilent Recommended: ≤ 5.00 %
Status: Pass

Overall Mass Ratio Precision Test Status

Pass

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

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System
System ID: GM-12
Manufacturer: Agilent Technologies
Name: 8890
Flow Data Input: Manual Data
Temperature Data Input: Manual Data or Other Data Logging
Tested Combination1
Injection Technique: Injection Tower
Inlet: Front
Detector: External
LTM Included?: No
Sampler 1
Manufacturer: Agilent Technologies
Type: Injection Tower
Name: 7693A
Model Number: G4513A
Serial Number: CN23125102
Firmware Revision: A.11.07
Usage: Sample Injection
Location: Front
Syringe Volume (μ L): 10

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Sampler 2	
Manufacturer	Agilent Technologies
Type	Tray
Name	7693A
Model Number	G4514A
Serial Number	CN23147049
Firmware Revision	A.12.03
Vial Heater	Not installed
Mainframe 1	
Manufacturer	Agilent Technologies
Name	8890
Model Number	G3540A
Serial Number	CN2303A031
Firmware Revision	2.8.1.6
Oven Type	Standard
Inlet 1	
Manufacturer	Agilent Technologies
Name	8890
Type	SSL
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes
Detector 1	
Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External

Date: May 10, 2024 2:18:55 PM
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Mass Spectrometer 1	
Manufacturer	Agilent Technologies
Type	SQ
Name	S977C
Model Number	G7077C
Serial Number	US2307MA35
Firmware Revision	6.00.35
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN Std
MS EI Source 1	
Manufacturer	Agilent Technologies
Source Type	EI - Extractor
Number of filaments	2

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

Electronic Signature

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

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

User Name: supasak.nimsongtham

Report Generated by Hostname: SCG1115H4C

System ID: GM-12

Print Date: May 10, 2024 2:18:57 PM

GM-12 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Options/Information
May 9, 2024 2:25:19 PM	Audit	SessionCreated	Session	Name
May 9, 2024 2:25:19 PM	Start	Configuration	Session	Name
May 9, 2024 2:26:19 PM	Audit	Enrollment	Logging	User is FieldEngineer and does not require an unlock code
May 9, 2024 2:31:20 PM	Audit	Exploaded	Session	EOP details for primary technique [GC] - File path: (Protocol\PackUp\GC\Config)\bwa\02.53\GC-02.53.aep, EOP File Name: (GC-02.53.aep), EOP Name: (AgilentRecommended)\Protocol Revision (GC-02.53) EOP details for hyphenated technique [GC/MS] - File path: (Protocol\PackUp\GC/MS\Config)\unions\02.54\GC/MS-02.54.aep, EOP File Name: (GC/MS-02.54.aep), EOP Name: (AgilentRecommended)
May 9, 2024 2:31:22 PM	End	Configuration	Session	Name
May 9, 2024 2:31:27 PM	Start	Qualification	Session	QC
May 9, 2024 2:31:27 PM	Start	Execution	CDS Login Verification - GC - 8890 - Qualitative Test	Name
May 9, 2024 2:32:31 PM	End	Execution	CDS Login Verification - GC - 8890 - Qualitative Test	Run Count: 1
May 9, 2024 2:32:35 PM	Start	Execution	System Inspection and Basic Safety and Operation - 8890 - Qualitative Test - No actions associated	Name

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

User Name: supasak.nimsongtham
Report Generated by Hostname: SCG1115HKG
System ID: GM-12
Print Date: May 10, 2024 2:18:57 PM

GM-12 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 9, 2024 2:32:44 PM	End	Execution	System Inspection and Basic Safety and Operation - 8590 - Qualitative Test - No reports associated	Run Count: 1
May 9, 2024 2:32:47 PM	Start	Execution	Inlet Pressure Accuracy - Front SSI - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
May 9, 2024 2:32:54 PM	End	Execution	Inlet Pressure Accuracy - Front SSI - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count: 1
May 9, 2024 2:33:03 PM	Audit	AccClosed	Session	None
May 9, 2024 2:33:43 PM	Audit	AccRestarted	Session	None
May 9, 2024 2:33:44 PM	Audit	SessionResumed	Session	None
May 9, 2024 2:33:45 PM	Start	Qualification	Session	OO
May 9, 2024 2:33:54 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front SSI, SQ - Source: E1 - Extractor - RSD L (Area): <= 5.00% - RSD L (Ret Time): <= 1.00%	None
May 9, 2024 2:34:18 PM	Start	Execution	Mass Ratio Precision - Injection Tower, Front SSI, SQ - Source: E1 - Extractor - L (RSD): <= 6.00%	None
May 9, 2024 2:34:28 PM	Audit	AccClosed	Session	None
May 10, 2024 10:19:05 AM	Audit	AccRestarted	Session	None
May 10, 2024 10:19:05 AM	Audit	SessionResumed	Session	None
May 10, 2024 10:19:06 AM	Start	Qualification	Session	OO
May 10, 2024 10:19:09 AM	Start	Execution	Mass Ratio Precision - Injection Tower, Front SSI, SQ - Source: E1 - Extractor - L (RSD): <= 5.00%	None

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

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User Name: supasak.nimsongtham
Report Generated by Hostname: SCG1115HKG
System ID: GM-12
Print Date: May 10, 2024 2:18:57 PM

GM-12 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 10:20:08 AM	Start	Execution	GC Oven Temperature Accuracy - 8590 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
May 10, 2024 10:24:46 AM	Audit	Data	GC Oven Temperature Accuracy - 8590 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
May 10, 2024 10:24:48 AM	End	Execution	GC Oven Temperature Accuracy - 8590 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
May 10, 2024 10:24:50 AM	Start	Execution	GC Oven Temperature Accuracy - 8590 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
May 10, 2024 10:25:33 AM	Audit	AccClosed	Session	None
May 10, 2024 10:27:35 AM	Audit	AccRestarted	Session	None
May 10, 2024 10:27:35 AM	Audit	SessionResumed	Session	None
May 10, 2024 10:27:36 AM	Start	Qualification	Session	OO
May 10, 2024 10:27:38 AM	Start	Execution	GC Oven Temperature Accuracy - 8590 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
May 10, 2024 10:28:03 AM	Audit	Data	GC Oven Temperature Accuracy - 8590 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
May 10, 2024 10:28:05 AM	End	Execution	GC Oven Temperature Accuracy - 8590 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1

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

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User Name: supasak.nimsongtham
Report Generated by Hostname: SCG1115HKG
System ID: GM-12
Print Date: May 10, 2024 2:18:57 PM

GM-12 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 10:26:00 AM	Start	Execution	GC Oven Temperature Stability - 8590 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
May 10, 2024 10:31:28 AM	Audit	Data	GC Oven Temperature Stability - 8590 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
May 10, 2024 10:31:28 AM	End	Execution	GC Oven Temperature Stability - 8590 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count: 1
May 10, 2024 10:31:39 AM	Start	Execution	Log Amp - 5877C SQ - Source: E1 - Extractor	None
May 10, 2024 10:35:49 AM	Audit	AccClosed	Session	None
May 10, 2024 10:37:37 AM	Audit	AccRestarted	Session	None
May 10, 2024 10:37:38 AM	Audit	SessionResumed	Session	None
May 10, 2024 10:37:38 AM	Start	Qualification	Session	OO
May 10, 2024 10:37:45 AM	Start	Execution	Log Amp - 5877C SQ - Source: E1 - Extractor	None
May 10, 2024 11:00:05 AM	End	Execution	Log Amp - 5877C SQ - Source: E1 - Extractor	Run Count: 1
May 10, 2024 11:00:07 AM	Start	Execution	RPPA - 5877C SQ - Source: E1 - Extractor	None
May 10, 2024 11:01:19 AM	End	Execution	RPPA - 5877C SQ - Source: E1 - Extractor	Run Count: 1
May 10, 2024 11:01:25 AM	Start	Execution	Turn E1 - 5877C SQ - Source: E1 - Extractor Filament 1 (Qualitative - No reports associated)	None
May 10, 2024 11:01:50 AM	End	Execution	Turn E1 - 5877C SQ - Source: E1 - Extractor Filament 1 (Qualitative - No reports associated)	Run Count: 1

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System ID: GM-12

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User Name: supasak.nimsongtham
Report Generated by Hostname: SCG1115HKG
System ID: GM-12
Print Date: May 10, 2024 2:18:57 PM

GM-12 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 11:01:53 AM	Start	Execution	Turn E1 - 5877C SQ - Source: E1 - Extractor Filament 2 (Qualitative - No reports associated)	None
May 10, 2024 11:05:40 AM	End	Execution	Turn E1 - 5877C SQ - Source: E1 - Extractor Filament 2 (Qualitative - No reports associated)	Run Count: 1
May 10, 2024 11:09:42 AM	Start	Execution	Soaking Run - Injection Tower, Front SSI, SQ - Source: E1 - Extractor - Part of GCMS System Preparation	None
May 10, 2024 11:09:49 AM	Start	Execution	Instrument Detection Limit - Injection Tower, Front SSI, SQ - Source: E1 - Extractor - RSD L (Area): <= 5.00% - RSD L (Ret Time): <= 1.00%	None
May 10, 2024 11:17:54 AM	Start	Execution	Soaking Run - Injection Tower, Front SSI, SQ - Source: E1 - Extractor - Part of GCMS System Preparation	None
May 10, 2024 11:17:59 AM	Start	Execution	Instrument Detection Limit - Injection Tower, Front SSI, SQ - Source: E1 - Extractor - RSD L (Area): <= 5.00% - RSD L (Ret Time): <= 1.00%	None
May 10, 2024 11:18:02 AM	Start	Execution	Mass Ratio Precision - Injection Tower, Front SSI, SQ - Source: E1 - Extractor - L (RSD): <= 6.00%	None
May 10, 2024 11:33:06 AM	Audit	AccClosed	Session	None
May 10, 2024 11:40:08 PM	Audit	AccRestarted	Session	None
May 10, 2024 11:40:09 PM	Audit	SessionResumed	Session	None

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

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User Name: supasak.khumsongkham
Report Generated by Hostname: SCG1115HRC
System ID: GM-12
Print Date: May 10, 2024 2:15:57 PM

GM-12 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 1:14:12 PM	Start	Qualification	Session	QC
May 10, 2024 1:14:12 PM	Start	Execution	Mass Ratio Precision - Injection	None Tower, Front SSL, SQ - Source: EI - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 1:15:17 PM	Start	Execution	Scouting Run - Injection Tower,	None Front SSL, SQ - Source: EI - Extractor - Part of GCMS System Preparation
May 10, 2024 1:15:40 PM	Audit	Data	Scouting Run - Injection Tower,	Data File Path: D:\GM-12 Front SSL, SQ - Source: EI - GC2024MARP002.D Extractor - Part of GCMS System Preparation
May 10, 2024 1:15:50 PM	Audit	Reporting	Reintegration	Reintegration Count: 1 - [Integration Type: Injection; BaselineCorrectionMode: Advanced; InitialSlopeSensitivity: 10; InitialPeakWidth: 0.01; InitialAreaReject: 0; InitialHeightReject: 50; Integration: Off at 0; Integration: On at 4;]
May 10, 2024 1:15:57 PM	Audit	Reporting	Reintegration	Reintegration Count: 2 - [Integration Type: Injection; BaselineCorrectionMode: Advanced; InitialSlopeSensitivity: 10; InitialPeakWidth: 0.01; InitialAreaReject: 0; InitialHeightReject: 50; Integration: Off at 0; Integration: On at 4;]

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System ID: GM-12

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User Name: supasak.khumsongkham
Report Generated by Hostname: SCG1115HRC
System ID: GM-12
Print Date: May 10, 2024 2:16:57 PM

GM-12 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 1:15:43 PM	Audit	Reporting	Reintegration	Reintegration Count: 1 - [Integration Type: Injection; BaselineCorrectionMode: Advanced; InitialSlopeSensitivity: 10; InitialPeakWidth: 0.01; InitialAreaReject: 0; InitialHeightReject: 200; Integration: Off at 0; Integration: On at 5;]
May 10, 2024 1:15:55 PM	Audit	Reporting	Reintegration	Reintegration Count: 2 - [Integration Type: Injection; BaselineCorrectionMode: Advanced; InitialSlopeSensitivity: 10; InitialPeakWidth: 0.01; InitialAreaReject: 0; InitialHeightReject: 200; Integration: Off at 0; Integration: On at 4;]
May 10, 2024 1:17:02 PM	End	Execution	Instrument Qualification Limit - Injection Tower, Front SSL, SQ - Source: EI - Extractor - RSD L (Peak): ≤ 5.00% - RSD L (Rel. Time): ≤ 1.00%	Run Count: 1
May 10, 2024 1:17:08 PM	Start	Execution	Mass Ratio Precision - Injection Tower, Front SSL, SQ - Source: EI - Extractor - L (RSD): ≤ 5.00%	
May 10, 2024 1:21:05 PM	Start	Execution	Mass Ratio Precision - Injection Tower, Front SSL, SQ - Source: EI - Extractor - L (RSD): ≤ 5.00%	

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Date: May 10, 2024 2:16:55 PM
System ID: GM-12

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User Name: supasak.khumsongkham
Report Generated by Hostname: SCG1115HRC
System ID: GM-12
Print Date: May 10, 2024 2:16:57 PM

GM-12 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 1:21:05 PM	Start	Execution	Mass Ratio Precision - Injection	None Tower, Front SSL, SQ - Source: EI - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 2:02:43 PM	Audit	Data	Mass Ratio Precision - Injection	Data File Path: D:\GM-12 Tower, Front SSL, SQ - Source: EI - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 2:02:45 PM	Audit	Data	Mass Ratio Precision - Injection	Data File Path: D:\GM-12 Tower, Front SSL, SQ - Source: EI - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 2:02:45 PM	Audit	Data	Mass Ratio Precision - Injection	Data File Path: D:\GM-12 Tower, Front SSL, SQ - Source: EI - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 2:02:45 PM	Audit	Data	Mass Ratio Precision - Injection	Data File Path: D:\GM-12 Tower, Front SSL, SQ - Source: EI - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 2:02:45 PM	Audit	Data	Mass Ratio Precision - Injection	Data File Path: D:\GM-12 Tower, Front SSL, SQ - Source: EI - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 2:02:45 PM	Audit	Data	Mass Ratio Precision - Injection	Data File Path: D:\GM-12 Tower, Front SSL, SQ - Source: EI - Extractor - L (RSD): ≤ 5.00%

Page 10 / 11

Date: May 10, 2024 2:16:55 PM
System ID: GM-12

Page 19 / 20

User Name: supasak.khumsongkham
Report Generated by Hostname: SCG1115HRC
System ID: GM-12
Print Date: May 10, 2024 2:16:57 PM


GM-12 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 10, 2024 2:02:19 PM	Audit	Reporting	Reintegration	Reintegration Count: 1 - [Integration Type: Injection; BaselineCorrectionMode: Advanced; InitialSlopeSensitivity: 10; InitialPeakWidth: 0.01; InitialAreaReject: 0; InitialHeightReject: 50000; Integration: Off at 0; Integration: On at 2;]
May 10, 2024 2:03:31 PM	End	Execution	Mass Ratio Precision - Injection	Run Count: 1 Tower, Front SSL, SQ - Source: EI - Extractor - L (RSD): ≤ 5.00%
May 10, 2024 2:03:49 PM	End	Qualification	Session	QC
May 10, 2024 2:03:49 PM	Start	Reporting	Session	None
May 10, 2024 2:16:42 PM	Audit	Reporting	Session	Report Generated: 1 Certificate
May 10, 2024 2:17:20 PM	Audit	Reporting	Session	Report Generated: Report

Page 11 / 11

Date: May 10, 2024 2:16:55 PM
System ID: GM-12

Page 20 / 20



RYG_EN0038

TEST REPORT

CUSTOMER NAME ALS Laboratory Group (Thailand) Co., Ltd. (บริษัท แอลเอส กรุ๊ป จำกัด (มหาชน) จำกัด)

EQUIPMENT NAME THC Analyzer

MANUFACTURER HORIBA **MODEL** APHA-370 **SERIAL NO** U125GTH2

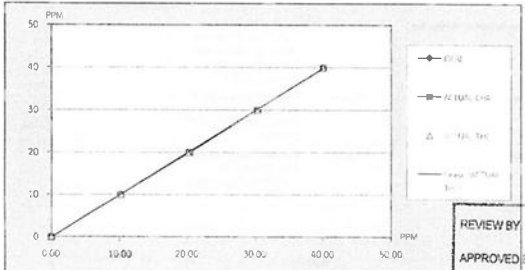
STANDARD GAS CONCENTRATION (PPM) (CH4) 50.0 PPM **CYLINDER NO** : C734373

CYLINDER PRESSURE (psig) : 1,600 PSI **CERTIFIED DATE** 12/05/2020

CERTIFIED BY : AIRSAS **EXPIRED DATE** : 12/05/2028

TEST RESULTS


POINT NO	TEST RESULTS						
	IDEAL	ACTUAL CH4	ERROR CH4	MEASURED CH4	ACTUAL THC	ERROR THC	MEASURED THC
ZERO	0.00	0.00	0.00	0.00	0.00	0.00	-
1	10.00	10.15	0.15	1.50	10.21	0.21	2.10
2	20.00	20.50	0.50	1.50	20.10	0.10	0.50
3	30.00	30.20	0.20	0.99	30.33	0.33	1.10
4	40.00	40.00	0.00	0.00	40.00	0.00	0.00
AVERAGE (%)				0.99		0.95	



REVIEW BY: *[Signature]*
APPROVED BY: *[Signature]*
NEXT CAL DATE: 25/03/2025

CALIBRATED BY: *[Signature]*
CHECKED BY: *[Signature]*

01-20-06-10-14



CHECK LIST

CUSTOMER NAME ALS Laboratory Group (Thailand) Co., Ltd. (บริษัท แอลเอส กรุ๊ป จำกัด (มหาชน) จำกัด)

EQUIPMENT NAME THC Analyzer

MANUFACTURER HORIBA **MODEL** APHA-370 **SERIAL NO.** : U125GTH2

TEST VALUES


NO.	THC Analyzer (APHA - 370)	UNIT	BEFORE	AFTER
1	Signal (mV)	mV	35.60	35.80
2	Signal (THC)	mV	35.60	35.20
3	Detector	Temp °C, Standard Value: Ambient Temp (-5°C to 15°C) Pressure kPa, Standard Value: Ambient/1013.250 to 106 kPa	46.04 69.30	46.70 69.30
4	Amplifier	Gas current atmospheric pressure	100.50	100.20
5	Response	°C Standard Value: 300.0°C to 450.0°C kPa Normal value: 8 kPa to 25 kPa	410.00 9.80	430.50 9.80
6	NARFC	°C Standard Value: 250.0°C to 260.0°C	264.90	264.00
7	DC 24 V	V Standard Value: 24 V ± 0.5 V	24.00	24.00
8	DC 5 V	V Standard Value: 5 V ± 0.5 V	5.00	5.00
9	Bypass (Optional)	µm, Normal value: 0.5 µm to 0.21 µm	-	-
10	Gas Flow (Optional)	L/min, Standard Value: 0.8 L/min or More	-	-
11	C.H. Sampling Reading	PPM	2.00	2.00
12	H2O Sampling Reading	PPM	0.75	0.11
13	THC Sampling Reading	PPM	3.18	2.13
14	Zero Gas CH4/THC	PPM	0.12/0.18	0.00/0.00
15	Signal Gas	ppm	56.75/45.45	40.00/40.00
16	Gas H2	ppm	20	20

Remark: Reference: EX-1017-10, Ambient: 10°C Monitor APHA-370 Gas current atmospheric pressure
Range: 1 Ambient temperature: 5°C to 40°C


Signature: *[Signature]*
Date: 25/03/2025

CALIBRATED BY: *[Signature]*
CHECKED BY: *[Signature]*

01-20-06-10-14



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
53/11 PATTANAKARN ROAD SOI 10, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL: 02-717-3000-2411 FAX: 02-719-9181



Certificate of Calibration

Certificate No.: 23E3924
Page: 1 of 2

Equipment: pri Meter

Manufacturer: Mettler Toledo

Model: SevenExcellence

Serial No.: B634291445

ID No.: RYG_EN0152

Condition As-Received: Used Item

Received Date: 08 December 2023

Calibration Date: 14 December 2023

Reference: 2312-015/DSC

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 10) %

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

Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
61610 Moo 5, T.Moenam Kru, A.Puaksaeng
Rayong 21140, Thailand

Procedure used: Calibration was conducted using calibration procedure No. CURET-17 according to EURAMET cg-15

Condition of this result of calibration

1. Reference standards instruments

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5502A	2435502	CC-0041-23	26 Apr 2024

2) This result of calibration was made on request of the point specified by customer

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


4) This Calibration is traceable to the Internal Calibration System of Unit maintained through:
National Institute of Metrology Thailand (NIMT)

REVIEW BY: *[Signature]*
APPROVED BY: *[Signature]*
NEXT CAL DATE: 14/06/25

Calibrated by: Napsornrak Prasomsri
Issue Date: 15 December 2023

Approved Signatory: *[Signature]*
Napsornrak Prasomsri
Nantawat Khamthong
Pongnarin Boonysorn

0331166



Cert. No.: 23E3924
Page: 2 of 2

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

Function: DC voltage measurement

Standard Value	UUC* Reading	Range	2000	mV	Uncertainty
(mV)	(mV)		Error		(± µV)
-200.0000	-199.9		0.1		68
-150.0000	-150.0		0.0		65
-100.0000	-100.0		0.0		63
-50.0000	-50.0		0.0		61
0.0000	0.0		0.0		58
50.0000	50.0		0.0		61
100.0000	100.0		0.0		63
150.0000	150.0		0.0		65
200.0000	199.9		-0.1		68

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

UUC* = Unit Under Calibration.

01193422



TECHNOLOGY PROMOTION ASSOCIATION (THAI AND JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
151/101 PATTANAKARN ROAD, SUKHUMVIT 11, KJONGTUMBUKI, B220
TEL : 02-2711 9991-99 Fax : 02-2711 9990



Cert.No.: 23CH1574
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 : 08 December 2023
Calibration Date : 15 December 2023
Reference : 2312-0151DSC-3
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch
616/10 Moo 5, T.Maenam Khu, A.Pluaekdaeng,
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 Lerngagrakul

Approved by : 
Approved Signatory

() Salitip Meangmai
() Warakorn Lerngagrakul
(x) Ponpan Palpin

Issue Date : 19 December 2023

The Uncertainties are for a confidence probability of approximately 95%

This certificate may be reproduced in whole or in part, provided the original source is acknowledged.
Approved by the Head of Laboratory, Warakorn Lerngagrakul, Rayong Branch, 151/101 PATTANAKARN ROAD, SUKHUMVIT 11, KJONGTUMBUKI, B220

A 0061696



Cert.No.: 23CH1574
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	23E2802	27 Aug 2024
2) Ref. Standard Thermometer	4982054	110RC044	23I908	26 July 2024

This certification is traceable to the International System of Unit maintained through -
- Technology Promotion Association (Thailand-Japan)

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	913598	14 July 2025
pH 6.906	CPA chem	931959	01 Oct 2024
pH 9.997	CPA chem	940106	02 Nov 2024

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

Calibration Results

Function : mV Measurement

Performing standard curve by Fluke at pH (4.7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (mV)	Coverage factor k
			mV	pH		
pH Meter S/N : B534291445	4.000	177.48	177.3	4.000	0.058	2.00
	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00

a 1183852



Cert.No.: 23CH1574
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 (±)	Coverage factor k
pH Electrode S/N : 3225368	4.008	4.013	184.1	0.0045	2.00
	6.986	6.998	8.7	0.0084	2.00
	9.997	10.002	-164.7	0.0088	2.11

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLab3Expert Pro-ISM
- Serial No. : 3225368
- 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 (± °C)	Coverage factor k
25.0	25.003	24.3	-0.703	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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a 1193851



Metrology

SCI ECO Services Company Limited

33/2 Moo 3, T. Banpa, A. Kaengkhro, Saraburi 18110, Thailand.
Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100

Bangkok Tel : +668 9205 6851, +669 8247 2360
Website : www.scieco.co.th E-Mail : calibrate@scg.com



Certificate No. T241120

Page 1 of 4

Certificate of Calibration

Equipment : Chamber (Cold Room)

Manufacturer : MODULAR

Model : IREYCOHCOO

Serial No. : C00351459

Customer Code : RYG_EN0184

ID No. : T1939A5

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

616/10 Moo 5 T.Maenam Khu,

A.Pluaekdaeng, Rayong 21140

Customer Location : Laboratory

Date of Receipt : 5 June 2024

Calibrated By : Sujjar Nuknakred (Site Calibration Manager)

Approved By :  Preecha Phisassuthikul (Temperature Calibration Manager)

Date of Issue : 12 JUN 2024

The uncertainties are for a confidence probability of approximately 95%.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrology.

TS04-0119 Rev.048

Certificate No. T241120

Page 2 of 4

Calibration Report

Equipment : Chamber (Cold Room)
Date of Calibration : 11 June 2024
Environment : Temperature : 23.1-24.1 °C
Line Voltage : 222.3-226.3 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert nine standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement. The calibration was done in according to WI-T20 (based on ASTM E145-94 (Reapproved 2001) and AS2853-1986).
All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN161-TN170	T240713	19 April 2025
TC	TYPE T	TN171-TN180	T240713	19 April 2025
DATA LOGGER	34970A	T149	T240713	19 April 2025

3. This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244)

4. Condition of calibrated item : good

Equipment Description :

Time Constant 3 Hour 30 Minute At 3 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

() without adjustment

(X) after adjustment

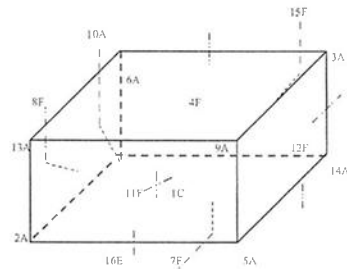
Approved By: 

FM-15110-3400-006

Certificate No. T241120

Page 3 of 4

Calibration Report



C = Centre, F = Centre of Face, A = Corner, E = Centre of Edge

1C = TN161	11F = TN171
2A = TN162	12F = TN172
3A = TN163	13A = TN173
4F = TN164	14A = TN174
5A = TN165	15F = TN175
6A = TN166	16E = TN176
7F = TN167	
8F = TN168	
9A = TN169	
10A = TN170	

Approved By: 

FM-15110-3400-006

Certificate No. T241120

Page 4 of 4

Calibration Report

Measurement Results:

Calibration Point	Average Standard Reading at each position (°C)								
	TN161	TN162	TN163	TN164	TN165	TN166	TN167	TN168	TN169
3	2.73	2.70	2.77	2.78	2.89	2.35	3.09	3.21	3.08
	TN171	TN172	TN173	TN174	TN175	TN176			
	2.59	3.01	2.92	2.81	3.42	3.42			

Chamber (Cold Room)			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (°C)	Uniformity (°C)	Uncertainty (± °C)	Coverage Factor k
	Min	Max					
3.0	2.9	4.4	3.7	2.97	1.32	1.13	2.02

* The quoted uncertainty exclude "uniformity"

The calibration results apply only the above calibrated item

The result of test was found accurate as shown on date and place of test only

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t distribution, providing a level of confidence of approximately 95 %

Approved By: 


FM-15110-3400-006

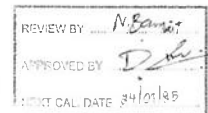


TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3 : EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3060 FAX 0-2719-9484

Cert.No.: 23TW168
Page: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : YSI
Model : 5000-115V
Serial No. : 15E102796
ID No. : RYG_EN0032
Received Date : 21 July 2023
Test Date : 24 July 2023
Reference : 2307-0713DSC-1
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
Rayong Branch
616/10 Moo 6, T.Maenam Khu, A.Pluakdaeng,
Rayong 21140, Thailand
Laboratory Condition : Temperature (25 ± 5) °C
Humidity (50 ± 20) %
Test Procedure : In - house method : CP-CH9
by Comparison Technique with Azido Modification Method
Tested by : Walalak Sirinthean
Approved by : 
Approved Signatory
() Malno Bulkrucra
(✓) Saitip Meangmai
() Warakorn Lemgagtrakul
Issue Date : 26 July 2023



H 0320211



Cert.No.: 23TW158
Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

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

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Burette	-	130BU10	23CG1172	22 Mar 2025
2) Balance	1126143764	140RC004	22MM50	20 Sep 2023

2. Standard Material :-

Material	Manufacturer	Lot.No.	Assay
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

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)
8.18	8.17	0.0055

This report was certified only for the instrument we tested. It is allowable to use for study the system efficiency. The environmental impact control and present to organization it may concerned. Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced other in full, without written approval of the laboratory.

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



Cert. No.: 23LM125
Page.: 1 of 2

Certificate of Calibration

Equipment : DO Meter with Sensor
Manufacturer : YSI
Model : 5000-115V
Serial No. : 15E102796
ID No. : RYG_EN0032
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
Rayong Branch
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng,
Rayong 21140 Thailand
Location : TPA On Site Calibration Laboratory
Received Order : 25 July 2023
Calibrated Date : 27 July 2023
Ambient Temperature : (25 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : Preecha Hiahit
Approved by : *P. Hiahit*
Approved Signatory
() Pornthippa Tameyakul
() Malee Butkruea
(✓) Suwit Imjai

Issue Date : 31 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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

A 0053616



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

Cert. No.: 23LM125
Page.: 2 of 2

Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	2188080	2211285	TPA	21 Oct 2023

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

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

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

Result of Calibration :- (°) Without Adjustment

Function : Temperature measurement.

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

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
20.00	100	20.011	19.91	-0.101	0.15	2.00

UUC* : Unit Under Calibration

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

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a 1159515



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



Certificate of Calibration

Cert. No.: 24TM1663
Page : 1 of 3

Equipment : Low Temp. Incubator
Manufacturer : Memmert
Model : IPP750
Serial No. : V818.0084
ID No. : RYG_EN0154
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
616/10 Moo 5, T. Maenam Khu,
A. Pluakdaeng,
Rayong 21140, Thailand
Location : BOD Room
Received Order : 01 November 2024
Calibration Date : 01 November 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : Krisda Malee
Approved by : *Kunchit*
Approved Signatory
() Ponpan Paipim
() Suwit Imjai
(✓) Kunchit Promprat
Issue Date : 07 November 2024

REVIEW BY :	<i>Thanitak</i>
APPROVED BY :	<i>D. Hiahit</i>
NEXT CAL DATE :	01/05/26

The Uncertainties are for a confidence probability of approximately 95%

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



Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2411-0002OC-1
Procedure Used :-

Cert. No.: 24TM1663
Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY44073381	24LM73	TPA	18 May 2025

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

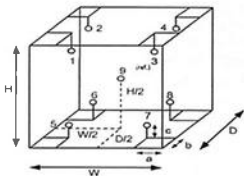
3. This certification is traceable to the International System of Unit.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details :

Dimension of Chamber :	
a = 10 cm	D = 0.60 m
b = 10 cm	W = 1.0 m
c = 10 cm	H = 1.2 m
	Capacity = 0.72 m ³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	24	25
REL Humid. (%)	55	53
AC Supply (Volt)	220	221

Position :	Ref. Std. ID No.:
1	1RTD-2/1
2	1RTD-2/2
3	22-01RTD-03
4	1RTD-2/4
5	1RTD-2/5
6	1RTD-2/6
7	23-01RTD-07
8	1RTD-2/8
9 (ref.)	23-01RTD-09



Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2411-0002OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 24TM1663
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
20.0	20.0	20.0	0.026	0.26	0.53	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	20.071	19.915	20.273	20.179	19.977	19.782	20.056	20.026	20.033	0.30

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

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.
Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.
UUC* : Unit Under Calibration

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

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

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Certificate of Calibration

Cert.No.: 24CG3711
Page.: 1 of 2

Equipment : Burette

Capacity : 50 mL

Serial No. : -

ID. No. : RYG_EN0216

Manufacturer : Wileg

Made In : Germany

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

Ambient Temperature : (20 ± 2.5) °C

Relative Humidity : (50 ± 10) %

Barometric Pressure : 756 mmHg

Calibration Procedure : ASTM E 542 - 01

Calibrated by : Sa-ngeunkam Wongsu

Approved by :

(✓) Srisuda Khamlha
() Ponpan Paipim
() Unnopphol Harachai

Issue Date : 24 September 2024

REVIEW BY : *Thanita K.*
APPROVED BY : *D. Khamlha*
NEXT CAL DATE : 24/09/25



Equipment : Burette
Received Date : 19 September 2024
Condition As-Received : Used Item
Calibration Date : 24 September 2024
Reference : 2409-0756DSC-3

Cert.No.: 24CG3711
Page : 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

Instruments	Model	Serial No.	ID. No.	Certificate No.	Traceability	Due date
1) Balance	XP205	B134206712	140RC007	24MM316	TPA	15 July 2025
2) Data Logger	HL-20D	20683159	140EC012	23H2174	TPA	10 Oct 2024
3) Thermometer	-	1594592	140EC010	24I175	TPA	20 Feb 2025

This certification is traceable to SI Unit

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

3. True value is converted to true volume at the standard temperature of 20 °C

Calibration result :

Nominal capacity (mL)	Reading (mL)	Uncertainty (± mL)	k Factor
10	10.0259	0.0082	2.00
20	20.0214	0.0085	2.00
30	30.0006	0.0089	2.00
40	40.0003	0.0094	2.00
50	49.9988	0.011	2.00

Remark mL = cm³

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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The Uncertainties are for a confidence probability of approximately 95%

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NSC-TIS-1717025
CALIBRATION 0426

SARTORIUS

Certificate of Calibration

REVIEW BY: *Thaniak*
APPROVED BY: *D. Jirapong*
NEXT CAL. DATE: 21/09/25

Model Number: MSE224S-100-DU
Description: Analytical Balance
Serial Number: 0026207038
ID No.: RYG_EN0002
Manufacturer: Sartorius
Certificate No.: 24BC0069
Issued Date: Friday, February 23, 2024
Reference No.: 229196
Page No.: 1 of 2

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

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

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

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

Metrological data:
Capacity: 220 g Readability: 0.0001 g
Temperature: 24.2 °C ± 5.0 °C
Humidity: 57.0 % RH ± 10.0 % RH
Pressure: ±

Reasons for calibration

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

Equipment Condition: ☒ Good Operate ☐ 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	TCS	M2306197S	23-Aug-2025
MHB-382SD	Humidity/Balometer/Temp Lutron MHB-382SD	OKSH	C19231845	23-Aug-2024

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

Mr.Chonchai Inthana
Mr.chonchai Inthana(Technical Manager)



SOP FM 33 03 February 2022

SARTORIUS

Certificate of Calibration

Model Number: MSE224S-100-DU
Description: Analytical Balance
Serial Number: 0026207038
ID No.: RYG_EN0002
Manufacturer: Sartorius
Certificate No.: 24BC0069
Issued Date: Friday, February 23, 2024
Reference No.: 229196
Page No.: 2 of 2

Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)		
The reproducibility 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 express reproducibility 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 R76).		
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	20.0001	Difference		
	20.0000	199.9999	1		
	20.0001	200.0000	2		
Nominal Value : (High Load)	19.9999	200.0000	3		
200 g	20.0000	200.0000	4		
Tolerance	20.0000	199.9999	5		
0.0001 g	19.9999	200.0001	6		
	19.9999	200.0000			
Standard Deviation	0.00007	0.00006			

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

End of Report.

SOP FM 33 03 February 2022



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Certificate of Calibration

Cert. No.: 24TM632
Page : 1 of 3

Equipment: Hot Air Oven
Manufacturer: Memmert
Model: UFE 500
Serial No.: G511.1572
ID No.: RYG_EN0010
Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. (Rayong Branch)
616/10 Moo 5 T. Maenam Khu,
A. Plua Daeng,
Rayong 21140 Thailand
Location: Oven Room
Received Order: 21 March 2024
Calibration Date: 21 March 2024
Ambient Temperature: (26 ± 10) °C
Relative Humidity: (50 ± 30) %
Calibrated by: Man Pattanapongpalboon

REVIEW BY: *Thaniak*
APPROVED BY: *D. Jirapong*
NEXT CAL. DATE: 21/09/25

Approved by: *Man Pattanapongpalboon*
() Ponthipha Tameyakul
() Unnopphol Harachai
(✓) Suwit Imjai

Issue Date: 22 March 2024

The Uncertainties are for a confidence probability of approximately 95%

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

Cert. No.: 24TM632
Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard Instrument:-

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

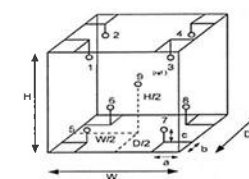
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

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

Result of Calibration:-

(*) Without Adjustment
Function of UUC: Temperature Source
Fresh air setting: Close



Probe Installation Details: Dimension of Chamber:
a = 5.0 cm D = 0.40 m
b = 5.0 cm W = 0.56 m
c = 5.0 cm H = 0.48 m
Capacity = 0.11 m³

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

Ref. Std. ID No.: @ Calibration Point		
Position:	(180) °C	(104) °C
1	18-18TC-01	18-18RTD-01
2	18-18TC-02	18-18RTD-02
3	18-18TC-03	18-18RTD-03
4	18-18TC-04	18-18RTD-04
5	18-18TC-05	18-18RTD-05
6	18-18TC-06	23-18RTD-06
7	18-18TC-07	18-18RTD-07
8	18-18TC-08	22-18RTD-08
9 (ref.)	18-18TC-09	18-18RTD-09



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

Cert. No.: 24TM632
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
104.0	104.0	104.0	0.051	0.59	0.62	2
180.0	180.0	180.0	0.15	1.3	1.7	2

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

Average* : The average of 30 values in each position.
Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.
Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.
UUC* : Unit Under Calibration
Note : The reported uncertainty of measurement was included stability and excluded uniformity.

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

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Cert.No.: 23CH1088
Page : 1 of 2

Certificate of Calibration

Equipment : Conductivity Meter
Manufacturer : Mettler Toledo
Model : S230
Serial No. : B241407147
ID No. : RYG_EN0029
Condition As-Received : Used Item
Received Date : 01 September 2023
Calibration Date : 04 September 2023
Reference : 2309-0010DSC-7
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd, Rayong Branch
616/10 Moo 5, T.Maenam Khu,
A Pluakdaeng, Rayong 21140, Thailand

Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In -house method .
- CP-CH6 : based on direct measurement by using certified reference material (CRM)

Calibrated by : Warakorn Lemgagrakul

Approved by :
Approved Signatory

(✓) Saitip Meangmai
() Warakorn Lemgagrakul
() Ponpan Paipim

Issue Date : 7 September 2023

The Uncertainties are for a confidence probability of approximately 95%

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A 0058059



Cert.No.: 23CH1088
Page : 2 of 2

Condition of this result of calibration

1. Reference Standard Instrument -

Instrument	Serial No.	ID No.	Certificate No.	Due date
1) Thermometer	9549224	130RC003	231435	10 Apr 2024

- This Certification is traceable to SI Through Technology Promotion Association (Thailand - Japan)

2. Certified Reference Materials -

- Conductivity calibration solution, CPA chem Ltd., The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Conductivity Solution	Manufacturer	Lot No.	Exp. date
84,000 µS/cm	CPA Chem	865120	28 Mar 2024
1413.0 µS/cm	CPA Chem	913596	14 July 2024
12,680 mS/cm	CPA Chem	865123	28 Mar 2024

- Control Conductivity calibration solution temperature by Water bath (25.0 ± 1) °C

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

Calibration results

Function : Conductivity Measurement

(*) After Adjustment at 1413.0 µS/cm

Conductivity Electrode Serial No.: 5823251000

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (±)	Coverage factor k
84,000 µS/cm	83.8 µS/cm	85.3 µS/cm	0.62 µS/cm	2.00
1413.0 µS/cm	1388 µS/cm	1413 µS/cm	9.2 µS/cm	2.00
12,680 mS/cm	12,41 mS/cm	12,63 mS/cm	0.086 mS/cm	2.00

Remark : UUC* = Unit Under Calibration
Cell constant = 0.545371 cm⁻¹

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

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Certificate of Calibration

Cert. No.: 24TM634
Page : 1 of 3

Equipment : Hot Air Oven
Manufacturer : Memmert
Model : UF 110
Serial No. : B423.0853
ID No. : RYG_EN0213

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

Received Order : 21 March 2024
Calibration Date : 21 - 22 March 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (60 ± 30) %

Calibrated by : Man Pattanapongpalboon

Approved by :
Approved Signatory

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

Issue Date : 23 March 2024

The Uncertainties are for a confidence probability of approximately 95%

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

Cert. No.: 24TM634
Page : 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

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

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

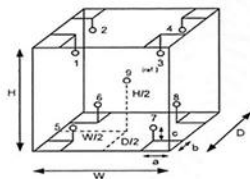
3. This certification is traceable to the International System of Unit.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details : Dimension of Chamber :
a = 50 cm D = 0.40 m
b = 50 cm W = 0.56 m
c = 50 cm H = 0.48 m
Capacity = 0.11 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	27	27
REL Humid. (%)	59	59
AC Supply (Volt)	224	223

Ref. Std. ID No. : @ Calibration Point		
Position :	(180) °C	(104) °C
1	18-18TC-01	18-18RTD-01
2	18-18TC-02	18-18RTD-02
3	18-18TC-03	18-18RTD-03
4	18-18TC-04	18-18RTD-04
5	18-18TC-05	18-18RTD-05
6	18-18TC-06	23-18RTD-06
7	18-18TC-07	18-18RTD-07
8	18-18TC-08	22-18RTD-08
9 (ref.)	18-18TC-09	18-18RTD-09



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

Cert. No.: 24TM634
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
104.0	104.0	104.0	0.065	0.52	0.90	2
180.0	180.0	180.0	0.20	1.2	2.0	2

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

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

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

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

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation
UUC* : Unit Under Calibration

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

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

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Certificate of Calibration

Cert. No.: 24TM635
Page : 1 of 3

Equipment : Water Bath

Manufacturer : Memmert

Model : WNB22

Serial No. : L513.0648

ID No. : RYG_EN0061

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

Location : Wet Chemistry Lab

Received Order : 21 March 2024

Calibration Date : 21 March 2024

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Man Pattanapongpaiboon

Approved by :
Approved Signatory

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

Issue Date : 23 March 2024

The Uncertainties are for a confidence probability of approximately 95%

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

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

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

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

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

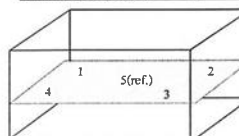
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Heat transfer medium used : Water

	Environmental		AC Voltage Supply (Volt)
	(°C)	(%R.H.)	
Beginning of Calibration	25	55	222
Finished of Calibration	25	57	223



Front

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



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

Cert. No.: 24TM635
Page : 3 of 3

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

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Coverage Factor k
85.0	0.19	0.11	2

Average* : The average of 30 values in each position.
Uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
Stability : One-half of the greatest maximum difference of measured temperature at any one probe.
UUC* : Unit Under Calibration
Note : The reported uncertainty of measurement was included stability and excluded uniformity.

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

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Certificate of Calibration

Cert.No.: 24CH774
Page.: 1 of 2

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenGo S2
Serial No. : C221115514
ID No. : RYG_FS0596
Condition As-Received : Used Item
Received Date : 28 June 2024
Calibration Date : 01 July 2024
Reference : 2406-0969DSC-6
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd, Rayong Branch
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand

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

Calibrated by : Warakorn Lemgagrakul
Approved by : Saithip
Approved Signatory

() Unnophol Harachai
() Ponpan Paipim
(✓) Saithip Meangmai
Issue Date : 03 July 2024

The Uncertainties are for a confidence probability of approximately 95%
This certificate may not be reproduced other than in full, except with the prior written approval of the head of Corporate Services 3: Equipment Calibration and Testing Services



Cert.No.: 24CH774
Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	23E2802	27 Aug 2024

- This Certification is traceable to SI Through Technology Promotion Association (Thailand - Japan)

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	970851	25 Apr 2026
pH 6.986	CPA chem	970852	25 Apr 2025
pH 9.997	CPA chem	970853	25 Apr 2025

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

Calibration Results

Function : mV Measurement

Performing standard curve by Document Process Calibrator at pH (4,7,10)

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

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement (±)	Coverage factor k
pH Electrode S/N.: 3293232	4.008	4.01	180	0.0079	2.00
	6.986	6.99	5	0.011	2.00
	9.997	10.00	-172	0.0092	2.00

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

-00-



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



Certificate of Calibration

Cert. No.: 24LM108
Page.: 1 of 2

Equipment : pH Meter with Sensor
Manufacturer : Mettler Toledo
Model : SevenGo S2
Serial No. : C221115514
ID No. : RYG_FS0596
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
(Rayong Branch)
616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140 Thailand
Location : TPA On Site Calibration Laboratory

Received Order : 28 June 2024
Calibrated Date : 01 July 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V

Calibrated by : Warakorn Lemgagrakul
Approved by : Saithip
Approved Signatory

() Ponpan Paipim
(✓) Suwit Imjai
() Kunchit Promprat

Issue Date : 03 July 2024

The Uncertainties are for a confidence probability of approximately 95%
This certificate may not be reproduced other than in full, except with the prior written approval of the head of Corporate Services 3: Equipment Calibration and Testing Services

Calibration Results:
Without adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC, (°C)	Uncertainty (± °C)
A1	360	365	365	362.5	17.5	1.5
A2				362.4	17.4	1.5
A3				362.1	17.1	1.5
A4				379.7	14.7	1.5
A5				376.3	13.3	1.5
B1				360.1	15.1	1.5
B2				360.1	15.1	1.5
B3				376.5	13.5	1.5
B4				376.3	13.3	1.5
B5				379.1	14.1	1.5
C1				360.1	15.1	1.5
C2				360.1	15.1	1.5
C3				376.6	13.9	1.5
C4				376.2	13.2	1.5
C5				377.3	12.3	1.5
D1				360.5	15.5	1.5
D2				360.6	15.6	1.5
D3				376.1	13.1	1.5
D4				376.7	13.7	1.5
D5				377.7	12.7	1.5

The End of Certificate

ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน WO-00020429

ชนิดเครื่องมือ: Block Digestion Unit รุ่น: KT-20s
หมายเลขเครื่อง: 5720210009/5770200073

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
11 Mar 2024			11 Mar 2024		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
<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. การแสดงผล 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 checked="" type="checkbox"/>	<input type="checkbox"/>	6. สภาพฝาปิด	<input checked="" 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. สภาพแวดล้อม ณ สถานที่ตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

ข้อแนะนำ

Mr. Thanathorn Phunook
Service Engineer

Certificate of System Qualification

GC-QQ + GCMS-QQ

System ID: GM-10
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Pathanakarn 40, Pathanakarn Rd., Kwang Suen Luang, Khet Suan Luang, Bangkok 10250

Date: November 21, 2024 2:12:44 PM
EQP Name: AgilentRecommended, AgilentRecommended

EQP Revision: GC.02.55, GCMS.02.56
Overall Qualification Status: Pass

REVIEW BY: Suchada T.
APPROVED BY: Nanti S.
NEXT CAL DATE: 21-May-21

CDS Logon Verification - GC

Logon: asbkk.sm/03

Overall CDS Logon Verification 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 MMI

Setpoint Status: Pass

Inlet Pressure: 25.0 psi Actual: 25.2 psi

Accuracy: 0.2 psi

Agilent Recommended: ≤ 1.2

Overall Inlet Pressure Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 230.0 228.2 °C

Accuracy: -1.8 °C

Agilent Recommended: ≤ 1.0 % setpoint in K (-5.0 °C)

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 100.0 100.7 °C

Accuracy: 0.7 °C

Agilent Recommended: ≤ 1.0 % setpoint in K (3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

NOTE: This test's 2 comment(s) and 0 deviation(s) are available in the Attachments section.

GC Oven Temperature Stability

Name: 7890

Setpoint Status: Pass

Setpoint/Average

Temperature: 100.0 100.7333 °C

Stability: 0.1 °C

Agilent Recommended: ≤ 0.5

Overall GC Oven Temperature Stability Test Status

Pass

NOTE: This test's 1 comment(s) and 0 deviation(s) are available in the Attachments section.

Tune EI

Tested Combination1	Front	MMI	/ External	TQ
Name:	7000D			
Selfpoint Status:	Pass			
Filament:	1			
Selfpoint Status:	Pass			
Filament:	2			

Overall Tune EI Test Status

Pass

Scouting Run

Tested Combination1	Front	MMI	/ External	TQ
Name:	Injection Tower			
Source:	EI - Extractor			
Selfpoint Status:	Completed			
Injection Volume on Column:	1.0 uL			
Overall Scouting Run Status	Completed			

Instrument Detection Limit

Tested Combination1	Front	MMI	/ External	TQ
Name:	Injection Tower			
Source:	EI - Extractor			

Date: November 21, 2024 2:12:44 PM
System ID: GM-10

Selfpoint Status:

Pass

Injection Volume on Column:

1.0 uL

Minimum RSD:

4.58 %

Agilent Recommended:

<= 12.00

Status:

Pass

Retention Time

0.01 %

<= 1.00

Pass

Instrument Detection Limit:

1.54238 fg

Agilent Recommended:

<= 4.03800

Status:

Pass

Overall Instrument Detection Limit Test Status

Pass

Mass Ratio Precision

Tested Combination1	Front	MMI	/ External	TQ
Name:	Injection Tower			
Source:	EI - Extractor			
Selfpoint Status:	Pass			
Injection Volume on Column:	0.5 uL			
RSD:	2.23 %			
Agilent Recommended:	<= 5.00			
Status:	Pass			
Area Mass 1	Abundance's			
Mass Ratio	0.10 %			
Status:	<= 5.00			
Pass	Pass			

Overall Mass Ratio Precision Test Status

Pass

Date: November 21, 2024 2:12:44 PM
System ID: GM-10

Instrument Details

Purpose

This section describes the as found system configuration

Details

System

System ID	GM-10
Manufacturer	Agilent Technologies
Name	7890
Flow Data Input	Manual Data
Temperature Data Input	Manual Data or Other Data Logging

Tested Combination1

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

Sampler 1

Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7693A
Model Number	G4513A
Serial Number	CN18160003
Firmware Revision	A.11.02
Usage	Sample Injection
Location	Front
Syringe Volume (uL)	10

Date: November 21, 2024 2:12:44 PM
System ID: GM-10

Sampler 2

Manufacturer	Agilent Technologies
Type	Tray
Name	7693A
Model Number	G4514A
Serial Number	CN18170137
Firmware Revision	A.11.03
Vial Heater	Not installed

Mainframe 1

Manufacturer	Agilent Technologies
Name	7890
Model Number	G3442B
Serial Number	CN18153080
Firmware Revision	B.02.05
Oven Type	Standard

Inlet 1

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

Inlet 2

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

Date: November 21, 2024 2:12:44 PM
System ID: GM-10

Detector 1

Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External

Mass Spectrometer 1

Manufacturer	Agilent Technologies
Type	TQ
Name	7000D
Model Number	G7000D
Serial Number	US1826U108
Firmware Revision	G.7000.085A
High Vacuum System	Turbo Pump
Liquid Injection Scouting Run Standard	OFN Std

MS EI Source 1

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

Date: November 21, 2024 2:12:44 PM
System ID: GM-10

Electronic Signature

Purpose

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

Details

Full Name of Signer:	Supasak Nimsongtham
Logged On User Name:	supasak.nimsongtham@agilent.com
Signature Creation Date:	November 21, 2024
Reason for Signature:	Executed protocol and published the original version of document

ACE Self Qualification Status

The installed version of ACE used to deliver this service passed qualification; the results conform with expected values. The self qualification summary report is available in the session folder location SDS/ClearStore/AceSelfQualification

Regulatory Disclaimer

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: November 21, 2024 2:12:44 PM
System ID: GM-10

User Name: supasak.nimsongtham
Report Generated by Hostname: SGC1115H-KC

System ID: GM-10
Print Date: November 21, 2024 2:12:45 PM

GM-10 2024 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 21, 2024 11:56:17 AM	Audit	Session Created	Emission	Host Name: SGC1115H-KC Drive Serial Number: C2001778
November 21, 2024 11:58:17 AM	Start	Configuration	Session	None
November 21, 2024 11:58:17 AM	Audit	Emittance	Licensing	User is Field Engineer and does not require an unlock code
November 21, 2024 12:01:30 PM	Audit	Exp. loaded	Session	EQP details for primary technique (GC) - File path: [Protocol\Packa\GC\Config\kms02.55\GC.02.55.asp] EQP File Name: [GC.02.55.kms] EQP Name: [Agilent Recommended Protocol Revision: (GC.02.55)] EQP details for hyphenated technique (GC/MS) - File path: [Protocol\Packa\GC/MS\Config\kms02.56\GC/MS.02.56.asp] EQP File Name: [GC/MS.02.56.asp], EQP Name: [Agilent Recommended]
November 21, 2024 12:02:04 PM	End	Configuration	Session	None
November 21, 2024 12:02:12 PM	Start	Qualification	Session	OQ
November 21, 2024 12:02:12 PM	Start	Execution	QDS Logon Verification - GC - 7000 - Qualitative test	None
November 21, 2024 12:03:09 PM	End	Execution	QDS Logon Verification - GC - 7000 - Qualitative test	Run Count: 1

Date: November 21, 2024 2:12:44 PM
System ID: GM-10

User Name: supasak.nimsongtham
Report Generated by Hostname: SGC1115H-KC

System ID: GM-10
Print Date: November 21, 2024 2:12:46 PM

GM-10 2024 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 21, 2024 12:03:11 PM	Start	Execution	System inspection and Basic Safety and Operation - 7890 - Qualitative Test - No samples associated	None
November 21, 2024 12:03:20 PM	End	Execution	System inspection and Basic Safety and Operation - 7890 - Qualitative Test - No samples associated	Run Count: 1
November 21, 2024 12:03:23 PM	Start	Execution	Inlet Pressure Accuracy - Front MM - Pressure Controlled Inlet - S 25.0 psi - L <= 1.2 psi	None
November 21, 2024 12:03:28 PM	End	Execution	Inlet Pressure Accuracy - Front MM - Pressure Controlled Inlet - S 25.0 psi - L <= 1.2 psi	Run Count: 1
November 21, 2024 12:03:30 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature - Oven - S 230.0°C - L >= -1.0 AND <= 1.0 % setpoint in K	None
November 21, 2024 12:06:02 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
November 21, 2024 12:06:05 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
November 21, 2024 12:06:07 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature - Oven - S 100.0°C - L >= -1.0 AND <= 1.0 % setpoint in K	None
November 21, 2024 12:06:20 PM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature - Oven - S 100.0°C - L >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry

Date: November 21, 2024 2:12:44 PM
System ID: GM-10

User Name: suprasak.nimsongitum
Report Generated by Hostname: SCG1115HKC
Print Date: November 21, 2024 2:12:45 PM
System ID: GM-10

GM-10 2024 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 21, 2024 12:06:23 PM	End	Execution	GC Oven Temperature Activity: 7800 - Temperature : Oven - S: 100.0°C - L: <= 1.0 AND <= 1.0 % support in K	Run Count: 1
November 21, 2024 12:06:25 PM	start	Execution	GC Oven Temperature Stability - 7800 - Temperature: Oven - S: 100.0°C - L: <= 0.5°C	None
November 21, 2024 12:07:10 PM	Auto	Data	GC Oven Temperature Stability - 7800 - Temperature: Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
November 21, 2024 12:07:34 PM	End	Execution	GC Oven Temperature Stability - 7800 - Temperature: Oven - S: 100.0°C - L: <= 0.5°C	Run Count: 1
November 21, 2024 12:07:16 PM	start	Execution	Tune EI - 70000 TO - Source - None EI - Extractor Filament 1 (Qualitative - No supports associated)	None
November 21, 2024 12:07:26 PM	End	Execution	Tune EI - 70000 TO - Source - None EI - Extractor Filament 1 (Qualitative - No supports associated)	Run Count: 1
November 21, 2024 12:07:28 PM	start	Execution	Tune EI - 70000 TO - Source - None EI - Extractor Filament 2 (Qualitative - No supports associated)	None
November 21, 2024 12:07:38 PM	End	Execution	Tune EI - 70000 TO - Source - None EI - Extractor Filament 2 (Qualitative - No supports associated)	Run Count: 1
November 21, 2024 12:07:41 PM	start	Execution	Scouting Run - Injection Tower, Front MM, TQ - Source - EI - Extractor - Part of GCMS System Preparation	None

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Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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User Name: suprasak.nimsongitum
Report Generated by Hostname: SCG1115HKC
Print Date: November 21, 2024 2:12:45 PM
System ID: GM-10

GM-10 2024 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 21, 2024 12:08:53 PM	Auto	Data	Scouting Run - Injection Tower, Front MM, TQ - Source - EI - Extractor - Part of GCMS System Preparation	Data File Path: C:\GM-10 002024\00001.D
November 21, 2024 12:09:23 PM	Auto	Reporting	Reintegration	Reintegration Count: 1 - [] Integration Type: Injection Baseline Correction Mode: Advanced Initial Slope Sensitivity: 10 Initial Peak Width: 0.01 Initial Area Reject: 0.01 Initial Area 50 Integration: Off at 0 Integration: On at 4
November 21, 2024 12:09:50 PM	End	Execution	Scouting Run - Injection Tower, Front MM, TQ - Source - EI - Extractor - Part of GCMS System Preparation	Run Count: 1
November 21, 2024 12:09:53 PM	start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	None
November 21, 2024 12:16:46 PM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: C:\GM-10 002024\00001.D
November 21, 2024 12:16:48 PM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: C:\GM-10 002024\00002.D

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Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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User Name: suprasak.nimsongitum
Report Generated by Hostname: SCG1115HKC
Print Date: November 21, 2024 2:12:45 PM
System ID: GM-10

GM-10 2024 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 21, 2024 12:16:46 PM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: C:\GM-10 002024\00003.D
November 21, 2024 12:16:46 PM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: C:\GM-10 002024\00004.D
November 21, 2024 12:16:47 PM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: C:\GM-10 002024\00005.D
November 21, 2024 12:16:47 PM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: C:\GM-10 002024\00006.D
November 21, 2024 12:16:47 PM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: C:\GM-10 002024\00007.D
November 21, 2024 12:16:47 PM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: C:\GM-10 002024\00008.D
November 21, 2024 12:16:47 PM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: C:\GM-10 002024\00009.D

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Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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User Name: suprasak.nimsongitum
Report Generated by Hostname: SCG1115HKC
Print Date: November 21, 2024 2:12:45 PM
System ID: GM-10

GM-10 2024 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 21, 2024 12:16:47 PM	Auto	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Data File Path: C:\GM-10 002024\00010.D
November 21, 2024 12:18:15 PM	Auto	Reporting	Reintegration	Reintegration Count: 1 - [] Integration Type: Injection Baseline Correction Mode: Advanced Initial Slope Sensitivity: 10 Initial Peak Width: 0.01 Initial Area Reject: 0.01 Initial Area 50 Integration: Off at 0 Integration: On at 4
November 21, 2024 12:22:43 PM	End	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.00% - RSD L (Rel. Time): <= 1.00%	Run Count: 1
November 21, 2024 12:22:52 PM	start	Execution	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source - EI - Extractor - L (RSD) <= 5.00%	None
November 21, 2024 12:27:38 PM	Auto	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source - EI - Extractor - L (RSD) <= 5.00%	Data File Path: C:\GM-10 002024\00002.D
November 21, 2024 12:27:38 PM	Auto	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source - EI - Extractor - L (RSD) <= 5.00%	Data File Path: C:\GM-10 002024\00003.D
November 21, 2024 12:27:38 PM	Auto	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source - EI - Extractor - L (RSD) <= 5.00%	Data File Path: C:\GM-10 002024\00004.D

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Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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User Name: sudhakar.m.singh@barascientific.com
Report Generated by: Hasekuma: BCG115HNCSystem ID: GM-10
Print Date: November 21, 2024 2:12:45 PM

GM-10 2024 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 21, 2024 12:27:38 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source: EI - Extractor - L (RSD) ≤ 5.00%	Data File Path: C:\GM-10 0Q2024\MM\005.D
November 21, 2024 12:27:38 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source: EI - Extractor - L (RSD) ≤ 5.00%	Data File Path: C:\GM-10 0Q2024\MM\006.D
November 21, 2024 12:27:38 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source: EI - Extractor - L (RSD) ≤ 5.00%	Data File Path: C:\GM-10 0Q2024\MM\007.D
November 21, 2024 12:33:20 PM	Audit	Reporting	Reintegration	Reintegration Count: 1 - [Integration Type: Injection; Baseline Correction Mode: Advanced Initial Slope Sensitivity: 10/min Peak Width: 0.01/min Area Reject: 0/min Height Reject: 5000; Integration Off at Reintegration: On at 4]
November 21, 2024 12:35:42 PM	End	Execution	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source: EI - Extractor - L (RSD) ≤ 5.00%	Run Count: 1
November 21, 2024 12:37:11 PM	End	Qualification	Session	DQ
November 21, 2024 12:37:11 PM	Start	Reporting	Session	None
November 21, 2024 1:11:02 PM	Audit	Reporting	Session	Report Generated: Certificate
November 21, 2024 1:17:20 PM	Audit	Reporting	Session	Report Generated: Report

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Date: November 21, 2024 2:12:44 PM
System ID: GM-10

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Bara Scientific Co., Ltd.
968 U Chu Liang Building Floor 7 Ramak Road
Siam Bangkok Bangkok Thailand 10500
Tel: 02-6324300 Fax: 02-6375496-7
www.barascientific.com

Certificate of Calibration

Number of Page(s) 1 of 3

Certificate No. BSCC-UV-374/24
Equipment UV/Vis Spectrophotometer
Model UV-1800
Manufacturer Shimadzu
Serial No. A11454908533 CD
ID No. BKK_EN0018
Date of receipt 13 September 2024
Date of calibration 13 September 2024
Date of issue 13 SEP 2024

REVIEW BY	<i>Jude K</i>
APPROVED BY	<i>Sult P</i>
NEXT CAL DATE	13/09/2025

Customer name ALS Laboratory Group (Thailand) Co., Ltd.
Address 104 Soi Phattanakan 40, Phattanakan Road, Phattanakan, Suan Luang, Bangkok 10250

Temperature (25.3 - 26.7) °C (On site)
Humidity (50.4 - 55.9) %RH (On site)

Equipment condition Good Operation

Calibration Location Organic Preparation Lab

Calibration Procedure In-house method WI-UV-702-01 based on ASTM E275-01

Traceability Wavelength Accuracy is traceable to certificate No. 106372 and 106371
Photometric Accuracy is traceable to certificate No. 106364 and 111398
Stray Light is traceable to certificate No. 106377
The above certificate are traceable to SI unit through Sigma Scientific Ltd.
(UKAS accredited calibration laboratory NO. 0659)

Calibrated by Mr. Wanchana Janloy

Approved by

*Sonthi*Mr. Sonthi Temboonsakdi
Service Manager

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.
Advertising the report / Certificate and publicity of the results are prohibited and also shall not be reproduced
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BSCC-UV-374/24 Rev 01 (23/01/23)

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Certificate of Calibration

Certificate No. BSCC-UV-374/24

Number of Page(s) 2 of 3

Calibration Results:

1. Wavelength Accuracy

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty (±nm)
241.70	241.55	-0.15	0.18
334.02	333.85	-0.17	0.18
418.53	418.57	0.04	0.18
572.99	572.97	-0.02	0.18
879.41	879.17	-0.24	0.18

2. Photometric Accuracy (UV)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
235	0.0000	0.0000	0.0000	0.0075
	0.7171	0.7169	-0.0002	0.0075
257	0.0000	0.0000	0.0000	0.0075
	0.8354	0.8345	-0.0009	0.0075
313	0.0000	0.0000	0.0000	0.0075
	0.2786	0.2781	-0.0005	0.0075
350	0.0000	0.0000	0.0000	0.0075
	0.6199	0.6184	-0.0005	0.0075

*CNR = Customer not request

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FM-UV-708-02 Rev 01 (23/01/23)

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www.barascientific.com

Certificate of Calibration

Certificate No. BSCC-UV-374/24

Number of Page(s) 3 of 3

Calibration Results:

3. Photometric Accuracy (Visible)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
420.0	0.0000	0.0000	0.0000	0.0042
	0.5761	0.5765	0.0004	0.0042
	0.7119	0.7165	-0.0046	0.0042
	1.0189	1.0174	-0.0015	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.5610	0.5613	0.0003	0.0042
	0.7001	0.6984	-0.0017	0.0042
	1.0026	1.0011	-0.0015	0.0042
465.0	0.0000	0.0000	0.0000	0.0042
	0.5235	0.5232	-0.0003	0.0042
	0.6614	0.6599	-0.0015	0.0042
	0.9456	0.9444	-0.0012	0.0042
546.1	0.0000	0.0000	0.0000	0.0042
	0.5249	0.5245	-0.0004	0.0042
	0.6975	0.6956	-0.0019	0.0042
	1.0009	0.9994	-0.0015	0.0042
590.0	0.0000	0.0000	0.0000	0.0042
	0.5590	0.5586	-0.0004	0.0042
	0.7725	0.7708	-0.0017	0.0042
	1.1125	1.1114	-0.0011	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	0.5666	0.5665	0.0000	0.0042
	0.7620	0.7604	-0.0016	0.0042
	1.0982	1.0971	-0.0011	0.0042

*CNR = Customer not request

4. Stray Light*

Standard cut-off wavelength (nm)	Wavelength (nm)	Unit Under Calibration (UUC) Transmission (%)	Absorbance (A)
200.85±0.11nm	199.58	0.9520	2.0217

The Stray Light transmission reference is less than 1.0%T and Stray Light absorbance reference is greater than 2.00A

*Stray Light not NSC-ONSC Accredited.

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

End of Certificate

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.
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FM-UV-708-02 Rev 01 (23/01/23)



Agilent Technologies (Thailand) Limited
13 CHU LUNG BLDG 22/F UNIT A/D
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Bangkok 10520 Thailand

Tel: +662 637 4300
Fax: +662 632 4334
Email: ccc-sm@agilent.com
Website: www.agilent.com/thai

Customer Contact:

ALS Laboratory Group (Thailand) Co., Ltd.
104 Phatthanakan 40 Phatthanakan Rd.
Khaewang Phatthanakan Bang. Suan
TAX ID : 01055-0004859
Chanatiparn.juchan@agilent.com
276C3068

Invoice To:

ALS Laboratory Group (Thailand) Co., Ltd.
104 Phatthanakan 40 Phatthanakan Rd.
Khaewang Phatthanakan Bang. Suan

Delivery Site:

ALS Laboratory Group (Thailand) Co., Ltd.
104 Phatthanakan 40 Phatthanakan Rd.
Khaewang Phatthanakan Bang. Suan

Location:
Room:
Bldg:
Lab:
Dept:

Products / Applications / Software / Services

Agilent Technologies (Thailand) Limited Head Office
13 Chu Lung Bldg 22/F Unit A/D
148 Rama 4 Road, Sathabangrae
Bangkok 10520 Thailand
Tax ID: 01055-0004859

SERVICE REPORT

Customer Purchase Order Number: 70571013

Service Request: Service Request Date:

Service Order: 0000041203 Service Confirmation: 6905338201

REVIEW BY: *Supakorn N.*
APPROVED BY: *Supakorn N.*
NEXT CAL. DATE: 13/06/2025

Direct Inquiries to:
Contact Name: Customer Contact Center
Contact Email: ccc-sm@agilent.com
Contact Telephone: +662 637 6363
Contact Fax: +662 632 4334

Learn more about Agilent's Special Offers, Products, Services and our full range of laboratory productivity solutions optimized for your applications and workflow. Visit us at www.agilent.com/thai

CHU LUNG
13 Chu Lung Bldg 22/F Unit A/D
148 Rama 4 Road, Sathabangrae
Bangkok 10520 Thailand
Tax ID: 01055-0004859

Service Confirmation Number: 6905338201
Service Confirmation Date: 12.12.2023

Service Instrument:

Model Number	Model Description	Serial Number	System Handle	Parent Asset
SYS-IM-7700-E	ICPMS 7700 System Enhanced		ICP MS 7700 (HPLC)	
G1316A	1260 Thermostatted Column Compartment	DEACN12300	ICP MS 7700 (HPLC)	SYS-IM-7700-E
G1329B	1260 Standard Autosampler	DEAAC11098	ICP MS 7700 (HPLC)	SYS-IM-7700-E
G1311B	1260 Quaternary Pump	DEAB704383	ICP MS 7700 (HPLC)	SYS-IM-7700-E
G3281A	Agilent 7700x ICP-MS	JP12091612	ICP MS 7700 (HPLC)	SYS-IM-7700-E

Service Items:

Item	Service/Part #	Description	Qty	Entitlement	Service Start	Service End
1000	EQO	Enterprise Operational Qualification	1.00	Agreement Entitlement - 100 % covered	12.12.2023	12.12.2023
1010	5185-5850	ICP-MS Checkout Solutions	1.00	Agreement Entitlement - 100 % covered		

Additional Information:

Service Confirmation Number: 6905338201
Service Confirmation Date: 12.12.2023

Service Information:

Problem Description:
WU 00 IM/HPLC-7700-5801143313

Service Provided:
Perform DQ Hardware control test CSD logon, Autosample, iSIS, Auto tune, BG and Stability. After done the instrument BKK_EL0026 calibrated pass all.

Service Overview Code:
Reason Code: Scheduled Service
Diagnosis Code: Scheduled Service
Resolution Code: Scheduled Service

Reported Hours: 6.0	Travel Hours: 1.0	
Customer Field Service Representative Name: Panthea Korasathien	Customer Field Service Representative Signature: <i>Panthea</i>	Date: 12 Dec 2023
Customer Name: Supakorn Mak	Customer Signature: <i>Supakorn</i>	Date: 12 Dec 2023

Additional Comments:



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A Kaengkhon, Saraburi 18110

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Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T231676

Page 1 of 6

Certificate of Calibration

Equipment : HEATING BLOCK
Manufacturer : Environmental Express
Model : SC 196
Serial No. : 6974CECW3285
Customer Code : BKK_EL0054
ID No. : T5306A3
Customer : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd., Khaewang Phatthanakan,
Khet Suan Luang, Bangkok 10250
Customer Location : Acid Digestion Lab
Date of Receipt : 13 September 2023
Calibrated By : Saneek Musikawan (Site Calibration Manager)
Approved By : *Sujjar N.* / Sujjar Nakkakred (Site Calibration Manager)
Date of Issue : 26 SEP 2023
The uncertainties are for a confidence probability of approximately 95%.

REVIEW BY: *Jattaporn C.*
APPROVED BY: *Sujjar N.*
NEXT CAL DATE: 09/09/25

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.



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Certificate No. T231676

Page 2 of 6

Calibration Report

Equipment : HEATING BLOCK
Date of Calibration : 22 September 2023
Environment : Temperature : 21.8-23.1 °C
Line Voltage : 221.6-226.3 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert 20 standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20 .

All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN21-TN30	T230014	17 January 2024
TC	TYPE T	TN31-TN40	T230014	17 January 2024
DATA LOGGER	34970A	T151	T230014	17 January 2024

3. This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC -TISI-TIS 17025 CALIBRATION 0244)

4. Condition of calibrated item : good

Equipment Description :

Time Constant : 2 Hour 20 Minute At 95 °C
Fresh Air Damper : ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

() without adjustment (X) after adjustment

Approved By.

FM-L13 108 30-05-57



Metrological Center

SCI ECO Services Company Limited

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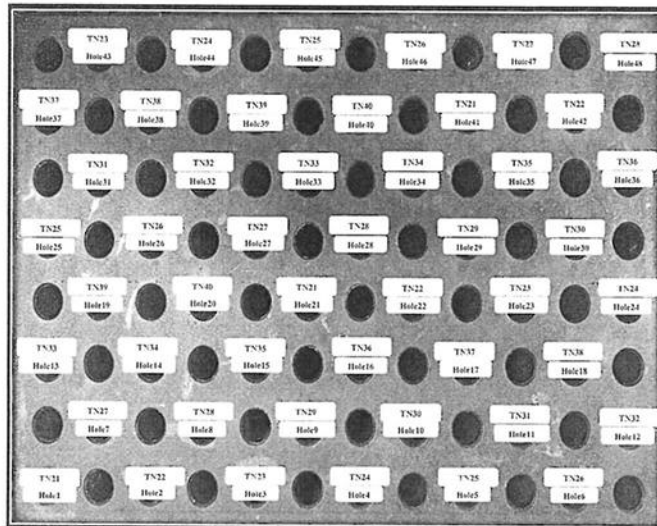
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Certificate No. T231676

Page 3 of 6

Calibration Report



FRONT CONTROL

Approved By.

FM-L13 108 30-05-57



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Certificate No T231676

Page 4 of 6

Calibration Report

Measurement Results						
Calibration Point		Average Standard Reading at each position (°C)				
R1 Hole1-Hole6		TN21	TN22	TN23	TN24	TN25
CAL POINT	Max	95.01	94.41	95.20	95.41	94.51
	Min	94.47	93.95	94.75	94.92	94.00
	Average	94.79	94.18	94.98	95.17	94.26
R2 Hole7-Hole12		TN27	TN28	TN29	TN30	TN31
CAL POINT	Max	95.36	95.43	95.19	95.16	95.35
	Min	94.94	94.95	94.72	94.71	94.90
	Average	95.15	95.19	94.96	94.94	95.13
R3 Hole13-Hole18		TN33	TN34	TN35	TN36	TN37
CAL POINT	Max	95.37	95.50	95.22	95.21	95.33
	Min	94.99	95.09	94.78	94.82	94.88
	Average	95.18	95.30	95.00	95.02	95.11
R4 Hole19-Hole24		TN39	TN40	TN21	TN22	TN23
CAL POINT	Max	95.59	94.42	94.52	94.24	94.63
	Min	95.21	94.06	94.13	93.88	94.28
	Average	95.40	94.24	94.33	94.06	94.45
R5 Hole25-Hole30		TN25	TN26	TN27	TN28	TN29
CAL POINT	Max	95.19	95.18	92.93	95.30	95.14
	Min	94.63	95.03	92.56	94.95	94.79
	Average	95.01	95.20	92.75	95.12	94.96
R6 Hole31-Hole36		TN31	TN32	TN33	TN34	TN35
CAL POINT	Max	94.63	94.90	94.77	94.31	94.24
	Min	94.24	94.55	94.44	93.98	93.92
	Average	94.43	94.72	94.60	94.14	94.08
R7 Hole37-Hole42		TN37	TN38	TN39	TN40	TN21
CAL POINT	Max	94.30	94.44	94.04	93.81	94.19
	Min	93.95	94.05	93.67	93.48	94.39
	Average	94.13	94.24	93.86	93.65	94.64
R8 Hole43-Hole48		TN23	TN24	TN25	TN26	TN27
CAL POINT	Max	95.99	95.63	95.28	95.29	95.45
	Min	95.57	95.15	94.62	94.84	94.99
	Average	95.78	95.39	95.05	95.07	95.22

Approved By.

FM-L13 108 30-05-57



Metrological Center

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Certificate No T231676

Page 5 of 6

Calibration Report

Measurement Results						
Calibration Point		Average Standard Reading at each position (°C)				
R1 Hole1-Hole6		TN21	TN22	TN23	TN24	TN25
CAL POINT	Max	105.33	104.32	105.43	105.25	104.44
	Min	104.94	103.95	105.15	105.04	104.11
	Average	105.09	104.13	105.29	105.15	104.28
R2 Hole7-Hole12		TN27	TN28	TN29	TN30	TN31
CAL POINT	Max	105.30	105.12	105.18	105.22	105.12
	Min	105.11	104.92	104.96	105.00	104.92
	Average	105.20	105.02	105.07	105.11	105.02
R3 Hole13-Hole18		TN33	TN34	TN35	TN36	TN37
CAL POINT	Max	105.37	105.63	105.02	104.80	104.69
	Min	105.17	103.37	104.75	104.59	104.50
	Average	105.27	105.50	104.88	104.69	104.60
R4 Hole19-Hole24		TN39	TN40	TN21	TN22	TN23
CAL POINT	Max	105.31	104.43	106.41	104.71	105.63
	Min	105.08	104.22	106.15	104.41	105.37
	Average	105.19	104.33	106.28	104.56	105.50
R5 Hole25-Hole30		TN25	TN26	TN27	TN28	TN29
CAL POINT	Max	104.95	106.26	103.34	105.78	105.59
	Min	104.67	105.96	103.08	105.56	105.36
	Average	104.81	106.11	103.21	105.67	105.48
R6 Hole31-Hole36		TN31	TN32	TN33	TN34	TN35
CAL POINT	Max	104.75	104.86	104.80	105.20	104.50
	Min	104.54	104.63	104.59	105.00	104.32
	Average	104.65	104.75	104.69	105.10	104.41
R7 Hole37-Hole42		TN37	TN38	TN39	TN40	TN21
CAL POINT	Max	104.30	104.90	104.85	104.65	104.84
	Min	104.09	104.72	104.66	104.49	104.62
	Average	104.19	104.81	104.75	104.57	104.76
R8 Hole43-Hole48		TN23	TN24	TN25	TN26	TN27
CAL POINT	Max	105.71	105.85	105.39	105.61	105.42
	Min	105.45	105.61	105.14	105.27	105.18
	Average	105.58	105.73	105.27	105.44	105.30

Approved By.

FM-L13 108 30-05-57



Metrological Center

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Certificate No. T231676

Page 6 of 6

Calibration Report

Measurement Results:

HEATING BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (°C)	Uncertainty (°C)
	Min, Max	Average		
100.0	100.3 ~ 100.5	100.4	0.26	0.51
107.0	107.0 ~ 107.1	107.1	0.19	0.78

* The quoted uncertainty exclude "u" uniformity.

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k, which for a t-distribution, providing a level of confidence of approximately 95%.

Approved By: _____

FM-L13 B08 30-05-57



Metrology

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Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100

Bangkok Tel : +668 9205 6851 , +669 8247 2360

Website : www.scieco.co.th E-Mail : calibrate@scg.com



Certificate No. T232160

Page 1 of 4

Certificate of Calibration

Equipment : Chamber (Cooling Room)

Manufacturer : KOLDTECH

Model : KM 320

Serial No. : TBN-1012061/05

Customer Code : BKK_EN0167

ID No. : T2463A3

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

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,

Khet Suan Luang, Bangkok 10250

Customer Location : Laboratory

Date of Receipt : 29 November 2023

Calibrated By : Atiphong Rongrat (Technician)

Approved By : _____ / Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 09 JAN 2024

The uncertainties are for a confidence probability of approximately 95%.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrology.

FM-L14 I19/18-08-66



Metrology

SCI ECO Services Company Limited

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Certificate No. T232160

Page 2 of 4

Calibration Report

Equipment : Chamber (Cooling Room)
Date of Calibration : 6 December 2023
Environment : Temperature : 23.4-24.9 °C
Line Voltage : 221.4-230.2 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert 16 standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20 (based on ASTM E145-94 (Reapproved 2001) and AS2853-1986).

All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN161-TN170	T230773	10 April 2024
TC	TYPE T	TN171-TN180	T230773	10 April 2024
DATA LOGGER	34970A	T149	T230773	10 April 2024

3. This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244).

4. Condition of calibrated item : good

Equipment Description :

Time Constant : 1 Hour
Fresh Air Damper : ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

(X) without adjustment () after adjustment

Approved By: _____

FM-L15 I18/18-08-66



Metrology

SCI ECO Services Company Limited

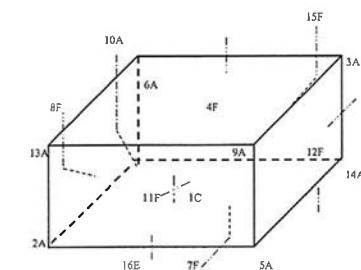
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.



Certificate No. T232160

Page 3 of 4

Calibration Report



C = Centre , F = Centre of Face , A = Corner , E = Centre of Edge

1C = TN161	12F = TN172
2A = TN162	13A = TN173
3A = TN163	14A = TN174
4F = TN164	15F = TN175
5A = TN165	16E = TN176
6A = TN166	
7F = TN167	
8F = TN168	
9A = TN169	
10A = TN170	
11F = TN171	

Approved By: _____

FM-L15 I18/18-08-66



Certificate No. T232160

Page 4 of 4

Calibration Report

Measurement Results

Calibration Point	Average Standard Reading at each position (°C)											
	TN161	TN162	TN163	TN164	TN165	TN166	TN167	TN168	TN169	TN170	TN171	TN172
3.0	2.83	3.34	2.95	3.46	3.45	3.76	3.25	3.46	3.39	3.50	3.58	3.42
	TN173	TN174	TN175	TN176								
	3.33	3.39	3.15	3.43								

Chamber (Cooling Room)			Temperature Distribution					
Setting (°C)	Reading (°C)		Average (°C)	Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage Factor <i>k</i>	
	Min	Max						
3.0	2.8	4.1	3.5	3.36	1.10	2.00	1.90	2.09

The calibration result apply only the above calibrated item.

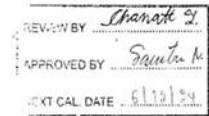
The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 %.

Approved By: 

FM-LIS 118/15-08-66

BKK_EL0128



Performance Verification Certificate for Mercury Analyzer

PRODUCT ID Quicktrace M-8000 , Teledyne Leeman Labs

Equipment ID BKK_EL0128 Mercury Analyzer
S/N: US22133002

BKK_EL0129 Autosampler
S/N: 052222A560

Customer Name ALS Laboratory Group (Thailand) Co., Ltd.
Address 104 Soi Pattana 40, Pattana Rd, Suan Luang, Suan Luang
Bangkok 10250 Thailand

Date of Qualified December 6, 2023
Next Due date December 6, 2024

This certifies for products which was performed in acceptable criteria specifications

Autosampler & Sample Introduction	PASSED
Analyzer	PASSED
Gas Liquid Separator & Dryer	PASSED
CVAFS Detector	PASSED
Electronics/Mechanical	PASSED
Data station/PC	PASSED
Analytical test	PASSED

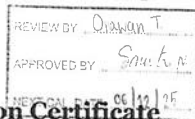
Provided by

Scientist Instrument Co., Ltd.
111 Soi Ekachai 44, Ekachai Road
Khlong Bang Phran, Bangbun
Bangkok 10150 Thailand

Certified by 
Thunraphol Sakdayos
Service Engineer



BKK_EL0128



Performance Verification Certificate for Mercury Analyzer

PRODUCT ID Quicktrace M-8000 , Teledyne Leeman Labs

Equipment ID BKK_EL0128 Mercury Analyzer
S/N: US22133002

BKK_EL0129 Autosampler
S/N: 052222A560

Customer Name ALS Laboratory Group (Thailand) Co., Ltd.
Address 104 Soi Pattana 40, Pattana Rd, Suan Luang, Suan Luang
Bangkok 10250 Thailand

Date of Qualified December 6, 2024
Next Due date December 6, 2025

This certifies for products which was performed in acceptable criteria specifications

Autosampler & Sample Introduction	PASSED
Analyzer	PASSED
Gas Liquid Separator & Dryer	PASSED
CVAFS Detector	PASSED
Electronics/Mechanical	PASSED
Data station/PC	PASSED
Analytical test	PASSED

Provided by

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Certified by 
Thunraphol Sakdayos
Service Engineer



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MTDC: L-0614/2024

Report No.: ALS-799/01

ASI Maintenance Report


Instrument	: Automatic Sample Injector	Measuring	: Vial 40 mL
Model	: ASI-L	Place of Installation	: -
Serial No.	: H57415200799	Department	: LABORATORY
Manufacture	: Shimadzu		


Customer ALS Laboratory Group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaen Suan Luang, Khut Suan Luang,
Bangkok 10250 Thailand

Date of Maintenance : 26 / 06 / 2024

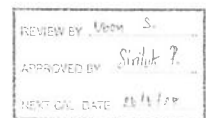
Ambient Condition : Temperature 25.5 ± 5 °C
: Humidifier 58 ± 15 %RH

Maintenance By : 
(Mr. Tawatchai Somri)
Technician

Approved By : 
(Mr. Nipon Phungsomsak)
Technician Manager

User Name : 
(Mr.)

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Prachinburi : 58 M.10, Thabum, Srimahaphote, Prachinburi [T. 037-208-680]

MTOC : L-0614/2024

Report No. : ALS-799/01

Maintenance Sheet

Customer : ALS Laboratory Date : 26 / 06 / 2024
Model : ASI-L Serial No. H57415200799

Item	Carry out maintenance work	Result	Exchange	Comment
1.	Arm Drive section	O.K.		
	Check Arm Drive Belt for wear and tension	O.K.		
	Check grease of Screw Arm Drive	O.K.		
2.	Rinse pump (only ASI-V 24mL, 40mL)	O.K.		
	Check pump rate (>40mL/min)	O.K.		
	Check pump and tube connection for leakage	O.K.		
	Check if outlet flow is in proper condition	O.K.		
3.	Check and if necessary exchange consumable, Maintenance parts	O.K.		See appropriate list of maintenance parts
4.	Check Stirrer [When installed]	O.K.		
5.	Verify ASI function via mechanical check	O.K.		

Inspection by : T. Somri
(Mr. Tawatchai Somri)
Technician

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Prachinburi : 58 M.10, Thabum, Srimahaphote, Prachinburi [T. 037-208-680]

MTOC : L-0614/2024

Report No. : ALS-799/01

List of Consumable, Maintenance parts

Pos.	Part Number	Part Name	Result	Exchange	Recommended Interval
1.	017-27021-01	Grease Paste, Lubricant 100g	O.K.	✓	1 time per year
2.	032-22661-02	Belt, 60S2m596, Arm Drive	O.K.		1 time per year
3.	034-03067-02	Spring, F-642, Arm Drive	O.K.		Depending on condition
4.	042-00405-11	Pump Head, for ASI Rinse Pump (only ASI-V 24mL, 40mL)	O.K.		Depending on condition
5.	638-41448-01	Std. Needle Type1 24mL, 40mL* (for tube 2, 1x1, 6), Sparge needle	N/A		After 300 h of operating
6.	638-41448-02	Std. Needle Type1 125mL* (for tube 2, 1x1, 6)	N/A		Depending on condition
7.	631-41660-03	Flare Pipe 2x1.5x700mm* (for Standard Needle Type1 24mL, 40mL, 125mL)	N/A		Depending on condition (may cut to origin length 600mm)
8.	638-41450-01	Needle for Suspended Particles,* 0.8mm (only ASI-V 24mL, 40mL)	N/A		Depending on condition
9.	638-41450-01	Std. Needle Type2 125mL* (for tube 1.4x0.9)	N/A		Depending on condition
10.	638-41472-01	Std. Needle Type2 24mL, 40mL* (for tube 1.4x0.9)	O.K.		Depending on condition
11.	631-41660-02	Flare Pipe 1.4x0.9x600mm* (for Suspended + Needle Type2)	O.K.		Depending on condition
12.	638-41449-01	Double Needle, only 24mL, 40mL (simultaneous sparge type)*	N/A		Depending on condition
13.	631-41660-01	Flare Pipe 1.1x0.6x600mm* (for Double Needle 24mL, 40mL)	N/A		Depending on condition

*Note: needed parts depending on installed needle types!

Inspection by : T. Somri
(Mr. Tawatchai Somri)
Technician

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Prachinburi : 58 M.10, Thabum, Srimahaphote, Prachinburi [T. 037-208-680]

MTOC : L-0613/2024

Report No. : ALS-416/01

TOC-L Maintenance Report

Instrument : Total Organic Carbon Analyzer Measuring : TC O - 30000 mg/L
Model : TOC-LCSH Place of Installation :-
Serial No. : H54425300416 Department : LABORATORY
Manufacture : Shimadzu

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

Date of Maintenance : 26 / 06 / 2024

Ambient Condition : Temperature 25.5 ± 5 °C
Humidifier 58 ± 15 %RH

Maintenance By : T. Somri
(Mr. Tawatchai Somri)
Technician

Approved By : N. Phongsomsak
(Mr. Nipon Phongsomsak)
Technician Manager

User Name : Sinluk P

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Prachinburi : 58 M.10, Thabum, Srimahaphote, Prachinburi [T. 037-208-680]

MTOC : L-0613/2024

Report No. : ALS-416/01

Maintenance Sheet

Customer : ALS Laboratory Date : 26 / 06 / 2024
Model : TOC-LCSH Serial No. H54425300416

Item	Carry out maintenance work	Result	Exchange	Comment
1.	Check functionality of the device			
	Check furnace temperature (Standard cat. 680 °C / for TN cat. 720 °C)	O.K.		
	Check dehumidifier temperature (1 °C)	O.K.		
	Check the entire flow line related to leakage	O.K.		
	Check baseline status (OK)	O.K.		
	Check carrier gas pressure (200 ± 10 kPa)	O.K.		
	Check carrier gas flow rate (150 mL/min)	O.K.		
2.	Tubes			
	Check all tubing for contamination, if necessary clean them	O.K.		
	Check all tubing for tight connection	O.K.		
3.	Container and Drainage			
	Fill up humidifier with pure water to max. level	O.K.		
	Check filling of dilution water and acid container	O.K.		
	Rinse Drain Pot. after wards refill again with pure water	O.K.		
	Check if outlet flow is in proper conditions	O.K.		
4.	TC and IC Injection			
	Clean injector Block	O.K.		
	Check injector Block for wear	O.K.		
	Check injection tube adjustment	O.K.		
	Check injection for leakage	O.K.		
	Check injection for clogging	O.K.		
5.	IC Measurement (N-type)			
	Check acidification in syringe			
	Check sparging in syringe			
6.	Eye check of 8-Port valve, for sample residues or moist spots that indicate possible leakage	O.K.		
7.	Check and if necessary exchange consumable, Maintenance parts	O.K.		See list of consumable, maintenance parts

Inspection by : T. Somri
(Mr. Tawatchai Somri)
Technician

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Lamphun: 122/5 M.4, Ban Kleng, Muang Lamphun [T. 053-581-870]
Prachinburi: 148 M.10, Thabum, Srimahaphote, Prachinburi [T. 037-206-880]

MTOC: L-0613/2024

Report No.: ALS-416/01

Item	Carry out maintenance work	Result	Exchange	Comment
8.	Due to instrument condition, clean the instrument inside and outside.	O.K.		
9.	After checking the system and exchanging of consumable and maintenance parts a new 1-3 point calibration have to be done.	O.K.		Addition test 1.
10.	After wards the calibration perform check sample measurement.	O.K.		Addition test 2.

Addition test

Test no.	Test conditions	Meas. value	Result
1.	Calibration TC standard solution at 0, 0.1, 0.5, 1, 5, 10, 20 injection volume 50 µL No. of measurement 2 times (Max.3) Criteria: $R^2 = 0.995$ or more	0.9996	Pass
2.	Measurement of reagent water and TC standard solution at 5.0 mg/L injection volume 50 µL No. of measurement 2 times (Max.3) and calculate accuracy by Meas. of TC standard - Meas. of Reagent water Criteria: Accuracy % Recovery 10% or less	5.216 - 0.2800 = 4.936 ppm	Pass

Inspection by: T. Somri
(Mr. Tawatchai Somri)
Technician

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MTOC: L-0613/2024

Report No.: ALS-416/01

List of Consumable, Maintenance parts

Pos.	Part Number	Part Name	Result	Exchange	Recommended Interval
1.	036-11209-84	O-ring, 4D P10A (Viton, for TC/IC Slider)	O.K.	✓	1 time per year, Depending on condition
2.	036-11219-84	O-ring, 4D P20 (for sealing TC-Combustion tube)	O.K.	✓	1 time per year, Depending on condition
3.	638-15025	O-ring, PIFE (for TC/IC Slider)	O.K.	✓	1 time per year, Depending on condition
4.	630-00105-01	Platinum net, (2pcs-set) (to support catalyst)	O.K.	✓	6 month same time as catalyst exchange
5.	630-00557	Silica Wool (to support catalyst)	O.K.	✓	6 month same time as catalyst exchange
6.	630-00992	Halogen Scrubber	O.K.	✓	6 month
7.	630-00996	High Sensitivity TC Catalyst (When installed)	N/A		Depending on condition
8.	638-60116	Regular Catalyst (33g) (When installed)	O.K.	✓	6 month
9.	638-56251-01	8-Port valve rotor	O.K.		1 time per year
10.	638-41323	TC-Combustion Tube	O.K.	✓	6 month same time as catalyst exchange
11.	631-43404-01	Packing, gasket slider (for TC-Injection tube)	O.K.		1 time per year, Depending on condition
12.	638-59296	Syringe 5mL	O.K.		Depending on condition
13.	638-59296-01	Plunger Tip (for syringe 5mL)	O.K.		6 month
14.	042-00405-11	IC reagent supply pump head	O.K.		1 time per year
15.	630-00999	CO2-Absorber (for cell space purge)	O.K.		1 time per year
16.	630-00964	Molecular Sieves 13x	O.K.	✓	1 time per year

Note. Table indicates the guidelines replacement periods when NPOC measurement is performed on sample that are comparatively as clean as tap water, use standard catalyst and at a rate of about 500 sample per month (operating five days a week)

Inspector By: T. Somri
(Mr. Tawatchai Somri)
Technician

SHIMADZU ANALYZER
4/4

TOC-Control L Report

2024-06-26 09:17:13

Information

Instrument: TOC-1010
Operator: T. Somri

Cal. Curve

Sample Name: TOC-1010
Sample ID: TOC-1010
Date: 2024-06-26 09:17:13

Test

Test: TOC-1010

Test 1 (0.000g)

Test: TOC-1010

Test: TOC-1010

Test: TOC-1010

Test: TOC-1010

Test: TOC-1010

Test: TOC-1010

Test: TOC-1010

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Test: TOC-1010

Test: TOC-1010

Test: TOC-1010

Test: TOC-1010

TOC-Control L Report

2014-06-10 10:00:00

Test Information

Equipment Options: TOC-1012-100
Category: TOC-1012-100

Sample

Sample Name: 101-101
Sample ID: 101-101
Group: 101-101
Status: 101-101
C/N Result: 101-101

Type	Area	Method Name	Result
101-101	101-101	101-101	101-101

1. Det

Area: 101-101

Seq	Area	Code	PL	VR	Alt	Ex	Cell Count	Cell Type
1	101-101	101-101	101-101	101-101	101-101	101-101	101-101	101-101



TOC-Control L Report

2014-06-10 10:00:00

Test Information

Equipment Options: TOC-1012-100
Category: TOC-1012-100

Sample

Sample Name: 101-101
Sample ID: 101-101
Group: 101-101
Status: 101-101
C/N Result: 101-101

Type	Area	Method Name	Result
101-101	101-101	101-101	101-101

1. Det

Area: 101-101

Seq	Area	Code	PL	VR	Alt	Ex	Cell Count	Cell Type
1	101-101	101-101	101-101	101-101	101-101	101-101	101-101	101-101

