

ภาคผนวก ง

ใบรับรองการสอบเทียบเครื่องมือ

[illegible]

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Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Running Lab	Total Dissolved Solids (TDS)	Electronic Balance	AVG_E0002	22-Feb-24	22-Feb-25	12
Running Lab	Total Dissolved Solids (TDS)	Hot Air Oven	AVG_E0010	21-Mar-24	21-Mar-25	12
Running Lab	Conductivity	Conductivity meter	AVG_E0020	15-Feb-23	15-Feb-25	24
Running Lab	Electronic Balance	Electronic Balance	AVG_E0002	22-Feb-24	22-Feb-25	12
Running Lab	Oil & Grease	Hot Air Oven	AVG_E0010	21-Mar-24	21-Mar-25	12
Running Lab	Oil & Grease	Water Bath	AVG_E0003	21-Mar-24	21-Mar-25	12
Running Lab	Temperature	Thermometer	AVG_E0009	15-Feb-23	15-Feb-25	24
Running Lab	Blank Hydrogen Nitrogen	Blank Dispersion Unit	AVG_E0028	14-Dec-23	14-Dec-24	12
Running Lab	Total Hydrogen Nitrogen	SP Meter	AVG_E0352	14-Dec-23	14-Dec-24	12
Running Lab	Total Petroleum Hydrocarbon	Electronic Balance	AVG_E0002	22-Feb-24	22-Feb-25	12
Running Lab	Total Petroleum Hydrocarbon	Hot Air Oven	AVG_E0010	21-Mar-24	21-Mar-25	12
Running Lab	Total Petroleum Hydrocarbon	Total Fume Burn	AVG_E0063	15-Feb-23	15-Feb-25	24
Water Lab	Transmembrane Particulate	CF MEM	AVG_E0294	15-Feb-23	15-Feb-24	12
Water Lab	Resuspension Chamber	Light Transmission	BKH_E0016	15-Sep-23	15-Sep-24	12
Water Lab	Barium	CFMS	BKH_E0020	15-Sep-23	15-Jun-25	26
Water Lab	Barium	Hot Block	BKH_E0034	22-Sep-23	22-Mar-25	18
Water Lab	Barium	Chamber (Cooling Room)	BKH_E0037	15-Sep-23	15-Jun-25	26
Water Lab	Lead	CFMS	BKH_E0020	15-Sep-23	15-Jun-25	26
Water Lab	Lead	Hot Block	BKH_E0034	22-Sep-23	22-Mar-25	18
Water Lab	Lead	Chamber (Cooling Room)	BKH_E0037	15-Sep-23	15-Jun-25	26
Water Lab	Manganese	CFMS	BKH_E0020	15-Sep-23	15-Jun-25	26
Water Lab	Manganese	Hot Block	BKH_E0034	22-Sep-23	22-Mar-25	18
Water Lab	Manganese	Chamber (Cooling Room)	BKH_E0037	15-Sep-23	15-Jun-25	26
Water Lab	Copper	CFMS	BKH_E0020	15-Sep-23	15-Jun-25	26
Water Lab	Copper	Hot Block	BKH_E0034	22-Sep-23	22-Mar-25	18
Water Lab	Copper	Chamber (Cooling Room)	BKH_E0037	15-Sep-23	15-Jun-25	26
Water Lab	Nickel	CFMS	BKH_E0020	15-Sep-23	15-Jun-25	26
Water Lab	Nickel	Hot Block	BKH_E0034	22-Sep-23	22-Mar-25	18
Water Lab	Nickel	Chamber (Cooling Room)	BKH_E0037	15-Sep-23	15-Jun-25	26
Water Lab	Barium	CFMS	BKH_E0020	15-Sep-23	15-Jun-25	26
Water Lab	Barium	Hot Block	BKH_E0034	22-Sep-23	22-Mar-25	18
Water Lab	Barium	Chamber (Cooling Room)	BKH_E0037	15-Sep-23	15-Jun-25	26
Water Lab	Selenium	CFMS	BKH_E0020	15-Sep-23	15-Jun-25	26
Water Lab	Selenium	Hot Block	BKH_E0034	22-Sep-23	22-Mar-25	18
Water Lab	Selenium	Chamber (Cooling Room)	BKH_E0037	15-Sep-23	15-Jun-25	26
Water Lab	Barium	CFMS	BKH_E0020	15-Sep-23	15-Jun-25	26
Water Lab	Barium	Hot Block	BKH_E0034	22-Sep-23	22-Mar-25	18
Water Lab	Barium	Chamber (Cooling Room)	BKH_E0037	15-Sep-23	15-Jun-25	26
Water Lab	Cadmium	CFMS	BKH_E0020	15-Sep-23	15-Jun-25	26
Water Lab	Cadmium	Hot Block	BKH_E0034	22-Sep-23	22-Mar-25	18
Water Lab	Cadmium	Chamber (Cooling Room)	BKH_E0037	15-Sep-23	15-Jun-25	26
Water Lab	Lead	CFMS	BKH_E0020	15-Sep-23	15-Jun-25	26
Water Lab	Lead	Hot Block	BKH_E0034	22-Sep-23	22-Mar-25	18
Water Lab	Lead	Chamber (Cooling Room)	BKH_E0037	15-Sep-23	15-Jun-25	26
Water Lab	Chromium	CFMS	BKH_E0020	15-Sep-23	15-Jun-25	26
Water Lab	Chromium	Hot Block	BKH_E0034	22-Sep-23	22-Mar-25	18
Water Lab	Chromium	Chamber (Cooling Room)	BKH_E0037	15-Sep-23	15-Jun-25	26
Water Lab	Chromium	Mercury Analyzer	BKH_E0018	20-Jun-24	20-Jun-24	12
Water Lab	Total Organic Carbon	TOC Analyzer	BKH_E0018	20-Jun-24	20-Jun-24	12

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Reference Stopwatch Data		Console Control	Meter Data
Stopwatch ID No. :	E18051	Dry Gas Meter No. :	BKK_FS0468
Model :	F808	Model :	XC-572-V
Serial No. :	-	Serial No. :	1302005
Calibration Date :	8 Sep 20		
Certificate No.	E-2009018		

Run No.	Time Actual (m:ss.ms)	Time Reading (m:ss)	Diff (ms)	Diff (min)
1	5:00:03	5:00	3	0.00005
2	5:00:09	5:00	8	0.00013
3	5:00:09	5:00	9	0.00015
4	5:00:11	5:00	11	0.00018
5	5:00:05	5:00	5	0.00008
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	5:00:09	5:00	9	0.00015
10	5:00:07	5:00	7	0.00012
			Average	0.00012
			SD	0.00004

Calibrate by: Saksit Phaisarnphut Approved by: Natthapol Jengwareewong
Mr. Saksit Phaisarnphut Mr. Natthapol Jengwareewong
RYG Field Service Scientist (4) RYG Field Service Specialist (1)

CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date	6 Jan 24	Stomach Pressure (mmHg)
Test Car Date	6 Jun 24	Active Immunity (%)
		Temperature (°C)
<u>Console Counter Meter Data</u>		<u>Reference Dry Gas Meter Data</u>
Calibration No	0340124 BFW-FC3456	Reference Dry Gas Meter ID
Dry Gas Meter ID	BFW-FC0468	Serial No
Serial No	130209	Conversion Factor (1)
Model No	FC0212V	Test Gas Meter Date

Run No.	Time (min)	Respiratory Dr. Gas Meter Calibration				Cannula Cuffing, Dräger Meter			
		In (L/min)		Total	SD	Flow (L/min)		Total	SD
		Flow	Volume			Flow	Volume		
15	10:57	150.00	0.00	150.00	0.0	4250.00	4250.00	140.00	2.0
20	8:12	150.00	2.00	150.00	3.0	4250.00	4250.00	143.00	3.0
30	6:28	150.00	0.00	150.00	0.0	4252.14	4250.00	147.00	3.0
40	4:47	150.00	0.00	150.00	0.0	4258.14	4252.33	148.00	3.0
50	4:11	150.00	2.00	150.00	10.0	4258.14	4250.00	149.00	3.0

Ratio of rearing or maintenance to dry gas meter: tolerance for individual values $\pm 1.5\%$ from average

Δp = orifice pressure differential. Math equation for 20, 24 in. of air @ 20°C and 760 mm of mercury, mmH₂O: tolerance for individual values $\pm 1.5\%$

Procedure: Δp (CMH) \div Δp (mmH₂O) = SEC 5.6 T

Calculated by: W. J. G. 10/1/57 W. J. G. 10/1/57 Approved by: N. J. G. 10/1/57

Lab: San Joaquin County San Joaquin County

Anal: Field Service Scientist Field Service Scientist



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	8 Jan 24	Ambient Temperature (°C)	27.3
Calibration sheet No. :	C-080124-BKK_FS0469	Relative Humidity (%) :	35
Digital Temperature ID :	BKK_FS0469	Reference Temperature ID :	RYG_FS0681
Serial No. :	1302005	Serial No. :	201090014018
Model :	XC-572-V	Model :	Digicon-CC-VI-MS
		Next Calibrate :	13 Nov 24

Location	Reference Temperature °C	Digital Temperature °C	Error	MPE	Pass / Fail
Stack	0	0	0	±3	Pass
	25	24	-1	±3	Pass
	50	49	-1	±3	Pass
	100	101	1	±3	Pass
	150	150	0	±3	Pass
	200	200	0	±3	Pass
Probe	250	250	0	±3	Pass
	300	300	0	±3	Pass
	500	501	1	±3	Pass
	100	101	1	±3	Pass
	120	120	0	±3	Pass
	140	140	0	±3	Pass
Oven	100	100	0	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Filter	100	102	2	±3	Pass
	120	121	1	±3	Pass
	140	141	1	±3	Pass
Exit	0	0	0	±3	Pass
	10	9	-1	±3	Pass
	20	19	-1	±3	Pass
Meter	0	-1	-1	±3	Pass
	25	24	-1	±3	Pass
	50	48	-2	±3	Pass
AUX	0	0	0	±3	Pass
	25	24	-1	±3	Pass
	50	49	-1	±3	Pass

MPE : (Maximum permissible error of measurement) ค่าความคลาดเคลื่อนสูงสุดที่อนุญาต

Calibrated by : Saksit Phaisanphut Approved by : Nattapon Jengwareewong
 (Mr. Saksit Phaisanphut) (Mr. Nattapon Jengwareewong)
 RYG Field Service Scientist (4) RYG Field Service Specialist (1)

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



PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date :	8 Jan 24	Nozzle Set ID :	BKK_FS0474
Calibration Sheet No. :	C-080124-BKK_FS0474	Vernier Caliper ID :	BKK_FS1123

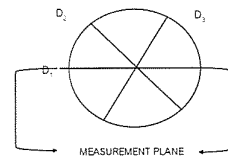
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo ΔD	ID = (D ₁ + D ₂ + D ₃) / 3
	D ₁	D ₂	D ₃		
1	0.305	0.300	0.305	0.005	0.303
2	0.455	0.455	0.455	0.000	0.455
3	0.604	0.602	0.601	0.003	0.602
4	0.760	0.765	0.770	0.010	0.765
5	0.935	0.945	0.935	0.010	0.938
6	1.095	1.098	1.092	0.006	1.095
7	1.260	1.260	1.260	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



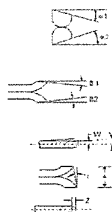
Calibrated by : Saksit Phaisanphut Approved by : Nattapon Jengwareewong
 (Mr. Saksit Phaisanphut) (Mr. Nattapon Jengwareewong)
 Field Scientist (4) Field Specialist (1)

FORM NO. F 06-028 REVISION NO. 1 ISSUE DATE 16/2/23



Type S Pitot Tube Calibration

Date Calibration 8-Jan-24 Due Date 8-Jul-24
 Pitot ID BKK_FS0473 Inclinator ID BKK_FS1131
 Pitot SN - Vernier ID RYG_FS0539



Parameter	Value	Allowable Range	Check
α1	2.5	-10° < α1 < +10°	OK
α2	1.4	-10° < α2 < +10°	OK
β1	-0.8	-5° < β1 < +5°	OK
β2	-0.4	-5° < β2 < +5°	OK
γ	0.3	-	-
θ	0.2	-	-
Z = A tan γ	0.005	Z ≤ 0.125"	OK
W = A tan θ	0.003	W ≤ 0.043"	OK
Dt	0.310	0.188" to 0.375"	OK
A/2Dt	1.484	1.05 ≤ PA/Dt ≤ 1.5	OK
A	0.92	2.1Dt ≤ A ≤ 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 fact of 0.84. See 40 CFR Pt. 60, App. A, EPA Method 2.

Calibrated by : Saksit Phaisanphut Approved by : Nattapon Jengwareewong
 (Mr. Saksit Phaisanphut) (Mr. Nattapon Jengwareewong)
 RYG Field Services Scientist (4) RYG Field Services Specialist (1)

FORM NO. F 06-124 REVISION NO. 0 ISSUE DATE 25/12/23



Calibration Certificate

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

Instrument description : Flue Gas Analyzer
 Instrument model : Testo 340
 Control unit serial no. :
 Instrument serial no. : 62150585
 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

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 60.14, 302, 1003 ppm) Nitric Oxide 10.01, 151.5, 322.5 ppm, Sulphur Dioxide 50.36, 100.8, 600.8 ppm)

Condition of UUC. : Used
 Ambient condition : All of the Measurement were carried out the stabilized laboratory
 Temperature : 23 ± 5 °C
 Humidity : 55 ± 15 %RH
 Calibration place : 17/121 So Ngamwongwan 47 Yaek 48, Toongsonghong, Lakso, Bangkok 10210

Calibration procedure no. : This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no. WI-CL-28-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%. This certificate is applied only to item under test Environmental condition. This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature and seal not valid and The results relate only to the items tested calibrated. 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

Kwanthong Nongluck
 Mr. Kwanthong Khamsoung Ms. Nongluck Wongsettee
 Calibration Technician Technical Manager

FORM-CL-05-C Rev B

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Issued Date 26/02/16

Entech Industrial Solution Co., Ltd.

17/121 So Ngamwongwan 47 Yaek 48 Toongsonghong, Lakso, Bangkok 10210 Thailand Tel: 0 2779-88888 Calibration@entech.co.th
 Fax: 0 21055350355591 www.entech.co.th



Certificate No.: G 670124

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.50 % Vol	2412/23	Linde	27-Aug-27
Oxygen (O ₂) 10.04 % Vol	CG-0153-21	Nmt	18-Nov-26
Oxygen (O ₂) 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	22-Jan-25
Nitric Oxide (NO) 322.5 ppm	1974/23	Linde	17-Jul-25
Sulphur Dioxide (SO ₂) 50.36 ppm	2004/23	Linde	17-Jul-25
Sulphur Dioxide (SO ₂) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide (SO ₂) 600.8 ppm	2003/23	Linde	17-Jul-25

Measured room conditions

Temperature : 22.7 °C Humidity : 60.2 %RH Pressure : 1011.8 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 600 ml/min Gas pressure : 1014.1 mbar

Calibration Results (Without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O ₂ (%Vol)	2.50	2.44	-0.06	0.15
O ₂ (%Vol)	10.04	9.92	-0.12	0.20
O ₂ (%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	8.0
NO (ppm)	151.5	151	-0.5	8.0
NO (ppm)	322.5	321	-1.5	12
SO ₂ (ppm)	50.36	52	1.64	6.0
SO ₂ (ppm)	100.8	102	1.2	6.0
SO ₂ (ppm)	600.8	604	3.2	13

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

End of Report

FM-CL-09-C Rev.8

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Issued Date 26/02/16

Entech Industrial Solution Co., Ltd.

17/121 Soi Niamwongwong 47, Yank 48, Toonsongrong, Laksi, Bangkok 10210 THAILAND Tel: 0-2779-8888 Calibration@entech.co.th
Tax ID: 0106536035591 www.entech.co.th

MULTI-POINT CALIBRATION REPORT

CUSTOMER NAME : ALS Laboratory Group (Thailand) Co.Ltd

EQUIPMENT NAME : CO Analyzer

MANUFACTURER : Teledyne - API

MODEL : T300

SERIAL NO. : 1215

STANDARD GAS CONCENTRATION (PPM) : 4512

CERTIFIED DATE : CC745109

CYLINDER PRESSURE (psig) : 500

CERTIFIED DATE : Mar 10 2021

CERTIFIED BY : AIRGAS SPECIALTY GASES

EXPIRED DATE : Mar 10 2029

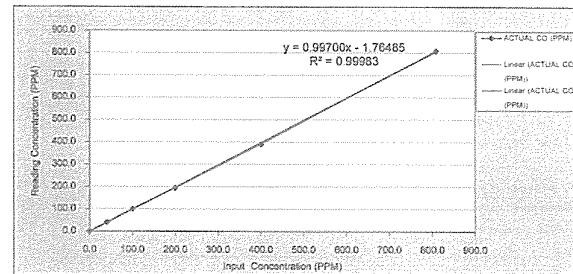
CALIBRATION RESULTS

POINT NO	CALIBRATION RESULTS			
	IDEAL (PPM)	ACTUAL CO (PPM)	ERROR CO (PPM)	% ERROR CO
ZERO	0.000	0.003	0.003	0.000
1	40.000	40.110	0.110	0.275
2	100.000	99.868	-0.132	-0.132
3	199.200	194.462	-4.738	-2.379
4	400.600	390.569	-10.031	-2.504
5	808.900	808.458	-0.442	-0.055
AVERAGE (%)				0.891

REVIEW BY : Thavitak

APPROVED BY : P. P.

NEXT CAL DATE : 15 Dec 2024



CALIBRATED BY : คุณพรชัย ภาตธนาภักดิ์

DATE : 13 มิถุนายน 2566

ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : คุณพรชัย ภาตธนาภักดิ์ โทรศัพท์ 02-515-8987

เลขที่ 388 ถนนวิภาวดีรังสิต แขวงจันทน์เกษม เขตจตุจักร กรุงเทพฯ 10900 โทรศัพท์ 0-2515-8999 โทรสาร 0-2515-8988 E-Mail: info@kinetics.co.th

รายงานผลการซ่อมและปรับเทียบอุปกรณ์ตรวจวัดคุณภาพอากาศ

ลูกค้า : หน่วยงาน : ALS Laboratory Group (Thailand) Co.Ltd

รายชื่ออุปกรณ์ : เครื่องมือ : CO Analyzer

รุ่นของอุปกรณ์ : เครื่องมือ : T300

วันที่ : 13 มิถุนายน 2566

บริษัทผู้ผลิต : Teledyne API

หมายเลขอุปกรณ์ : เครื่องมือ : 1215

TEST VALUES			
API MODEL T300	BEFORE	AFTER	
1. RANGE	1 - 1000 PPM	100.0	100.0
2. STABILITY	≤ 1 PPM	0.011	0.009
3. CO MEASURE	2500 - 4800 mV	3232.1	3547.0
4. CO REFERENCE	2000 - 4800 mV	2992.6	2932.0
5. VR RATIO	1.1 - 1.3	1.217	1.218
6. PRESSURE	25 - 35 in - Hg A	29.3	29.2
7. SAMPLE FLOW	800 ± 10% cc/min	796	801
8. SAMPLE TEMP	48 ± 2 °C	45.4	45.0
9. BENCH TEMP	48 ± 2 °C	48.0	48.0
10. WHEEL TEMP	68 ± 2 °C	68.0	68.0
11. BOX TEMP	AMBIENT ± 5 °C	33.5	29.6
12. PWT DRIVE	250 - 4750 mV	4372.1	4769.3
13. CO SLOPE	1.0 ± 0.3	0.915	0.907
14. CO OFFSET	0.0 ± 0.3	0.006	0.000
15. CO READING (AMBIENT)	PPM	0.981	0.467
16. ELECTRICAL TEST	40 ± 2 PPM	39.826	41.054
17. VOLTAGE TEST	+5 V - +12 V - +15 V - +5 V	0.21 / 12.15 / 16.78 / 15.28	0.21 / 12.15 / 16.78 / 15.28
18. ZERO GAS	0.00 PPM	0.362	0.003
19. SPAN GAS	40.0 PPM	39.399	40.110

หมายเหตุ

ค่าการปรับเทียบเครื่องมือเป็นของ Ozone 2 ชั้น SS 500 และ 1 ชั้น 500 และ 1 ชั้น

(คุณพรชัย ภาตธนาภักดิ์)
กรรมการผู้จัดการ (Signature)

ต้องการข้อมูลเพิ่มเติมทางด้านเทคนิค กรุณาติดต่อ : คุณพรชัย ภาตธนาภักดิ์ โทรศัพท์ 0-2515-8987

เลขที่ 388 ถนนวิภาวดีรังสิต แขวงจันทน์เกษม เขตจตุจักร กรุงเทพฯ 10900 โทรศัพท์ 0-2515-8999 โทรสาร 0-2515-8988 E-Mail: info@kinetics.co.th



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE

MANUFACTURER : DWYER

MODEL / TYPE : DPGA-00

SERIAL NO. : DVG08(BKK_F50483)

CLID. NO. : 212300280

JOB CONTROL NO. : 230211016392

CUSTOMER : ALS LABORATORY GROUP (THAILAND) CO., LTD.

104 PHATTHANAKAN 40, PHATTHANAKAN RD.,

KHWAENG PHATTHANAKAN, KHET SUAN LUANG, BANGKOK 10250, THAILAND

DATE OF RECEIVED : 11 February 2023

DATE OF ISSUED : 16 February 2023

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

Calibrated By : Sitipong Pimdee
Calibration Engineer

(Signature)



Approved By : Mongkol Yotsoontorn
Authorized Signatory
16 February 2023

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. Q23016392

F3-011-8491-12

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CALIBRATION LABORATORY CO., LTD.

210-11-14 55 Soi Prasert Manukit 29 Yaei 4 Prasert Manukit Rd. Ladphrao, Bangkok 10230
Tel: 02-578-0353-4 Fax: 02-578-2672 www.cal-lab.co.th E-mail: sales@cal-lab.co.th



CALIBRATION LABORATORY CO., LTD.

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Tel: 02-578-0353-4 Fax: 02-578-2672 www.cal-lab.co.th E-mail: sales@cal-lab.co.th



REPORT OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : DWYER
MODEL / TYPE : DPGA-00
SERIAL NO. : DVG08[BKK_FS0483]
DATE OF CALIBRATION : 14 February 2023

ENVIRONMENT CONDITIONS :

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

PROCEDURE USED :

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

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

REFERENCE STANDARD USED :

Document Process Calibrator, Fluke Model 744 SN: 9226007 with Pressure Module Model 706PV4 SN: 1929401.

TRACEABILITY :

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

UNCERTAINTY :

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

Certificate No. Q23016392

F3-011-04-01-12

page 2 of 3



CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

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

CALIBRATION DATA

CORRECTION OF PRESSURE

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

Uncertainty of measurement ± 0.007 inHg

Transmitting fluid : Air

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

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

End of Certificate

Certificate No. Q23016392

F3-011-04-01-12

page 3 of 3



Certificate of Calibration

Equipment: SPECTROPHOTOMETER
Model: 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 $^\circ\text{C}$ ± 0.2
Humidity 65.3 $\% \text{RH}$ ± 1.5

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 Rungreusang

Calibration Date: 18 September 2023

The Method used: In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04

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

The standard for Wavelength Certificate No. 111583 and 111584
The standard for Photometric Certificate No. 9114984 and 111588
The standard for Stray Light Certificate No. 111586 and 111585
The standard for Spectral resolution Certificate No. 111587

(Mr. Nattapat Rungreusang)
Person in charge

(Mr. Nitinun Srihawan)
Authorized signatory

This certificate is issued in 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.

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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	0.518	-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
	0.2516	0.250	0.0016	0.0045
	0.4595	0.462	-0.0025	0.0045
	0.9334	0.933	0.0004	0.0045
545.1 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
	0.2584	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
	0.2578	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

Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
235 nm	0.0000	0.000	0.0000	0.0080
	0.7355	0.737	-0.0015	0.0090
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
	0.2894	0.280	-0.0036	0.0080
350 nm	0.0000	0.000	0.0000	0.0080
	0.6374	0.637	0.0004	0.0080
Spectral Resolution *				
Nominal Concentration 0.02 % v/v	Peak	Trough	Ratio	SBW
Standard Wavelength (nm)	268.66	269.69	1.38	2.00
UUC: Wavelength (nm)	268.2	266.1		
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

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CAL-FM-C06-15: 12 Sep 2022



ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00005362

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR8000

หมายเลขเครื่อง: 1627845

การตรวจสอบ (วัน)		การตรวจสอบ (ค่า)		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 checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิตช์ ปิด - เปิด เครื่อง (On-Off Switch)	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	
Spectrophotometer				
<input type="checkbox"/>	<input type="checkbox"/>	6. แบตเตอรี่ (Battery Backup) >= 2.5 VDC	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	7. ความแม่นยำความยาวคลื่น (Wavelength Control)	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input checked="" type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	<input type="checkbox"/>	9.2 Hours
<input type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	<input type="checkbox"/>	741.5 Hours
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. ช่องใส่ตัวอย่าง (Carousel Module)	<input checked="" 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"/>	13. ระดับสารละลายใน Electrode (Level KCl)	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	14. ฝาปิดกันฝุ่น Electrode (Dust Protection Hood)	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาตั้งอิเล็กโทรด (Stand)	<input type="checkbox"/>	
Turbidimeter				
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นที่หาได้ (No Sample)	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่นับ 3.0)	<input type="checkbox"/>	
Automatic titrator				
<input type="checkbox"/>	<input type="checkbox"/>	18. ฝาปิด Burette	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	19. Function Rinsing and Dosing	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	20. ระบบท่อจ่ายและอุปกรณ์ประกอบ	<input type="checkbox"/>	

เชื้อเพลิงมาตรฐาน: *656.1กWh=656.1kWh

*486.0กWh=486.0kWh

Mr.Nattapat Rungrasang
Service Engineer

บริษัท ดีเคเอส อีเซีย จำกัด
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CAL-FM-R31-03: 29 Jul 2022

Sartorius (Thailand) Co., Ltd.
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SARTORIUS

Certificate of Calibration

Model Number: MSU2245-100-DU
Description: Analytical Balance
Serial Number: 0031709552
ID No.: RYG_EN0003
Manufacturer: Sartorius

Certificate No.: 24BCI0073
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.Pluek Daeng, Rayong 21140, Thailand.

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

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

Calibration Procedure No.: This calibration was conducted by
Using in-house calibration procedure number (WH-003)
Based on UKAS LAB 14: 2015

Metrolological data:
Capacity: 220 g Readability: 0.0001 g

Reasons for calibration
☐ New Installation ☐ Service / Repair ☒ Re-calibration Maintenance

Ambients Conditions:
Temperature: 23.7 °C ± 5.0 °C
Humidity: 62.0 % RH ± 10.0 % RH
Pressure: 1013.25 hPa ± 0.1 hPa

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 realize the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came form list of Sartorius Metrolological Specifications.

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YC5011-522-00	Sartorius weight set 1mg - 5000g E2, YC5011-522-00	TCS	M2308197S	23-Aug-2026
MHB-382SD	Humidity/Balometer/Temp. Lutron MHB-382SD	DKSH	C18231845	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.chonchal inthana(Technical Manager)



Sartorius (Thailand) Co., Ltd.
123 Rama 9 Road, Huaykwang, Bangkok 10310
Tel: +66 2043 8351-6, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number: MSU2245-100-DU
Description: Analytical Balance
Serial Number: 0031709552
ID No.: RYG_EN0003
Manufacturer: Sartorius

Certificate No.: 24BCI0073
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 results under constant test 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 reproducibility quantitatively.			The eccentric loading error is yielded by the difference between the midpoint 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 g	200.0001 g	Nominal value :	100 g	
20 g	20.0000	200.0000	Tolerance :	0.0004 g	
0.0001 g	20.0001	200.0001			
	20.0000	200.0001			
	20.0000	200.0001			
	20.0000	200.0001			
	20.0000	200.0001			
Nominal Value : (High Load)	200 g	200.0001 g			
200 g	19.9999	200.0001			
0.0001 g	20.0000	200.0000			
	20.0000	200.0000			
	20.0000	200.0000			
	20.0000	200.0000			
	20.0000	200.0000			
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	0.0013
0.5	0.5000	0.5000	0.0000	0.0013
1	1.0000	1.0000	0.0000	0.0013
5	5.0000	5.0000	0.0000	0.0013
10	10.0000	10.0000	0.0000	0.0013
20	20.0000	20.0000	0.0000	0.0013
50	50.0000	50.0000	0.0000	0.0024
100	100.0000	99.9999	-0.0001	0.0018
200	200.0000	199.9999	-0.0001	0.0029

End of Report.

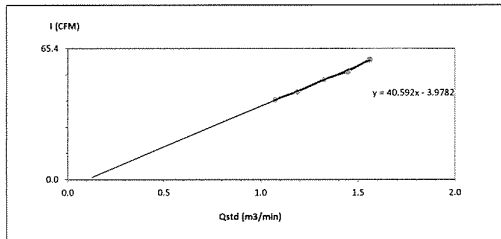
SOP FM 33 03 February 2022



High Volume Air Sampler Calibration Worksheet

Project Site : Siam Polystyrene Co., Ltd. Barometric Pressure (mm Hg) : 751
Calibrate Location : บริเวณด้านทิศตะวันตกของบริเวณ Temperature (°C) : 31.5
Calibrate Date : 9-Jun-24 High Volume ID : RYG_FS0664
Calibration Sheet No. : C-090624-RYG_FS0664 High Volume Model : TE-5009X
Calibrator ID : RYG_FS0205 High Volume S/N : 6261
Calibrator Model : TE-5028A Calibrator Slope : 1.52567
Calibrator S/N : 1166 Calibrator Intercept : -0.03613

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.6	1.0755	40	Slope : 40.5921 Intercept : -3.9782 Correlation Coefficient : 0.9975
2	3.2	1.1892	44	
3	4.0	1.3253	50	
4	4.8	1.4483	54	
5	5.6	1.5614	60	



Calibrated by : จตุพร ชัย
(Mr.Chatchai Sukpia)
Field Scientist(1)

Approved by : นพปง จันตารูป
(Mr.Noppong Jantarupan)
Enviro Field Coordinator Scientist (3)

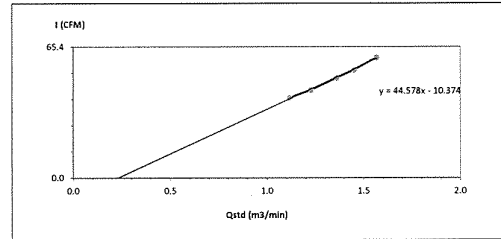
FORM NO.: F 06-073 REVISION NO.:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Siam Styrene Monomer Co., Ltd. Barometric Pressure (mm Hg) : 757
Calibrate Location : บ้านอ่าวไร่หวด (โรงหมักยางสังเคราะห์) Temperature (°C) : 32
Calibrate Date : 9-Jun-24 High Volume ID : RYG_FS0395
Calibration Sheet No. : C-090624-RYG_FS0395 High Volume Model : TE-5170D
Calibrator ID : RYG_FS0205 High Volume S/N : 5692
Calibrator Model : TE-5028A Calibrator Slope : 1.52567
Calibrator S/N : 1166 Calibrator Intercept : -0.03613

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.8	1.1181	40	Slope : 44.5782 Intercept : -10.3737 Correlation Coefficient : 0.9980
2	3.4	1.2284	44	
3	4.2	1.3613	50	
4	4.8	1.4528	54	
5	5.6	1.5663	60	



Calibrated by : จตุพร ชัย
(Mr.Chatchai Sukpia)
Field Scientist(1)

Approved by : นพปง จันตารูป
(Mr.Noppong Jantarupan)
Enviro Field Coordinator Scientist (3)

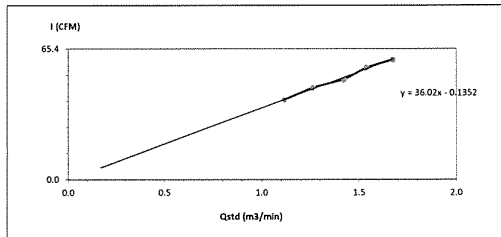
FORM NO.: F 06-073 REVISION NO.:2 ISSUE DATE: 20/11/23



High Volume Air Sampler Calibration Worksheet

Project Site : Siam Styrene Monomer Co., Ltd. Barometric Pressure (mm Hg) : 754.6
Calibrate Location : บ้านนาตาหลวง Temperature (°C) : 31
Calibrate Date : 8-Jun-24 High Volume ID : RYG_FS0662
Calibration Sheet No. : C-080624-RYG_FS0662 High Volume Model : TE-5009X
Calibrator ID : RYG_FS0205 High Volume S/N : 6259
Calibrator Model : TE-5028A Calibrator Slope : 1.52567
Calibrator S/N : 1166 Calibrator Intercept : -0.03613

Test No.	Delta H ₂ O (Inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.8	1.1182	40	Slope : 36.0195 Intercept : -0.1352 Correlation Coefficient : 0.9956
2	3.6	1.2039	46	
3	4.6	1.4230	50	
4	5.4	1.5388	56	
5	6.4	1.6720	60	



Calibrated by : จตุพร ชัย
(Mr.Chatchai Sukpia)
Field Scientist(1)

Approved by : นพปง จันตารูป
(Mr.Noppong Jantarupan)
Enviro Field Coordinator Scientist (3)

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

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129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2043 8361-6, e-mail: service.thailand@sartorius.com



SARTORIUS
NSC-T151715 17025
CALIBRATION 0426

Certificate of Calibration

Model Number : LA1305-F Certificate No. : 24BC10058
Description : Analytical Balance Issued Date : Friday, February 23, 2024
Serial Number : 25409664 Reference No. : 229198
ID No. : RYG_EN0001
Manufacturer : Sartorius Page No. : 1 of 1

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

Metrological data : Capacity : 150 g Readability : 0.0001 g
Reasons for calibration : ☐ New Installation ☐ Service / Repaired ☒ Re-calibration/ Maintenance
Ambients Conditions : Temperature : 23.6 °C ± 5.0 °C
Humidity : 54.0 % RH ± 10.0 % RH
Pressure : ± ±
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	C19231845	23-Aug-2024

This certificate relate and apply this equipment only.
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Sartorius (Thailand) Co., Ltd.

Mr.Chenchai Inthana(Technical Manager)



SOP FM 33 03 February 2022

Certificate of Calibration

Model Number: LA130S-F
Description: Analytical Balance
Serial Number: 25409854
ID No.: RYG_EN0001
Manufacturer: Sartorius

Certificate No.: 24BCI0088
Issued Date: Friday, February 23, 2024
Reference No.: 229195
Page No.: 2 of 2

Calibration Results : Without Adjustment

Repeatability

The repeatability is the ability of a weighing instrument to display nearly identical readings under constant test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability 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	100.0000
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 result of the load (i.e. 10g or 100g of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to GNM, R76).

Nominal value :	50 g	
Tolerance	0.0004 g	
		Difference
	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 31 03 February 2022

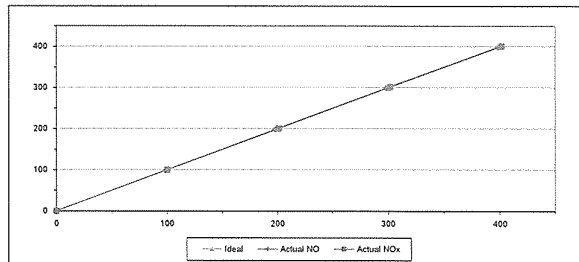


MULTIPOINT CALIBRATION REPORT

Calibration Date: 4-Jan-24
Manufacturer: HORIBA
Serial No.: BEEAW3E
Calibrator Manufacturer: Teledyne API
Serial No.: 947
Std. Gas Concentration (PPM): 55.88
Cylinder Pressure (psi): 1800
Certified Date: 9-Feb-22

Equipment Name: NOx Analyzer
Model: APNA-370
Equipment ID: RYG_F50261
Model: 700
Cylinder No.: GN0027222
Certified By: Aigas Inc.
Expired Date: 9-Feb-30

Point	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.70	-1.30	-1.30	100.20	0.20	0.20
2	200.00	197.70	-2.30	-1.15	201.50	1.50	0.75
3	300.00	298.10	-1.90	-0.63	302.00	2.00	0.67
4	400.00	398.50	-1.50	-0.38	401.40	1.40	0.35
AVERAGE (%)				-0.87			0.41



Calibrated By

Approved By

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

(Mr.Sarayuth Jitranont)
Assistant General Manager

ALS Laboratory Group

FORM NO : F 05-056 REVISION NO : ISSUE DATE 02/04/12

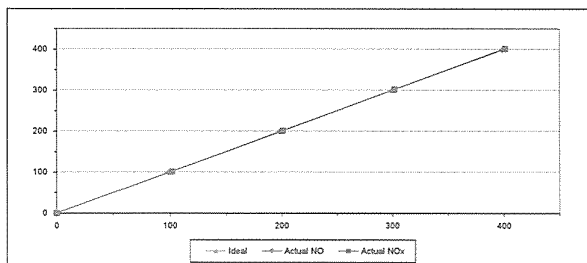


MULTIPOINT CALIBRATION REPORT

Calibration Date: 4-Jan-24
Manufacturer: HORIBA
Serial No.: ALPOVOWY
Calibrator Manufacturer: Teledyne API
Serial No.: 947
Std. Gas Concentration (PPM): 55.88
Cylinder Pressure (psi): 1800
Certified Date: 9-Feb-22

Equipment Name: NOx Analyzer
Model: APNA-370
Equipment ID: RYG_F50455
Model: 700
Cylinder No.: GN0027222
Certified By: Aigas Inc.
Expired Date: 9-Feb-30

Point	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.60	-1.40	-1.40	101.60	1.60	1.60
2	200.00	198.80	-1.20	-0.60	201.20	1.20	0.60
3	300.00	301.00	1.00	0.33	301.80	1.80	0.60
4	400.00	398.50	-1.50	-0.38	401.30	1.30	0.33
AVERAGE (%)				-0.39			0.64



Calibrated By

Approved By

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

(Mr.Sarayuth Jitranont)
Assistant General Manager

ALS Laboratory Group

FORM NO : F 05-056 REVISION NO : ISSUE DATE 02/04/12

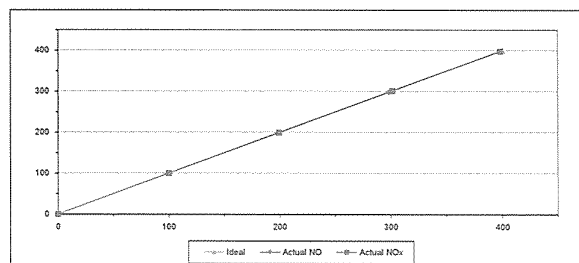


MULTIPOINT CALIBRATION REPORT

Calibration Date: 4-Jan-24
Manufacturer: HORIBA
Serial No.: 8G314J3K
Calibrator Manufacturer: Teledyne API
Serial No.: 947
Std. Gas Concentration (PPM): 55.88
Cylinder Pressure (psi): 1800
Certified Date: 9-Feb-22

Equipment Name: NOx Analyzer
Model: APNA-370
Equipment ID: RYG_F50264
Model: 700
Cylinder No.: GN0027222
Certified By: Aigas Inc.
Expired Date: 9-Feb-30

Point	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.05	0.05	0.05	0.10	0.10	0.10
1	100.00	99.20	-0.80	-0.80	100.10	0.10	0.10
2	200.00	198.50	-1.50	-0.75	199.30	-0.70	-0.35
3	300.00	298.60	-1.40	-0.47	301.50	1.50	0.50
4	400.00	398.20	-1.80	-0.45	398.00	-2.00	-0.50
AVERAGE (%)				-0.48			-0.03



Calibrated By

Approved By

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

(Mr.Sarayuth Jitranont)
Assistant General Manager

ALS Laboratory Group

FORM NO : F 05-056 REVISION NO : ISSUE DATE 02/04/12

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE
SERIAL NUMBER
ID NUMBER
CONDITION AS-RECEIVED
CUSTOMER

Cup anemometer
Novalyne
Sensor: WS-027
Data logger: 200-WS-2518
Sensor:
Data logger: AS376
RYG_150414
Used item
ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan Rd., Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand

Calibration procedure:
The cup anemometer was calibrated against Standard air velocity transducer model: 445551-2 and pitot tube with precision differential pressure meter model: DPA2500 in an open test section of Effel-type wind tunnel with 300 cm² cross test section area. The Wt-CI-007 based on IEC 61400-12-1. Wind energy generation systems - Part 12-1. Power performance measurements of electricity producing wind turbines. March 2017 was used as calibration guideline.

Traceability:
This certificate provides a traceability of the measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) with Certificate Number: NIMT-0053-21 and NIMT-0066-22

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

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

27 Jan 2023
10 Feb 2023
10 Feb 2023

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:
Temperature
Relative Humidity
Atmospheric Pressure

23.0 ± 3.0 °C
55.0 ± 15.0 %RH
1010 ± 10 hPa

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

CALIBRATION CONDITIONS

Wind tunnel cross-section area ¹	500	cm ²
Win direction frontal area ²	100	cm ²
Diameter of mounting pipe ³	0.111	mm
Blockage ratio of test object ⁴	0.111	[-]

Preconditioning
Measurement Condition

24 hours at ambient conditions
The average values during measurement are (24.1) °C, (47.6) %RH and (1014.7) hPa.

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

Calibrated by:
[X] Mr. Sorawit Thachakul
[X] Miss Jiraporn Lerksomphol



Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

Remarks:
¹ Hoely 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 $\frac{A_o}{A_t}$

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

Certificate Number

CL-021-66

Page 2 of 2 Pages

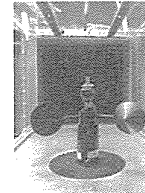
MEASUREMENT RESULTS¹

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

v_{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v_{ref} (m/s)	Error (m/s)	U (k=2) (m/s)
0.585	24.10	24.10	0.8	-0.2	0.35
2.033	24.10	24.10	1.9	-0.1	0.16
3.040	23.94	24.10	3.0	-0.1	0.23
4.134	24.10	24.10	4.0	-0.1	0.20
4.99	23.92	24.10	4.9	-0.1	0.44
5.58	24.10	24.10	6.0	0.0	0.18
7.05	23.90	24.10	7.0	-0.1	0.36
8.19	24.06	24.10	8.2	0.0	0.26
9.09	23.94	24.10	9.1	0.0	0.34
10.09	23.92	24.10	10.0	-0.0	0.28
11.15	23.80	24.10	11.1	0.0	0.45
12.14	23.80	24.10	12.2	0.0	0.31
13.10	23.80	24.10	13.2	0.0	0.47
14.26	23.74	24.10	14.3	0.0	0.42
15.25	23.78	24.10	15.1	-0.1	0.66
16.28	23.70	24.10	16.3	0.0	0.56

Remarks:
¹ Calibration results only count 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. Remark: The proportion of the set-up is not true to scale due to space limitation.



CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE
SERIAL NUMBER
ID NUMBER
CONDITION AS-RECEIVED
CUSTOMER

Wind Direction Sensor
Novalyne
Sensor: WS-027
Data logger: 200-WS-2518
Sensor:
Data logger: AS376
RYG_150414
Used item
ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan Rd., Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder, model: AS400975-0044 RS 5.0 in an open test section of Effel-type wind tunnel with 300 cm² cross test section area. The Wt-CI-008 based on IEC 61400-12-1. Wind energy generation systems - Part 12-1. Power performance measurements of electricity producing wind turbines. March 2017 was used as calibration guideline.

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

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

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

27 Jan 2023
10 Feb 2023
10 Feb 2023

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:
Temperature
Relative Humidity
Atmospheric Pressure

23.0 ± 3.0 °C
55.0 ± 15.0 %RH
1010 ± 10 hPa

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

CALIBRATION CONDITION

Wind tunnel cross-section area ¹	900	cm ²
Win direction frontal area ²	129	cm ²
Diameter of mounting pipe ³	0.143	mm
Blockage ratio of test object ⁴	0.143	[-]

Preconditioning
Measurement Condition

24 hours at ambient conditions
The average values during measurement are (24.0) °C, (40.0) %RH and (1014.1) hPa.

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

Calibrated by:
[X] Mr. Sorawit Thachakul
[X] Miss Jiraporn Lerksomphol



Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

Remarks:
¹ Hoely 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 $\frac{A_o}{A_t}$

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

Certificate Number

CL-019-66

Page 2 of 2 Pages

MEASUREMENT 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 counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below

Air speed m/s	D_{ref} Degree (°)	D_{ref} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	0.000	0	0	0.58
	45.000	41	-4	0.58
	90.000	87	-3	0.58
4.99	135.001	132	-3	0.68
	180.000	179	-1	0.74
	225.000	227	2	0.91
	270.001	273	3	0.58
	315.000	318	3	0.74

Remarks:
¹ Calibration results only count 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.
63/14-15, 67/35-36
Petchburi 7/1, Rd. Wattana, Bangkok
Bangkok 10500 (Thailand)
Tel: +66(0)80912
Mobile: +66(0)999451
E-mail: jna-calibration@jirantee.com
Web site: www.jirantee.com

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

Air speed measurement laboratory
Calibration services department

REVIEW BY: *[Signature]*
APPROVED BY: *[Signature]*
NEXT CAL DATE: 18/2/25

Certificate Number

CWS-003-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

PLACE OF CALIBRATION

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

CALIBRATION CONDITIONS

Wind tunnel cross-section area: 900 cm²
Win direction frontal area: 100 cm²
Diameter of mounting pipe: mm
Blockage ratio of test object: 0.111 [-]

Preconditioning

Measurement Condition

24 hour at ambient conditions.
The average values during measurement are (24.3) °C, (43.1) %RH and (1055.59) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☒ Mr. Sorawit Thachulad
☐ Miss Jitraporn Jertsomphol

Remarks:

- *Nozzle cross-section area of the wind tunnel
- *Projector cross-section area of the tested object include mounting pipe
- *Diameter of mounting pipe
- *Ratio 1 to 1



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

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-003-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

V_{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{UUC} (m/s)	Error (m/s)	U (k=2) (m/s)
1.032	24.30	24.30	0.9	-0.1	0.31
2.055	24.54	24.30	1.9	-0.2	0.31
3.000	24.08	24.30	2.9	-0.1	0.31
4.220	24.04	24.30	4.0	-0.2	0.31
5.000	23.76	24.30	4.9	-0.1	0.31
5.97	23.82	24.30	5.9	-0.1	0.31
7.01	23.76	24.30	6.9	-0.1	0.31
8.13	24.00	24.30	8.0	-0.1	0.31
9.07	23.82	24.30	9.0	-0.1	0.31
10.07	23.90	24.30	9.9	-0.1	0.31
11.13	23.84	24.30	11.1	0.0	0.31
12.13	23.80	24.30	12.0	-0.1	0.31
13.19	23.82	24.30	13.2	0.0	0.31
14.24	23.74	24.30	14.1	-0.1	0.31
15.20	23.80	24.30	15.2	0.0	0.31
16.26	23.74	24.30	16.1	0.2	0.31

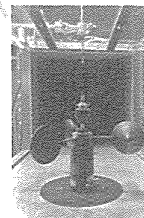
Remarks:

¹ Calibration results only count 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 Jirantee Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set-up is not true to scale due to missing proportion



JIRANATEE ASSOCIATES CO., LTD.

Jirantee Associates Co., Ltd.
63/14-15, 67/35-36
Petchburi 7/1, Rd. Wattana, Bangkok
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Tel: +66(0)80912
Mobile: +66(0)999451
E-mail: jna-calibration@jirantee.com
Web site: www.jirantee.com

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

Air speed measurement laboratory
Calibration services department

Certificate Number

CWD-003-66

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

PLACE OF CALIBRATION

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

CALIBRATION CONDITION

Wind tunnel cross-section area: 900 cm²
Win direction frontal area: 129 cm²
Diameter of mounting pipe: mm
Blockage ratio of test object: 0.143 [-]

Preconditioning

Measurement Condition

24 hour at ambient conditions.
The average values during measurement are (23.9) °C, (44.8) %RH and (1099.2) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☒ Mr. Sorawit Thachulad
☐ Miss Jitraporn Jertsomphol

Remarks:

- *Nozzle cross-section area of the wind tunnel
- *Projector cross-section area of the tested object include mounting pipe
- *Diameter of mounting pipe
- *Ratio 1 to 1



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

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-003-66

Page 2 of 2 Pages

MEASUREMENT RESULTS¹

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

Air speed m/s	D_{ref} Degree (°)	D_{UUC} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.00	45.000	41	-4	1.0
	90.000	87	-3	1.0
	135.001	132	-3	1.0
	180.000	178	-2	1.0
	225.000	226	1	1.0
	270.000	272	2	1.0
10.00	315.000	319	4	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

³ Direction of Unit Under Calibration



CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novolynx
MODEL/TYPE : Sensor: WS-02F
Data logger: Z00-WS-25DL
SERIAL NUMBER : Sensor: -
Data logger: A4587
ID NUMBER : RYG_150089
CONDITION AS-RECEIVED : 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 : 16 Jan 2023
MEASUREMENT DATE : 19 Jan 2023
ISSUE DATE : 20 Jan 2023

ENVIRONMENTAL CONDITIONS:

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

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

CALIBRATION CONDITION : Wind tunnel cross-section area¹ : 900 cm²
Win direction frontal area² : 129 cm²
Diameter of mounting pipe³ : - mm
Blockage ratio of test object⁴ : 0.143 [-]

Preconditioning : 74 hours at ambient conditions
Measurement Condition : The average values during measurement are (24.1)°C, (54.3) %RH and (1015.2) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
☒ Mr. Sorawit Thaisri
☐ Miss Jiraporn Jiratanee

Approved signatory: Mr. Parinya Booncharoen
Calibration Department Manager

Remarks:
¹ Nozzle 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 $\frac{A}{A_0}$

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

Certificate Number

CL-011-66

Page 2 of 2 Pages

MEASUREMENT 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 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	D _{ref}	D _{meas}	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
0.000	0	0	0	0.58
45.000	41	-4	-4	0.58
90.000	88	-2	-2	0.74
135.000	133	-2	-2	0.58
180.000	180	0	0	0.74
225.000	228	0	0	0.74
270.000	273	3	3	0.68
315.000	316	1	1	0.74

Remark:

⁵ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.

⁶ Direction of rotation

⁷ Direction of Unit under Calibration

End of Certificate of Calibration

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novolynx
MODEL/TYPE : Sensor: WS-02F
Data logger: Z00-WS-25DL
SERIAL NUMBER : Sensor: -
Data logger: A4587
ID NUMBER : RYG_150089
CONDITION AS-RECEIVED : 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 : 16 Jan 2023
MEASUREMENT DATE : 18 Jan 2023
ISSUE DATE : 20 Jan 2023

ENVIRONMENTAL CONDITIONS:

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

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

CALIBRATION CONDITIONS : Wind tunnel cross-section area¹ : 900 cm²
Win direction frontal area² : 100 cm²
Diameter of mounting pipe³ : - mm
Blockage ratio of test object⁴ : 0.111 [-]

Preconditioning : 24 hours at ambient conditions
Measurement Condition : The average values during measurement are (23.5)°C, (52.8) %RH and (1014.1) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
☒ Mr. Sorawit Thaisri
☐ Miss Jiraporn Jiratanee

Approved signatory: Mr. Parinya Booncharoen
Calibration Department Manager

Remarks:
¹ Nozzle 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 $\frac{A}{A_0}$

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Certificate Number

CL-011-66

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

The cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 100 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

v _{ref} (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v _{meas} (m/s)	Error (m/s)	U (k=2) (m/s)
0.003	23.50	23.45	0.8	-0.2	0.17
2.035	23.44	23.45	1.9	-0.1	0.16
3.048	23.50	23.45	2.9	-0.2	0.19
4.136	23.50	23.45	3.9	-0.2	0.20
5.01	23.40	23.45	4.9	-0.1	0.18
6.00	23.50	23.45	5.9	-0.1	0.19
7.07	23.40	23.45	7.0	-0.1	0.19
8.18	23.50	23.45	8.0	-0.2	0.19
9.10	23.26	23.45	9.0	-0.1	0.20
10.09	23.44	23.45	9.9	-0.1	0.21
11.15	23.30	23.45	11.0	-0.1	0.21
12.14	23.42	23.45	12.0	-0.1	0.25
13.20	23.22	23.45	13.1	-0.1	0.26
14.25	23.34	23.45	14.1	-0.1	0.24
15.24	23.24	23.45	15.0	-0.3	0.26
16.31	23.24	23.45	16.1	-0.2	0.24

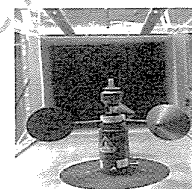
Remark:

⁵ Calibration results only count for the tested circumstances and environmental conditions during which calibration took place.

⁶ Velocity of standard

⁷ Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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

End of Certificate of Calibration



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., Muang, Samutprakan 10280.

Instrument Calibrated : Ambient Environment
Description : Sound Calibrator Temperature : (23 ± 3) °C
Manufacturer : Rion Relative Humidity : (50 ± 15) %
Model : NC-74 Ambient Pressure : (101.325 ± 1.500) kPa
Serial No. : 34178121 (ID-RYG_FS0213)

- 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 Tanagawa 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 relate only to the items tested/calibrated or value assigned.
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Head Office 35 Mu 3 Tambon Khlong Ma, Amphoe Khlong Luang, Changwat Pathumthani 12120, Thailand
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Office/Laboratory 368 Mu 2 Tambon Bangpaem, Amphoe Muang Samutprakan, Changwat Samutprakan 10280, Thailand
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E-mail: info@tistr.or.th Website: www.tistr.or.th

Office 195 Phahonyothin Road, Lat Yao, Chatuchak, Bangkok 10900, Thailand
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FIMBL/MTC.002 Rev.5



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 20µPa at 1000 Hz

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

1. Sound Pressure Level

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

2. Frequency

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

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
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 Deechaiyae)

Approved by :
(Mr. Prawat Klunya)

Director
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

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Office/Laboratory Sri 1C, Bangpoo Industrial Estate, Sukhumvit Road, Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel: (66) 0 2323 1672-80 ext. 115, 116
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E-mail: info@tistr.or.th Website: www.tistr.or.th

Office 195 Phahonyothin Road, Chatuchak, Bangkok 10900, Thailand
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Fax: (66) 0 2274 1121-30 ext. 5219, 5225, 5217
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FIMBL/MTC.002 Rev.4

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

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



Cert. No. : ACL23263
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 01122567 / 143473 / 22605
ID No.: RYG_FS0016

Condition As Found : GOOD

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

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

Received Date : 23 AUGUST 2023
Calibration Date : 01 SEPTEMBER 2023
Date of Issue : 04 SEPTEMBER 2023

Calibrated by : Nathakorn Proutpaian

Approved by :

T. Petchuray
(Thanakul Petchuray)

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.

QH-TS12-014-01-020664

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL23263
Job No. : VC66AC0094
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-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).

QH-TS12-014-01-020664

T. Petchuray

Continuation of Calibration Certificate

Cert. No. : ACL23263
Job No. : VC66AC0094
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.

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23263
Job No. : VC66AC0094
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	12.0
C - weight	18.3
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)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.3	0.3	0.4	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-2.0	-1.9	-1.9	±5.0

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23263
Job No. : VC66AC0094
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	0.1	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±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	S/L M Display at initial (dB)	S/L M Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.0	0.0	±0.3

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23263
Job No. : VC66AC0094
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23263
Job No. : VC66AC0094
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

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	136.1	-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

QI-TS12-04-04-020664

T. Petchu

Continuation of Calibration Certificate

Cert. No. : ACL23263
Job No. : VC66AC0094
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	89.5	-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

QI-TS12-04-04-020664

T. Petchu

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



Cert. No. : ACL24072
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 01122578 / 143842 / 22771
ID No. : RYG_FS0017

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAI) AND 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 : 11 JANUARY 2024
Calibration Date : 22-24 JANUARY 2024
Date of Issue : 24 JANUARY 2024

Calibrated by : Nuthakorn Pinotpaisan

Approved by :

T. Petchu
(Thanakul Petchu)

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.

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



Cert. No. : ACL24072
Job No. : VC67AC0054
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	MY53202742	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).

T. Petchu

SITHIPORN ASSOCIATES CO., LTD.
CALIBRATION LABORATORY

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Cert. No. : ACL24072
Job No. : VC67AC0054
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. : ACL24072
Job No. : VC67AC0054
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)
16.7

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	17.7
Flat	23.4

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	0.5	±1.5
1000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	±5.0

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Cert. No. : ACL24072
Job No. : VC67AC0054
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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Cert. No. : ACL24072
Job No. : VC67AC0054
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.0	0.0	± 1.1
25.0	25.0	0.0	± 1.1

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Cert. No. : ACL24072
Job No. : VC67AC0054
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	108.0	0.0	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	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	132.9	-0.1	±2.0
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

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Cert. No. : ACL24072
Job No. : VC67AC0054
Pages : 8 of 8

11. Overload indication

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

T. Petchar

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Cert. No. : ACL24084
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-52A / Microphone UC-59 / Preamplifier NH-25
Serial No. : 01120939 / 21940 / 22328
ID No. : RYG_FS0630

Condition As Found : GOOD

Customer : A.S.L. 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 : 11 JANUARY 2024
Calibration Date : 22- 24 JANUARY 2024
Date of Issue : 24 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petchar
(Thanakul Peichurai)

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. : ACL24084
Job No. : VC67AC0054
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	MY18017076	LT-0009-23	07-FEB-24
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL-BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL-BP 29/0266	13-FEB-24
Digital Multimeter	34461A	MY60024273	EEL-BP 31/0266	14-FEB-24
Programmable Attenuator	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAI	34560495	AA-3002-23	14-FEB-24

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

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

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

T. Petchar

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Cert. No. : ACL24084
Job No. : VC67AC0054
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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Cert. No. : ACL24084
Job No. : VC67AC0054
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)	94.0	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
13.8

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

Frequency Weighting	Measured value (dB)
A - weight	8.7
C - weight	14.0
Flat	19.8

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	± 1.0
1000	0.2	0.2	0.2	± 0.7
8000	0.6	0.6	0.6	+ 1.5, - 2.5

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Cert. No. : ACL24084
Job No. : VC67AC0054
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	0.0	0.0	±1.0
125	0.0	0.0	0.0	±1.0
250	0.0	0.0	0.0	±1.0
500	0.0	0.0	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+ 1.5, - 2.5
16000	0.0	-1.2	-1.2	+ 2.5, -16.0

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	± 0.1

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Cert. No. : ACL24084
Job No. : VC67AC0054
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	±0.8
136.0	136.0	0.0	±0.8
135.0	135.0	0.0	±0.8
134.0	134.0	0.0	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
129.0	129.0	0.0	±0.8
124.0	124.0	0.0	±0.8
119.0	119.0	0.0	±0.8
114.0	114.0	0.0	±0.8
109.0	109.0	0.0	±0.8
104.0	104.0	0.0	±0.8
99.0	99.0	0.0	±0.8
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	63.9	-0.1	±0.8
59.0	59.0	0.0	±0.8
54.0	53.9	-0.1	±0.8
49.0	48.9	-0.1	±0.8
44.0	43.9	-0.1	±0.8
39.0	38.9	-0.1	±0.8
34.0	33.9	-0.1	±0.8
30.0	29.9	-0.1	±0.8
29.0	28.9	-0.1	±0.8
28.0	27.9	-0.1	±0.8
27.0	26.9	-0.1	±0.8
26.0	25.9	-0.1	±0.8
25.0	24.8	-0.2	±0.8

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Cert. No. : ACL24084
Job No. : VC67AC0054
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	±0.8

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	0.75	1	108.0	107.0	-0.1	1.0 ; -2.0
	2	8	117.0	117.0	0.0	1.0 ; -1.5
	200	800	134.0	134.0	0.0	±0.5
Slow	2	8	108.0	108.0	0.0	1.0 ; -3.0
	200	800	127.6	127.6	0.0	±0.5
SEL	0.25	1	99.0	98.9	-0.1	1.0 ; -3.0
	2	8	108.0	108.0	0.0	1.0 ; -1.5
	200	800	128.0	128.1	0.1	±0.5

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	±2.0
One	136.4	136.3	-0.1	±2.0

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	±1.0
Positive half cycle	135.4	135.2	-0.2	±1.0
Negative half cycle	135.4	135.2	-0.2	±1.0

T. Petchur

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Cert. No. : ACL24084
Job No. : VC67AC0054
Pages : 8 of 8

11. Overload indication

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

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	137.0	137.0	0.0	±0.1

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

End of Calibration Certificate

T. Petchur

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Cert. No. : ACC24088
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 : Nathakorn Pisutpaisan

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

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Cert. No. : ACC24088
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	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MY53220104	EEL_BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MY53220076	EEL_BP 31/0267	13-FEB-24
Digital Multimeter	33461A	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
Audio Analyzer	AVR-3360A	V744B6069	EF-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).

T. Petchur

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Cert. No. : ACC24008
Job No. : VC67AC0055
Pages : 3 of 3

Result of calibration :

1. Sound pressure level

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

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty limit (%)	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

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Cert. No. : ACL24077
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-52A / Microphone UC-59 / Preamplifier NH-25
Serial No.: 00920831 / 22191 / 22220
ID No.: RYG_FS0622

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHAENG 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 JANUARY 2024
Calibration Date : 22-24 JANUARY 2024
Date of Issue : 24 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

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

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Cert. No. : ACL24077
Job No. : VC67AC0054
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	29779900	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).

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Cert. No. : ACL24077
Job No. : VC67AC0054
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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Cert. No. : ACL24077
Job No. : VC67AC0054
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)	94.0	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
13.8

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

Frequency Weighting	Measured value (dB)
A - weight	8.7
C - weight	13.7
Flat	19.6

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	0.1	0.2	0.2	± 1.0
1000	0.2	0.2	0.2	± 0.7
8000	0.4	0.5	0.5	+ 1.5, - 2.5

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Cert. No. : ACL24077
Job No. : VC67AC0054
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±1.0
125	0.1	0.1	0.0	±1.0
250	0.0	0.0	0.0	±1.0
500	0.0	0.0	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+ 1.5, - 2.5
16000	0.0	-1.2	-1.2	+ 2.5, -16.0

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	± 0.1

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Cert. No. : ACL24077
Job No. : VC67AC0054
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	±0.8
136.0	136.0	0.0	±0.8
135.0	135.0	0.0	±0.8
134.0	134.0	0.0	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
129.0	129.0	0.0	±0.8
124.0	124.0	0.0	±0.8
119.0	119.0	0.0	±0.8
114.0	114.0	0.0	±0.8
109.0	109.0	0.0	±0.8
104.0	104.0	0.0	±0.8
99.0	99.0	0.0	±0.8
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	53.9	-0.1	±0.8
49.0	49.0	0.0	±0.8
44.0	44.0	0.0	±0.8
39.0	38.9	-0.1	±0.8
34.0	33.9	-0.1	±0.8
30.0	29.9	-0.1	±0.8
29.0	28.9	-0.1	±0.8
28.0	27.9	-0.1	±0.8
27.0	26.9	-0.1	±0.8
26.0	25.9	-0.1	±0.8
25.0	24.9	-0.1	±0.8

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Cert. No. : ACL24077
Job No. : VC67AC0054
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	±0.8

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	1.0 ; -3.0
	2	8	117.0	117.0	0.0	1.0 ; -1.5
	200	800	134.0	134.1	0.1	±0.5
Slow	2	8	108.0	108.0	0.0	1.0 ; -3.0
	200	800	127.6	127.6	0.0	±0.5
SEL	0.25	1	99.0	98.9	-0.1	1.0 ; -3.0
	2	8	108.0	108.0	0.0	1.0 ; -1.5
	200	800	128.0	128.0	0.0	±0.5

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	±2.0
One	136.4	135.4	-1.0	±2.0

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	±1.0
Positive half cycle	135.4	135.2	-0.2	±1.0
Negative half cycle	135.4	135.2	-0.2	±1.0

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Cert. No. : ACL24077
Job No. : VC67AC0054
Pages : 8 of 8

11. Overload indication

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

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	137.0	137.0	0.0	±0.1

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. : ACL24078
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-52A / Microphone UC-59 / Preamplifier NH-25
Serial No.: 00920832 / 22192 / 22221
ID No.: RYG_FS0623

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHAENG 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 JANUARY 2024
Calibration Date : 22-24 JANUARY 2024
Date of Issue : 24 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by : *T. Petchurai*
(Thanakul Petchurai)

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Cert. No. : ACL24078
Job No. : VC67AC0054
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-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).

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Cert. No. : ACL24078
Job No. : VC67AC0054
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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Cert. No. : ACL24078
Job No. : VC67AC0054
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)	94.0	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.1

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

Frequency Weighting	Measured value (dB)
A - weight	8.7
C - weight	13.4
Flat	19.1

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	0.2	0.2	0.2	± 1.0
1000	0.2	0.2	0.2	± 0.7
8000	0.2	0.3	0.3	+ 1.5, - 2.5

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Cert. No. : ACL24078
Job No. : VC67AC0054
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	±1.0
125	0.0	0.1	0.0	±1.0
250	0.1	0.1	0.0	±1.0
500	0.0	0.1	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+ 1.5, - 2.5
16000	0.0	-1.2	-1.1	+ 2.5, -16.0

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	± 0.1

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Cert. No. : ACL24078
Job No. : VC67AC0054
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	±0.8
136.0	136.1	0.1	±0.8
135.0	135.1	0.1	±0.8
134.0	134.1	0.1	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
129.0	129.0	0.0	±0.8
124.0	124.0	0.0	±0.8
119.0	119.0	0.0	±0.8
114.0	114.0	0.0	±0.8
109.0	109.0	0.0	±0.8
104.0	104.0	0.0	±0.8
99.0	99.0	0.0	±0.8
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	54.0	0.0	±0.8
49.0	49.0	0.0	±0.8
44.0	44.0	0.0	±0.8
39.0	39.0	0.0	±0.8
34.0	34.0	0.0	±0.8
30.0	30.0	0.0	±0.8
29.0	29.0	0.0	±0.8
28.0	28.0	0.0	±0.8
27.0	27.0	0.0	±0.8
26.0	26.0	0.0	±0.8
25.0	25.0	0.0	±0.8

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Cert. No. : ACL24078
Job No. : VC67AC0054
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	±0.8

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	1.0 ; -3.0
	2	8	117.0	116.9	-0.1	1.0 ; -1.5
	200	800	134.0	134.0	0.0	±0.5
Slow	2	8	108.0	107.9	-0.1	1.0 ; -3.0
	200	800	127.6	127.5	-0.1	±0.5
	0.25	1	99.0	98.8	-0.2	1.0 ; -3.0
SEL	2	8	108.0	107.9	-0.1	1.0 ; -1.5
	200	800	128.0	128.0	0.0	±0.5

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	±2.0
One	136.4	135.4	-1.0	±2.0

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	±1.0
Positive half cycle	135.4	135.1	-0.3	±1.0
Negative half cycle	135.4	135.1	-0.3	±1.0

T. Petch.

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Cert. No. : ACL24078
Job No. : VC67AC0054
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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	89.7	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	±0.1

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. : ACL24079
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-52A / Microphone UC-59 / Preamplifier NH-25
Serial No. : 00920833 / 22193 / 22222
ID No. : RYG_FS0624

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 : 11 JANUARY 2024
Calibration Date : 22- 24 JANUARY 2024
Date of Issue : 24 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by : *T. Petchurai*
(Thanakul Petchurai)

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Cert. No. : ACL24079
Job No. : VC67AC0054
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 Anchoic 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).

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Cert. No. : ACL24079
Job No. : VC67AC0054
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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Cert. No. : ACL24079
Job No. : VC67AC0054
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)	94.0	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.1

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

Frequency Weighting	Measured value (dB)
A - weight	8.7
C - weight	13.4
Flat	19.0

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.2	± 1.0
1000	0.2	0.2	0.2	± 0.7
8000	0.3	0.5	0.4	+ 1.5, - 2.5

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Job No. : VC67AC0054
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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	0.0	±1.0
125	0.0	0.0	0.0	±1.0
250	0.0	0.0	0.0	±1.0
500	0.0	0.0	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+ 1.5, - 2.5
16000	0.0	-1.2	-1.2	+ 2.5, -16.0

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	± 0.1

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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	±0.8
136.0	136.0	0.0	±0.8
135.0	135.0	0.0	±0.8
134.0	134.0	0.0	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
129.0	129.0	0.0	±0.8
124.0	124.0	0.0	±0.8
119.0	119.0	0.0	±0.8
114.0	114.0	0.0	±0.8
109.0	109.0	0.0	±0.8
104.0	104.0	0.0	±0.8
99.0	99.0	0.0	±0.8
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	54.0	0.0	±0.8
49.0	49.0	0.0	±0.8
44.0	44.0	0.0	±0.8
39.0	39.0	0.0	±0.8
34.0	34.0	0.0	±0.8
30.0	30.0	0.0	±0.8
29.0	29.0	0.0	±0.8
28.0	28.0	0.0	±0.8
27.0	27.0	0.0	±0.8
26.0	26.1	0.1	±0.8
25.0	25.0	0.0	±0.8

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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)
Auto	94.0	94.0	0.0	±0.8

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	1.0 ; -3.0
	2	8	117.0	117.0	0.0	1.0 ; -1.5
	200	800	134.0	134.0	0.0	±0.5
Slow	2	8	108.0	108.0	0.0	1.0 ; -3.0
	200	800	127.6	127.6	0.0	±0.5
SEL	0.25	1	99.0	98.9	-0.1	1.0 ; -3.0
	2	8	108.0	108.0	0.0	1.0 ; -1.5
	200	800	128.0	128.0	0.0	±0.5

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	±2.0
One	136.4	135.7	-0.7	±2.0

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	±1.0
Positive half cycle	135.4	135.2	-0.2	±1.0
Negative half cycle	135.4	135.2	-0.2	±1.0

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11. Overload indication

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

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	137.0	137.0	0.0	±0.1

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. : ACL24080
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-52A / Microphone UC-59 / Preamplifier NH-25
Serial No.: 00920834 / 22194 / 22223
ID No.: RYG_FS0625

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 : 11 JANUARY 2024
Calibration Date : 22- 24 JANUARY 2024
Date of Issue : 24 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

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

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Cert. No. : ACL24080
Job No. : VC67AC0054
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	MY53202742	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).

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Cert. No. : ACL24080
Job No. : VC67AC0054
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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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Cert. No. : ACL24080
Job No. : VC67AC0054
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Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.98)	94.0	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
13.4

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

Frequency Weighting	Measured value (dB)
A - weight	8.7
C - weight	13.6
Flat	19.3

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.2	± 1.0
1000	0.2	0.2	0.2	± 0.7
8000	0.7	0.8	0.8	+ 1.5, - 2.5

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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	0.0	0.0	0.0	±1.0
125	0.0	0.1	0.0	±1.0
250	0.0	0.0	0.0	±1.0
500	0.0	0.0	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+ 1.5, - 2.5
16000	0.0	-1.2	-1.2	+ 2.5, -16.0

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	± 0.1

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Job No. : VC67AC0054
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	±0.8
136.0	136.0	0.0	±0.8
135.0	135.0	0.0	±0.8
134.0	134.0	0.0	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
130.0	130.0	0.0	±0.8
129.0	129.0	0.0	±0.8
128.0	128.0	0.0	±0.8
127.0	127.0	0.0	±0.8
126.0	126.0	0.0	±0.8
125.0	125.0	0.0	±0.8
124.0	124.0	0.0	±0.8
123.0	123.0	0.0	±0.8
122.0	122.0	0.0	±0.8
121.0	121.0	0.0	±0.8
120.0	120.0	0.0	±0.8
119.0	119.0	0.0	±0.8
118.0	118.0	0.0	±0.8
117.0	117.0	0.0	±0.8
116.0	116.0	0.0	±0.8
115.0	115.0	0.0	±0.8
114.0	114.0	0.0	±0.8
113.0	113.0	0.0	±0.8
112.0	112.0	0.0	±0.8
111.0	111.0	0.0	±0.8
110.0	110.0	0.0	±0.8
109.0	109.0	0.0	±0.8
108.0	108.0	0.0	±0.8
107.0	107.0	0.0	±0.8
106.0	106.0	0.0	±0.8
105.0	105.0	0.0	±0.8
104.0	104.0	0.0	±0.8
103.0	103.0	0.0	±0.8
102.0	102.0	0.0	±0.8
101.0	101.0	0.0	±0.8
100.0	100.0	0.0	±0.8
99.0	99.0	0.0	±0.8
98.0	98.0	0.0	±0.8
97.0	97.0	0.0	±0.8
96.0	96.0	0.0	±0.8
95.0	95.0	0.0	±0.8
94.0	94.0	0.0	±0.8
93.0	93.0	0.0	±0.8
92.0	92.0	0.0	±0.8
91.0	91.0	0.0	±0.8
90.0	90.0	0.0	±0.8
89.0	89.0	0.0	±0.8
88.0	88.0	0.0	±0.8
87.0	87.0	0.0	±0.8
86.0	86.0	0.0	±0.8
85.0	85.0	0.0	±0.8
84.0	84.0	0.0	±0.8
83.0	83.0	0.0	±0.8
82.0	82.0	0.0	±0.8
81.0	81.0	0.0	±0.8
80.0	80.0	0.0	±0.8
79.0	79.0	0.0	±0.8
78.0	78.0	0.0	±0.8
77.0	77.0	0.0	±0.8
76.0	76.0	0.0	±0.8
75.0	75.0	0.0	±0.8
74.0	74.0	0.0	±0.8
73.0	73.0	0.0	±0.8
72.0	72.0	0.0	±0.8
71.0	71.0	0.0	±0.8
70.0	70.0	0.0	±0.8
69.0	69.0	0.0	±0.8
68.0	68.0	0.0	±0.8
67.0	67.0	0.0	±0.8
66.0	66.0	0.0	±0.8
65.0	65.0	0.0	±0.8
64.0	64.0	0.0	±0.8
63.0	63.0	0.0	±0.8
62.0	62.0	0.0	±0.8
61.0	61.0	0.0	±0.8
60.0	60.0	0.0	±0.8
59.0	59.0	0.0	±0.8
58.0	58.0	0.0	±0.8
57.0	57.0	0.0	±0.8
56.0	56.0	0.0	±0.8
55.0	55.0	0.0	±0.8
54.0	54.0	0.0	±0.8
53.0	53.0	0.0	±0.8
52.0	52.0	0.0	±0.8
51.0	51.0	0.0	±0.8
50.0	50.0	0.0	±0.8
49.0	49.0	0.0	±0.8
48.0	48.0	0.0	±0.8
47.0	47.0	0.0	±0.8
46.0	46.0	0.0	±0.8
45.0	45.0	0.0	±0.8
44.0	44.0	0.0	±0.8
43.0	43.0	0.0	±0.8
42.0	42.0	0.0	±0.8
41.0	41.0	0.0	±0.8
40.0	40.0	0.0	±0.8
39.0	39.0	0.0	±0.8
38.0	38.0	0.0	±0.8
37.0	37.0	0.0	±0.8
36.0	36.0	0.0	±0.8
35.0	35.0	0.0	±0.8
34.0	34.0	0.0	±0.8
33.0	33.0	0.0	±0.8
32.0	32.0	0.0	±0.8
31.0	31.0	0.0	±0.8
30.0	30.0	0.0	±0.8
29.0	29.0	0.0	±0.8
28.0	28.0	0.0	±0.8
27.0	27.0	0.0	±0.8
26.0	26.0	0.0	±0.8
25.0	25.0	0.0	±0.8

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Cert. No. : ACL24080
Job No. : VC67AC0054
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	±0.8

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	1.0 ; -3.0
	2	8	117.0	117.0	0.0	1.0 ; -1.5
	200	800	134.0	134.0	0.0	±0.5
Slow	2	8	108.0	108.0	0.0	1.0 ; -3.0
	200	800	127.6	127.6	0.0	±0.5
	0.25	1	99.0	98.9	-0.1	1.0 ; -3.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -1.5
	200	800	128.0	128.0	0.0	±0.5

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	±2.0
One	136.4	136.3	-0.1	±2.0

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	±1.0
Positive half cycle	135.4	135.2	-0.2	±1.0
Negative half cycle	135.4	135.2	-0.2	±1.0

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Job No. : VC67AC0054
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	89.7	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	±0.1

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

End of Calibration Certificate

T. Petchurui

SITHIPORN ASSOCIATES CO., LTD.
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Tel: 0-2435-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACC23029
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No. : 34178123
ID No. : RYG_FS0215

REVIEW BY *Nathakorn P.*
APPROVED BY *T. Petchurui*
NOTICAL DATE 20/9/24

Condition As Found : GOOD

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

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

Received Date : 07 SEPTEMBER 2023
Calibration Date : 20 SEPTEMBER 2023
Date of Issue : 20 SEPTEMBER 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurui
(Thanakul Petchurui)

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QF-TS12-04-04-020664

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Continuation of Calibration Certificate

Cert. No. : ACC23029
Job No. : VC66AC0100
Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

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

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0010-23	07-FEB-24
Digital Multimeter	33161A	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	MAT-1070	62100114	EF-0011-23	08-FEB-24
Condenser Microphone	4180	2977900	AA-1001-23	14-FEB-24
Measuring Amplifier	NA-42KAI	34560495	AA-3002-23	14-FEB-24
Audio Analyzer	AVR-3360A	V744B6069	EF-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).

QF-TS12-04-04-020664

T. Petchurui

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Continuation of Calibration Certificate

Cert. No. : ACC23029
Job No. : VC66AC0100
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	94.1	0.10	0.14	0.40

2. Frequency

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

3. Total distortion

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

T. Petchurui

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Cert. No. : ACL24092
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 00734220 / 145286 / 34371
ID No. : RYG_FS0026

Condition As Found : GOOD

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

Location :
Ambient Temperature : (23.0 ± 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 :

T. Petchurai
(Thanakul Petchurai)

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Cert. No. : ACL24092
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-42KAI	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

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Cert. No. : ACL24092
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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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)
16.3

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

Frequency Weighting	Measured value (dB)
A - weight	13.4
C - weight	19.5
Flat	25.4

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	0.3	0.3	0.3	±1.5
1000	0.1	0.1	0.1	±1.0
8000	2.3	2.3	2.3	±5.0

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Job No. : VC67AC0058
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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	0.0	0.0	0.0	±2.0
125	0.0	0.1	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	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	94.0	0.0	± 0.3

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Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

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Cert. No. : ACL24092
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	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 : -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 : -5.0
	2	8	108.0	108.0	0.0	1.0 : -2.5
	200	800	128.0	128.1	0.1	±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	135.6	-0.8	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±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. : ACL24092
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	89.7	0.1	±1.5

12. High level stability

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

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

End of Calibration Certificate

T. Petch

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Cert. No. : ACL24035
Pages : 1 of 8

Calibration Certificate

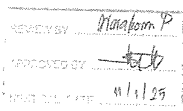
Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A / Microphone UC-52 / Preamplifier NH-24
Serial No. : 00623394 / 198641 / 26422
ID No. : RYG_FS0619

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 : 05 JANUARY 2024
Calibration Date : 12-15 JANUARY 2024
Date of Issue : 16 JANUARY 2024



Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur
(Thanakul Petchurai)

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Cert. No. : ACL24035
Job No. : VC67AC0052
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	MY53202742	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).

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SITHIPORN ASSOCIATES CO., LTD.
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Cert. No. : ACL24035
Job No. : VC67AC0052
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. : ACL24035
Job No. : VC67AC0052
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)
14.6

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

Frequency Weighting	Measured value (dB)
A-weight	10.8
C-weight	17.1
Flat	22.9

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.1	0.1	0.1	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.1	0.1	0.2	± 5.0

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Job No. : VC67AC0052
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	-0.1	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	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	94.0	0.0	± 0.3

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Job No. : VC67AC0052
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	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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Job No. : VC67AC0052
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

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	135.6	-0.8	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	±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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Job No. : VC67AC0052
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	89.5	-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

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Cert. No. : ACL24036
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A / Microphone UC-52 / Preamplifier NH-24
Serial No. : 00623395 / 198642 / 26423
ID No. : RYG_FS0620

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 : 05 JANUARY 2024
Calibration Date : 12-15 JANUARY 2024
Date of Issue : 16 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur
(Thanakul Petchurai)

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Cert. No. : ACL24036
Job No. : VC67AC0052
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-42KAI	34560495	AA-3002-23	14-FEB-24

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

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

3.1 National Institute of Metrology (Thailand).

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

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Cert. No. : ACL24036
Job No. : VC67AC0052
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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Job No. : VC67AC0052
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)
14.2

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

Frequency Weighting	Measured value (dB)
A - weight	9.9
C - weight	16.5
Flat	22.3

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.3	0.3	0.4	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.7	0.8	0.8	± 5.0

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Job No. : VC67AC0052
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	-0.1	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	-0.1	±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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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	79.0	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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Cert. No. : ACL24036
Job No. : VC67AC0052
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

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

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, 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	133.1	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

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Job No. : VC67AC0052
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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	89.7	0.0	±1.5

12. High level stability

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

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

End of Calibration Certificate

T. Pith.

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Cert. No. : ACL24077
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-52A / Microphone UC-59 / Preamplifier NH-25
Serial No. : 00920831 / 22191 / 22220
ID No. : RYG_FS0622

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 : 11 JANUARY 2024
Calibration Date : 22-24 JANUARY 2024
Date of Issue : 24 JANUARY 2024

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchur
(Thanakul Petchur)

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Cert. No. : ACL24077
Job No. : VC67AC0054
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	MYS2302742	EF-0010-23	07-FEB-24
Digital Multimeter	33461A	MYS5220104	EEL_BP 30/0266	13-FEB-24
Digital Multimeter	33461A	MYS53220076	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

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

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Cert. No. : ACL24077
Job No. : VC67AC0054
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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Job No. : VC67AC0054
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)	94.0	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
13.8

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

Frequency Weighting	Measured value (dB)
A - weight	8.7
C - weight	13.7
Flat	19.6

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	0.1	0.2	0.2	± 1.0
1000	0.2	0.2	0.2	± 0.7
8000	0.4	0.5	0.5	+ 1.5, - 2.5

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Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±1.0
125	0.1	0.1	0.0	±1.0
250	0.0	0.0	0.0	±1.0
500	0.0	0.0	0.0	±1.0
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±1.0
4000	0.0	0.0	0.0	±1.0
8000	0.0	0.1	0.1	+1.5, -2.5
16000	0.0	-1.2	-1.2	+2.5, -16.0

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	± 0.1

T. P. P. P.

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Cert. No. : ACL24077
Job No. : VC67AC0054
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	±0.8
136.0	136.0	0.0	±0.8
135.0	135.0	0.0	±0.8
134.0	134.0	0.0	±0.8
133.0	133.0	0.0	±0.8
132.0	132.0	0.0	±0.8
131.0	131.0	0.0	±0.8
129.0	129.0	0.0	±0.8
124.0	124.0	0.0	±0.8
119.0	119.0	0.0	±0.8
114.0	114.0	0.0	±0.8
109.0	109.0	0.0	±0.8
104.0	104.0	0.0	±0.8
99.0	99.0	0.0	±0.8
94.0	94.0	0.0	±0.8
89.0	89.0	0.0	±0.8
84.0	84.0	0.0	±0.8
79.0	79.0	0.0	±0.8
74.0	74.0	0.0	±0.8
69.0	69.0	0.0	±0.8
64.0	64.0	0.0	±0.8
59.0	59.0	0.0	±0.8
54.0	53.9	-0.1	±0.8
49.0	49.0	0.0	±0.8
44.0	44.0	0.0	±0.8
39.0	38.9	-0.1	±0.8
34.0	33.9	-0.1	±0.8
30.0	29.9	-0.1	±0.8
29.0	28.9	-0.1	±0.8
28.0	27.9	-0.1	±0.8
27.0	26.9	-0.1	±0.8
26.0	25.9	-0.1	±0.8
25.0	24.9	-0.1	±0.8

T. P. P. P.

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Job No. : VC67AC0054
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	±0.8

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	1.0 ; -3.0
	2	8	117.0	117.0	0.0	1.0 ; -1.5
	200	800	134.0	134.1	0.1	±0.5
Slow	2	8	108.0	108.0	0.0	1.0 ; -3.0
	200	800	127.6	127.6	0.0	±0.5
SEL	0.25	1	99.0	98.9	-0.1	1.0 ; -3.0
	2	8	108.0	108.0	0.0	1.0 ; -1.5
	200	800	128.0	128.0	0.0	±0.5

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	±2.0
One	136.4	135.4	-1.0	±2.0

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	±1.0
Positive half cycle	135.4	135.2	-0.2	±1.0
Negative half cycle	135.4	135.2	-0.2	±1.0

T. P. P. P.

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Cert. No. : ACL24077
Job No. : VC67AC0054
Pages : 8 of 8

11. Overload indication

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

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	137.0	137.0	0.0	±0.1

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

End of Calibration Certificate

T. P. P. P.



Calibration Certificate

Certificate No. 551422
Product 200-510M Defender 510 Medium Flow
Serial No. 208345
Cal. Date 18-Aug-2023

Sold To:

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

As Received Calibration Data

Technician	Aaron Schwartz	Lab. Pressure Lab. Temperature	620.1 mmHg 23.5 °C		
Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Received	
4523.09 ccm	4519.02 ccm	0.09%	1.00%	In Tolerance	
999.43 ccm	999.31 ccm	0.01%	1.00%	In Tolerance	
245.22 ccm	245.88 ccm	-0.27%	1.00%	In tolerance	

Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML_800_24	205307	25-May-2023	25-May-2024

REVIEW BY: *Aaron Schwartz*
APPROVED BY: *[Signature]*
NEXT CAL. DATE: 18/8/24

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1 of 2

FM-00228 Rev. D



As Shipped Calibration Data

Certificate No Technician	551422 Xiem Ly	Lab. Pressure Lab. Temperature	616.8 mmHg 24.2 °C		
Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped	
4516.61 ccm	4515.56 ccm	0.02%	1.00%	In Tolerance	
1000.87 ccm	1000.67 ccm	0.02%	1.00%	In Tolerance	
249.84 ccm	249.93 ccm	-0.04%	1.00%	In Tolerance	

Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML_800_24	100438	14-Sep-2022	14-Sep-2023

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:

Xiem Ly
Xiem Ly
Production Technician II

Approved By:

Norma Aragon
Norma Aragon
QC Inspector

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

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2 of 2

FM-00228 Rev. D



Calibration Certificate

Certificate No. 561587
Product 200-510L Defender 510 Low Flow
Serial No. 130026
Cal. Date 25-Sep-2023

Sold To:

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

As Received Calibration Data

Technician	Aaron Schwartz	Lab. Pressure Lab. Temperature	616.1 mmHg 24 °C		
Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Received	
0 ccm	456.41 ccm	-100.0%	1.00%	Out of Tolerance	
0 ccm	101.19 ccm	-100.0%	1.00%	Out of Tolerance	
0 ccm	30.36 ccm	-100.0%	1.00%	Out of Tolerance	

Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML_800_10	103743	25-Jan-2023	25-Jan-2024

REVIEW BY: *Aaron Schwartz*
APPROVED BY: *[Signature]*
NEXT CAL. DATE: 25/9/24

Mesa Laboratories Inc. 12100 W. 6th Ave. Lakewood, CO 80228 USA
(303) 987-5000 www.mesalabs.com Symbol "MLAB" on the NASDAQ

1 of 2

FM-00228 Rev. B



As Shipped Calibration Data

Certificate No Technician	561587 Aaron Schwartz	Lab. Pressure Lab. Temperature	622.2 mmHg 23.6 °C		
Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped	
449.75 ccm	450.46 ccm	-0.16%	1.00%	In Tolerance	
100.95 ccm	100.82 ccm	0.14%	1.00%	In Tolerance	
30.63 ccm	30.38 ccm	0.82%	1.00%	In Tolerance	

Mesa Laboratories Standards Used

Description	Standard Serial Number	Calibration Date	Calibration Due Date
ML_800_10	103743	25-Jan-2023	25-Jan-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:

Aaron Schwartz
Aaron Schwartz
Assembler I

Approved By:

David Thomas
David Thomas
Quality Engineer

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

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2 of 2

FM-00228 Rev. B



Calibration Certificate

Certificate No. 561588
Product 200-510M Defender 510 Medium Flow
Serial No. 151114
Cal. Date 30-Sep-2023

Sold To:

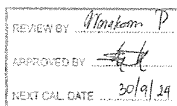
All calibrations are performed in accordance with ISO 17025 at Mesa Laboratories, Inc., 12100 W. 6th Ave., Lakewood, CO 80228, an ISO 17025:2017 accredited laboratory through NVLAP. This report shall not be reproduced except in full without the written approval of the laboratory. Results only relate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

As Received Calibration Data

Technician	Xiem Ly	Lab. Pressure Lab. Temperature	616.8 mmHg 25.8 °C	Deviation	Allowable Deviation	As Received
Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Received		
0 ccm	4499.86 ccm	-100.0%	1.00%	Out of Tolerance		
0 ccm	997.38 ccm	-100.0%	1.00%	Out of Tolerance		
0 ccm	250.32 ccm	-100.0%	1.00%	Out of Tolerance		

Mesa Laboratories Standards Used

Description ML_800_24 Standard Serial Number 117591 Calibration Date 16-Aug-2023 Calibration Due Date 16-Aug-2024



1 of 2

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FM-00228 Rev B



As Shipped Calibration Data

Certificate No	561588	Lab. Pressure	616.2 mmHg	
Technician	Xiem Ly	Lab. Temperature	26.1 °C	
Instrument Reading	Lab Standard Reading	Deviation	Allowable Deviation	As Shipped
4499.74 ccm	4494.43 ccm	0.05%	1.00%	In Tolerance
997.03 ccm	997.16 ccm	-0.01%	1.00%	In Tolerance
249.84 ccm	250.5 ccm	-0.26%	1.00%	In Tolerance

Mesa Laboratories Standards Used

Description ML_800_24 Standard Serial Number 117591 Calibration Date 05-Dec-2022 Calibration Due Date 05-Dec-2023

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 200651-0.

Technician Notes

By:

Xiem Ly
Production Technician II

Approved By:

Naima Aragon
QC Inspector

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.

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FM-00228 Rev B

INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7/10 ARBORE STREET, SINGAPORE 110000
AMBIER BANGKOK 11/10 ARBORE STREET, 10540 THAILAND
TEL: (66) 2110-5800 FAX: (66) 2110-7400



Certificate of Calibration

Certificate No : 24-AFM-018 Rev.1

Certificate No : 24-AFM-018 Rev.1

Request No : Req-2024-0043

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

Unit Under Calibration Details

Measurement Item : Air Flow Meter

Manufacturer : Bios

Model : Defender 510-L

Serial Number : 206395

ID : BKK-FS1346

Sensor Model :

Sensor Serial Number :

Location of Calibration : LAB 4 AIR VELOCITY METER

Calibration Environment and Details

Temperature : 25.0 ± 0.1 °C

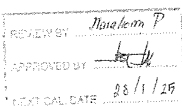
Humidity : 55 ± 5 %RH ± 20 %RH

Barometric Pressure : 1013 hPa ± 10 hPa

Received Date : 3 January 2024

Calibration Date : 29 January 2024

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



Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 Low flow	18501010906	Sensodyne	12 July 2024
Air Flow Meter	Gilibrator 3 Standard flow	19031011063	Sensodyne	12 July 2024
Temperature meter	GT 11	030000057	Oreohm	27 February 2024
Pressure meter	CPG2400	410000KDU-651832	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 %.

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

Calibration By :
Mr. Noppadol Luangart
Service Calibration Engineer

Approved By :
Mr. Paet Mathasom
Calibration Engineer Supervisor
Issue Date : 1 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.

FM-708-AFM-01 Rev 01 Issue date 15/01/24

INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7/10 ARBORE STREET, SINGAPORE 110000
AMBIER BANGKOK 11/10 ARBORE STREET, 10540 THAILAND
TEL: (66) 2110-5800 FAX: (66) 2110-7400



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	197.46	-1.5	5.6
25.00	101.61	300	298.15	-1.8	8.4
24.90	101.60	399	400.13	1	11
24.90	101.59	400	478.02	-2.0	6.8

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

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

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 15/01/24

Certificate of Calibration

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

Unit Under Calibration Details

Measurement Item : Primary Flow Calibrator

Manufacturer : Bios

Model : Defender 510-L

Sensor Model : -

Serial Number : 130027

Sensor Serial Number : -

ID : RYG_FS0208

Location of Calibration : LAB 4 AIR VELOCITY METER

Calibration Environment and Details

Temperature : 23 °C ± 3 °C

Humidity : 55 % RH ± 20 % RH

Barometric Pressure : 1013 hPa ± 10 hPa

Received Date : 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	Gilibrator 3 Low flow	18501010006	Sensidyne	12 July 2024
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensidyne	12 July 2024
Temperature meter	GT 11	080900057	Qrebon	27 February 2024
Pressure meter	CPG2400	41060KDU/651882	TPA	9 November 2024

Traceability :

This Certificate is traceable to SI Unit through Sensidyne A2LA Accreditation No. 3943-01

Note :

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

Calibration By : [Signature]
Mr Noppadon Luangart
Service Calibration Engineer

Approved By : [Signature]
Mr Panch Mathaveorn
Calibration Engineer Supervisor
Issue Date : 13 February 2024

The results related only to the item calibrated. This 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 No : 24-AFM-033

Request No : Req-2024-0241

Result of Calibration : Without Adjustment

Temperature (°C)	Pressure (kPa)	STD (cc/min)	UUC (cc/min)	Error (cc/min)	Uncertainty (cc/min)
24.50	101.26	20	19.965	6.0	1.3
24.20	101.25	101	100.50	-0.5	2.8
24.00	101.31	200	199.13	-0.9	5.6
23.90	101.42	301	301.56	2.6	8.4
24.10	101.41	401	404.57	4	11
24.30	101.49	490	483.81	3.8	7.0

Note

STD : Standard UUC : Unit Under Calibration

UUC Reference Condition : At atmospheric pressure and room temperature condition

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

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

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

* Indicates non accredited

End of Certificate

The results related only to the item calibrated. This 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

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

Unit Under Calibration Details

Measurement Item : Primary Flow Calibrator

Manufacturer : Bios

Model : Defender 510-M

Sensor Model : -

Serial Number : 129958

Sensor Serial Number : -

ID : RYG_FS0209

Location of Calibration : LAB 4 AIR VELOCITY METER

Calibration Environment and Details

Temperature : 23 °C ± 3 °C

Humidity : 55 % RH ± 20 % RH

Barometric Pressure : 1013 hPa ± 10 hPa

Received Date : 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	Gilibrator 3 Low flow	18501010006	Sensidyne	12 July 2024
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensidyne	12 July 2024
Temperature meter	GT 11	080900057	Qrebon	27 February 2024
Pressure meter	CPG2400	41060KDU/651882	TPA	9 November 2024

Traceability :

This Certificate is traceable to SI Unit through Sensidyne A2LA Accreditation No. 3943-01

Note :

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

Calibration By : [Signature]
Mr Noppadon Luangart
Service Calibration Engineer

Approved By : [Signature]
Mr Panch Mathaveorn
Calibration Engineer Supervisor
Issue Date : 13 February 2024

The results related only to the item calibrated. This 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 No : 24-AFM-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	501	513.93	12.9	7.2
24.18	101.62	1006	1019.3	13	14
24.00	101.81	1997	2023.0	26	29
24.10	101.87	2999	3055.5	37	45
24.60	102.00	3944	3991.8	48	59
24.60	102.08	4749	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. This 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



ROTA METER CALIBRATION RESULT JANUARY 2024

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R ²)
BKK_FS0585	10 Jan 24	Y = 1.0351x + 2.3733	0.9998
BKK_FS0587	10 Jan 24	Y = 1.0168x + 15.05	0.9997
BKK_FS0592	10 Jan 24	Y = 1.0013x + 12.556	1.0000
BKK_FS0594	10 Jan 24	Y = 1.0048x + 4.9762	1.0000
BKK_FS1004	04 Jan 24	Y = 0.9873x + 13.47	0.9993
BKK_FS1005	04 Jan 24	Y = 1.0187x + 1.25	0.9998
BKK_FS1006	04 Jan 24	Y = 1.1589x - 3.6605	0.9981
BKK_FS1007	10 Jan 24	Y = 1.1347x + 1.6007	0.9989
BKK_FS1008	10 Jan 24	Y = 1.127x + 4.3827	0.9996
BKK_FS1017	04 Jan 24	Y = 1.0632x - 0.0701	0.9998
BKK_FS1018	04 Jan 24	Y = 1.0115x + 1.2867	0.9996
BKK_FS1019	04 Jan 24	Y = 1.0019x + 8.4867	1.0000
BKK_FS1026	19 Jan 24	Y = 0.9618x + 1.9626	0.9999
BKK_FS1027	10 Jan 24	Y = 1.0065x - 4.3786	1.0000
BKK_FS1028	19 Jan 24	Y = 1.0184x - 37.308	0.9997
BKK_FS1029	19 Jan 24	Y = 0.9809x + 2.7925	0.9977
BKK_FS1030	19 Jan 24	Y = 0.996x - 1.3286	1.0000
BKK_FS1031	19 Jan 24	Y = 1.015x - 27.236	0.9997
BKK_FS1039	04 Jan 24	Y = 1.0047x + 8.0267	0.9997
BKK_FS1040	04 Jan 24	Y = 1.0059x + 3.6952	1.0000
BKK_FS1041	04 Jan 24	Y = 1.0677x - 0.0486	0.9995
BKK_FS1042	04 Jan 24	Y = 1.0021x + 11.273	0.9995
BKK_FS1043	04 Jan 24	Y = 1.0023x + 8.3905	1.0000
BKK_FS1044	04 Jan 24	Y = 1.0738x + 1.2527	0.9997
PHK_FS0027	10 Jan 24	Y = 1.1096x + 0.3565	1.0000
PHK_FS0028	10 Jan 24	Y = 1.034x - 2.52	1.0000
PHK_FS0029	10 Jan 24	Y = 1.0017x + 8.0124	1.0000
RYG_FS0197	04 Jan 24	Y = 1.0045x + 10.275	1.0000
RYG_FS0198	04 Jan 24	Y = 1.0024x + 10.1	1.0000
RYG_FS0199	04 Jan 24	Y = 1.0343x - 0.3854	0.9999
RYG_FS0654	04 Jan 24	Y = 1.0529x + 0.1565	0.9996
RYG_FS0655	04 Jan 24	Y = 0.992x + 8.9667	0.9992
RYG_FS0656	04 Jan 24	Y = 1.0068x - 2.8429	1.0000
RYG_FS0657	04 Jan 24	Y = 1.0472x + 1.9228	0.9999
RYG_FS0658	04 Jan 24	Y = 0.9675x + 20.263	0.9996
RYG_FS0659	04 Jan 24	Y = 1.0028x + 10.275	1.0000
SGK_FS0135	17 Jan 24	Y = 1.0145x + 2.8273	1.0000
SGK_FS0136	17 Jan 24	Y = 1.0113x + 1.75	0.9999
SGK_FS0138	04 Jan 24	Y = 1.0632x - 1.0034	0.9999

Page 1 of 2

ALS Laboratory Group



ROTA METER CALIBRATION RESULT JANUARY 2024

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R ²)
SGK_FS0139	04 Jan 24	Y = 1.0047x + 1.8667	0.9999
SGK_FS0140	04 Jan 24	Y = 1.0001x + 14.149	1.0000
SGK_FS0141	04 Jan 24	Y = 1.111x - 1.1337	0.9994
SGK_FS0142	04 Jan 24	Y = 1.0179x + 0.3633	0.9999
SGK_FS0143	04 Jan 24	Y = 1.054x + 2.2352	1.0000

Review By :

(Mr. Wichan Choonharat)

Enviro Field Services Manager

Approved By :

(Mr. Sarayuth Jitranont)

Assistant General Manager

Page 2 of 2

ALS Laboratory Group

Sartorius (Thailand) Co., Ltd.
128 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6, e-mail: service.thailand@sartorius.comREC-TS-17025
CALIBRATION 0426

SARTORIUS

Certificate of Calibration

REVIEW BY : Thawit
APPROVED BY : [Signature]
NEXT CAL. DATE : 11/01/2025

Model Number : MSE125P-100-DU
Description : Semi-micro Balance
Serial Number : 0033108993
ID No. : RYG_EN0004
Manufacturer : Sartorius

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

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

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

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

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

Metrological data :
Capacity : 60.120 g Readability : 0.00001/0.0001 g

Ambients Conditions:
Temperature : 24.0 °C ± 5.0 °C
Humidity : 60.0 % RH ± 10.0 % RH
Pressure :
Equipment Condition : ☒ Good Operate ☐ Fail

Reasons for calibration
☐ New Installation ☐ Service / Repaired ☒ 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 E2YCS011-522-00	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.

Mr. Chonchai Inthana (Technical Manager)



SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
128 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 Fax: +66 2643-8357, e-mail: service.thailand@sartorius.com

SARTORIUS

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 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 repeatability quantitatively.		The off-center loading error is yielded by the difference between the nominal of the load, i.e. 100 or 10g of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R110).	
Nominal Value : (Low Load) 5 g	5.00003 5.00001 5.00003 5.00002	50.00003 50.00003 50.00002 50.00003	Nominal value : 50 g Tolerance : 0.000015 g
Tolerance : 0.000015 g	5.00001 5.00002 5.00001 5.00002	50.00003 50.00003 50.00003 50.00002	Difference 1 - 2 -0.00001 3 0.00000 4 0.00001 5 0.00001 6 -
Nominal Value : (High Load) 50 g	50.00002 50.00001 50.00001 50.00002	50.00003 50.00003 50.00003 50.00002	
Tolerance : 0.000015 g	50.00002 50.00002 50.00002 50.00002	50.00003 50.00003 50.00003 50.00002	
Standard Deviation	0.000008	0.000005	

Linearity

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

Tolerance 0.00004 g			
Nominal Value	Conventional Mass Value	Displayed Value	Deviation
(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

SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huiyewang, Huiyewang, Bangkok 10110
Tel: +66 2043 8301-9 Fax: +66 2043 4307, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

REVIEW BY: Thanyakul
APPROVED BY: [Signature]
DATE: 21/01/2024

Model Number: MSE125P-100-DU
Description: Semi-micro Balance
Serial Number: C033108593
ID No.: RYG_EN0004
Manufacturer: Sartorius

Certificate No.: 24B01007 CAL DATE
Issued Date: Friday, February 23, 2024
Reference No.: 229198

Page No.: 3 of 3

Calibration Results : Without Adjustment

Repeatability

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

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

Eccentricity (Off-center loading error)

The off-center loading error is yielded by the difference between the result of the load, i.e. 50 or 100 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to DIN, NIST).

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

Linearity

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

Tolerance	0.0001	g			
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty	
(g)	(g)	(g)	(g)	(g)	
65	65.0000	65.0000	0.0000	0.00015	
70	70.0000	70.0000	0.0000	0.00015	
75	75.0001	75.0000	-0.0001	0.00015	
80	80.0001	80.0000	-0.0001	0.00015	
85	85.0001	85.0000	-0.0001	0.00015	
90	90.0001	90.0000	-0.0001	0.00015	
95	95.0001	95.0000	-0.0001	0.00015	
100	100.0000	100.0000	0.0000	0.00026	
110	110.0000	110.0000	0.0000	0.00026	
120	120.0000	120.0000	0.0000	0.00026	

End of Report

SOP FM 33 03 February 2022

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Agilent CrossLab Compliance Services

Certificate of System Qualification

GC-OQ - GCMS-OQ

REVIEW BY: Suchada T.
APPROVED BY: [Signature]
DATE: 19 Oct 24

System ID: GM-2
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Phathanakan 40, Phathanakan Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250
Date: April 18, 2023 3:15:25 PM
EOP Name: AgilentRecommended, AgilentRecommended
EOP Revision: GC.02.51, GCMS.02.51
Overall Qualification Status: Pass

System Inspection and Basic Safety and Operation

Name: 7890
Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status
Pass

Inlet Pressure Accuracy

Name: 7890
Front: MMI

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

Overall Inlet Pressure Accuracy Test Status
Pass

GC Oven Temperature Accuracy

Name: 7890

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

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Agilent CrossLab Compliance Services

Setpoint Status: Pass
Zone: Oven
Setpoint/Actual: 230.0 / 230.1 °C
Accuracy: 0.1 °C
Agilent Recommended: >= -1.0 °C setpoint in K (-5.0 °C) <= 1.0 °C setpoint in K (5.0 °C)

Setpoint Status: Pass
Zone: Oven
Setpoint/Actual: 100.0 / 100.4 °C
Accuracy: 0.4 °C
Agilent Recommended: >= -1.0 °C setpoint in K (-3.7 °C) <= 1.0 °C setpoint in K (3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: 7890
Setpoint Status: Pass
Setpoint/Average: 100.0 / 100.4 °C
Stability: 0.0 °C
Agilent Recommended: <= 0.5

Overall GC Oven Temperature Stability Test Status

Pass

Log Amp

Tested Combination1: Front MMI / External SQ
Name: 5975C Inert XL with TAD
Setpoint Status: Pass

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

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Agilent CrossLab Compliance Services

Overall Log Amp Test Status

Pass

RFPA

Tested Combination1: Front MMI / External SQ
Name: 5975C Inert XL with TAD
Setpoint Status: Pass
Amu: 1050 mV Drift After Five Minutes: 4 mV RFPA Voltage: 441 mV
Agilent Recommended: >= -100 and <= 100 <= 1100

Overall RFPA Test Status

Pass

Tune EI

Tested Combination1: Front MMI / External SQ
Name: 5975C Inert XL with TAD
Setpoint Status: Pass
Flament: 1
Setpoint Status: Pass
Flament: 2

Overall Tune EI Test Status

Pass

Scouting Run

Tested Combination1: Front MMI / External SQ
Injection Tower: 7693A
Name: 7693A
Source: El - Inert

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

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Setpoint Status: Completed

Injection Volume on Column: 1.0 µL

Overall Scouting Run Status

Completed

Signal to Noise EI

Tested Combination1 Front MMI / External SQ

Name: 5975C Inert XL with TAD

Source: EI - Inert Filament: 1

Setpoint Status: Pass

Signal to Noise: 456

Agilent Recommended: >= 320

Source: EI - Inert Filament: 2

Setpoint Status: Pass

Signal to Noise: 2034

Agilent Recommended: >= 320

Overall Signal to Noise EI Test Status

Pass

Injection Precision

Tested Combination1 Front MMI / External SQ

Name: 7693A

Source: EI - Inert

Setpoint Status: Pass

Injection Volume on Column: 1.0 µL

Area RSD: 1.66 % Retention Time RSD: 0.04 %

Agilent Recommended: <= 5.00 <= 1.00

Overall Injection Precision Test Status

Pass

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

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Mass Ratio Precision

Tested Combination1 Front MMI / External SQ

Injection Tower

Name: 7693A

Source: EI - Inert

Setpoint Status: Pass

Injection Volume on Column: 1.0 µL

Area Mass 1

Abundance's

RSD: 1.66 %

Agilent Recommended: <= 5.00

Pass

Mass Ratio

0.39 %

Agilent Recommended: <= 5.00

Pass

Overall Mass Ratio Precision Test Status

Pass

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

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Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

System ID GM-2
Manufacturer Agilent Technologies
Name 7890
Flow Data Input Manual Data
Temperature Data Input Manual Data or Other Data Logging

Tested Combination1

Injection Technique Injection Tower
Inlet Front
Detector External
LTM Included? No

Sampler 1

Manufacturer Agilent Technologies
Type Injection Tower
Name 7693A
Model Number G4519A
Serial Number CN10120123
Firmware Revision A.10.08
Usage Sample Injection
Location Front
Syringe Volume (µL) 10Date: April 18, 2023 3:15:25 PM
System ID: GM-2

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Sampler 2

Manufacturer Agilent Technologies
Type Tray
Name 7893A
Model Number G4514A
Serial Number CN10060099
Firmware Revision A.10.16
Vial Heater Not installed

Mainframe 1

Manufacturer Agilent Technologies
Name 7890
Model Number G3440A
Serial Number CN10141049
Firmware Revision A.01.16
Oven Type Standard

Inlet 1

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

Detector 1

Manufacturer Agilent Technologies
Name Mass Spectrometer
Type Mass Spectrometer
Location ExternalDate: April 18, 2023 3:15:25 PM
System ID: GM-2

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Mass Spectrometer 1

Manufacturer	Agilent Technologies
Type	SQ
Name	5975C inert XL with TAD
Serial Number	US10153217
Firmware Revision	5.02.12
High Vacuum System	Turbo Pump
Scouting Run Standard	OPN Std

MS EI Source 1

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

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

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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:	April 18, 2023
Reason for Signature:	Executed protocol and published this original version of document

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

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User Name: supasak.nimsongtham
Hostname: SGG1115H6C

System ID: GM-2
Print Date: April 18, 2023 3:15:31 PM

ALS GM2 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 18, 2023 2:14:25 PM	Audit	Session Created	Session	None
April 18, 2023 2:14:23 PM	Start	Configuration	Session	None
April 18, 2023 2:14:23 PM	Audit	Endorsement	Unlocking	User is Field Engineer and does not require an unlock code
April 18, 2023 2:15:04 PM	Audit	Exp. Loaded	Session	EDP details for primary technique [S6] - File path: [Protocol]Pasha\Gut\Conf\Gunt\Inert\2.51\Ge02.51.eqp], EQP File Name: [Ge02.51.eqp], EQP Name: [AgilentRecommended]Photo unit Flexion [Ge02.51] EQP details for hyphenated technique [G04]: File path: [Protocol]Pasha\Gut\Conf\Gunt\Inert\2.51\G04.02.51.eqp], EQP File Name: [G04.02.51.eqp], EQP Name: [AgilentRecommended]
April 18, 2023 2:15:09 PM	End	Configuration	Session	None
April 18, 2023 2:15:11 PM	Start	Configuration	Session	OO
April 18, 2023 2:16:11 PM	Start	Execution	System Inspection and Basic Safety and Operation - 7800 - Qualitative Test - No samples reanalyzed	None
April 18, 2023 2:17:27 PM	End	Execution	System Inspection and Basic Safety and Operation - 7800 - Qualitative Test - No samples reanalyzed	Run Count: 1

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

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User Name: supasak.nimsongtham
Hostname: SGG1115H6C

System ID: GM-2
Print Date: April 18, 2023 3:15:28 PM

ALS GM2 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 18, 2023 2:17:28 PM	Start	Execution	Inlet Pressure Accuracy - Front AMI - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
April 18, 2023 2:17:33 PM	End	Execution	Inlet Pressure Accuracy - Front AMI - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count: 1
April 18, 2023 2:17:36 PM	Start	Execution	GC Oven Temperature Accuracy - 7800 - Temperature - Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
April 18, 2023 2:18:00 PM	Audit	Data	GC Oven Temperature Accuracy - 7800 - Temperature - Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
April 18, 2023 2:18:01 PM	End	Execution	GC Oven Temperature Accuracy - 7800 - Temperature - Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
April 18, 2023 2:18:03 PM	Start	Execution	GC Oven Temperature Accuracy - 7800 - Temperature - Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
April 18, 2023 2:18:20 PM	Audit	Data	GC Oven Temperature Accuracy - 7800 - Temperature - Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
April 18, 2023 2:18:22 PM	End	Execution	GC Oven Temperature Accuracy - 7800 - Temperature - Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
April 18, 2023 2:18:44 PM	Start	Execution	GC Oven Temperature Stability - 7800 - Temperature - Oven - S: 100.0°C - L: <= 0.5°C	None

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

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User Name: supasak.nimsingtham
Hostname: SC01115HNC

System ID: GM-2
Print Date: April 18, 2023 3:15:26 PM

ALS GM2 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 18, 2023 2:18:51 PM	Audit	Date	GC Oven Temperature Stability	Manual Data Entry - 7882 - Temperature : Oven - S:100.0°C - L: <= 6.8°C
April 18, 2023 2:19:33 PM	End	Execution	GC Oven Temperature Stability	Run Count: 1 - 7882 - Temperature : Oven - S:100.0°C - L: <= 6.8°C
April 18, 2023 2:19:38 PM	Start	Execution	Log Amp - 5975C Inert XL with TAD SQ - Source: EI - Inert	None
April 18, 2023 2:19:49 PM	End	Execution	Log Amp - 5975C Inert XL with TAD SQ - Source: EI - Inert	Run Count: 1
April 18, 2023 2:19:49 PM	Start	Execution	RFPA - 5975C Inert XL with TAD SQ - Source: EI - Inert	None
April 18, 2023 2:30:54 PM	End	Execution	RFPA - 5975C Inert XL with TAD SQ - Source: EI - Inert	Run Count: 1
April 18, 2023 2:32:57 PM	Start	Execution	Turn EI - 5975C Inert XL with TAD SQ - Source: EI - Inert Flamelet 1 (Qualitative - No response associated)	None
April 18, 2023 2:34:06 PM	End	Execution	Turn EI - 5975C Inert XL with TAD SQ - Source: EI - Inert Flamelet 1 (Qualitative - No response associated)	Run Count: 1
April 18, 2023 2:34:07 PM	Start	Execution	Turn EI - 5975C Inert XL with TAD SQ - Source: EI - Inert Flamelet 2 (Qualitative - No response associated)	None
April 18, 2023 2:34:29 PM	End	Execution	Turn EI - 5975C Inert XL with TAD SQ - Source: EI - Inert Flamelet 2 (Qualitative - No response associated)	Run Count: 1

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

Page 12 / 16

User Name: supasak.nimsingtham
Hostname: SC01115HNC

System ID: GM-2
Print Date: April 18, 2023 3:15:33 PM

ALS GM2 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 18, 2023 2:34:29 PM	Start	Execution	Scouting Run - Injection Tower, Front MM, SQ - Source: EI - Inert- Part of GCMS System Preparation	None
April 18, 2023 2:34:56 PM	Audit	Data	Scouting Run - Injection Tower, Front MM, SQ - Source: EI - Inert- Part of GCMS System Preparation	Data File Path: E:\GM-2 Front MM, SQ - Source: EI - C02023\PMRP_P1_001.D\DATA. MS
April 18, 2023 2:35:12 PM	End	Execution	Scouting Run - Injection Tower, Front MM, SQ - Source: EI - Inert- Part of GCMS System Preparation	Run Count: 1
April 18, 2023 2:35:13 PM	Start	Execution	Signal to Noise EI - Injection Tower, Front MM, SQ - Source: EI - Inert using Flamelet 1 - L: >= 320	None
April 18, 2023 2:35:24 PM	Audit	Data	Signal to Noise EI - Injection Tower, Front MM, SQ - Source: EI - Inert using Flamelet 1 - L: >= 320	Data File Path: E:\GM-2 C02023\SNIF_1_001.D\DATA. MS
April 18, 2023 2:35:45 PM	End	Execution	Signal to Noise EI - Injection Tower, Front MM, SQ - Source: EI - Inert using Flamelet 1 - L: >= 320	Run Count: 1
April 18, 2023 2:35:47 PM	Start	Execution	Signal to Noise EI - Injection Tower, Front MM, SQ - Source: EI - Inert using Flamelet 2 - L: >= 320	None
April 18, 2023 2:36:52 PM	Start	Execution	Injection Precision - Injection Tower, Front MM, SQ - Source: EI - Inert L (Area) <= 5.00% - L (Rel. Time) <= 1.00%	None

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

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User Name: supasak.nimsingtham
Hostname: SC01115HNC

System ID: GM-2
Print Date: April 18, 2023 3:15:26 PM

ALS GM2 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 18, 2023 2:38:29 PM	Audit	Date	Injection Precision - Injection Tower, Front MM, SQ - Source: EI - Inert L (Area) <= 5.00% - L (Rel. Time) <= 1.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:38:29 PM	Audit	Date	Injection Precision - Injection Tower, Front MM, SQ - Source: EI - Inert L (Area) <= 5.00% - L (Rel. Time) <= 1.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:38:30 PM	Audit	Date	Injection Precision - Injection Tower, Front MM, SQ - Source: EI - Inert L (Area) <= 5.00% - L (Rel. Time) <= 1.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:38:30 PM	Audit	Date	Injection Precision - Injection Tower, Front MM, SQ - Source: EI - Inert L (Area) <= 5.00% - L (Rel. Time) <= 1.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:38:30 PM	Audit	Date	Injection Precision - Injection Tower, Front MM, SQ - Source: EI - Inert L (Area) <= 5.00% - L (Rel. Time) <= 1.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:38:30 PM	Audit	Date	Injection Precision - Injection Tower, Front MM, SQ - Source: EI - Inert L (Area) <= 5.00% - L (Rel. Time) <= 1.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:38:30 PM	Audit	Date	Injection Precision - Injection Tower, Front MM, SQ - Source: EI - Inert L (Area) <= 5.00% - L (Rel. Time) <= 1.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:38:30 PM	Audit	Date	Injection Precision - Injection Tower, Front MM, SQ - Source: EI - Inert L (Area) <= 5.00% - L (Rel. Time) <= 1.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:38:30 PM	Audit	Date	Injection Precision - Injection Tower, Front MM, SQ - Source: EI - Inert L (Area) <= 5.00% - L (Rel. Time) <= 1.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:38:42 PM	End	Execution	Injection Precision - Injection Tower, Front MM, SQ - Source: EI - Inert L (Area) <= 5.00% - L (Rel. Time) <= 1.00%	Run Count: 1
April 18, 2023 2:38:45 PM	Start	Execution	Mass Ratio Precision - Injection Tower, Front MM, SQ - Source: EI - Inert - L (RSD) <= 5.0%	None

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

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User Name: supasak.nimsingtham
Hostname: SC01115HNC

System ID: GM-2
Print Date: April 18, 2023 3:15:26 PM

ALS GM2 Transaction Log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
April 18, 2023 2:37:04 PM	Audit	Date	Mass Ratio Precision - Injection Tower, Front MM, SQ - Source: EI - Inert - L (RSD) <= 5.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:37:04 PM	Audit	Date	Mass Ratio Precision - Injection Tower, Front MM, SQ - Source: EI - Inert - L (RSD) <= 5.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:37:04 PM	Audit	Date	Mass Ratio Precision - Injection Tower, Front MM, SQ - Source: EI - Inert - L (RSD) <= 5.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:37:04 PM	Audit	Date	Mass Ratio Precision - Injection Tower, Front MM, SQ - Source: EI - Inert - L (RSD) <= 5.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:37:04 PM	Audit	Date	Mass Ratio Precision - Injection Tower, Front MM, SQ - Source: EI - Inert - L (RSD) <= 5.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:37:04 PM	Audit	Date	Mass Ratio Precision - Injection Tower, Front MM, SQ - Source: EI - Inert - L (RSD) <= 5.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:37:04 PM	Audit	Date	Mass Ratio Precision - Injection Tower, Front MM, SQ - Source: EI - Inert - L (RSD) <= 5.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:37:04 PM	Audit	Date	Mass Ratio Precision - Injection Tower, Front MM, SQ - Source: EI - Inert - L (RSD) <= 5.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:37:04 PM	Audit	Date	Mass Ratio Precision - Injection Tower, Front MM, SQ - Source: EI - Inert - L (RSD) <= 5.00%	Data File Path: E:\GM-2 C02023\PMRP_P1_001.D\DATA.MS
April 18, 2023 2:37:17 PM	End	Execution	Mass Ratio Precision - Injection Tower, Front MM, SQ - Source: EI - Inert - L (RSD) <= 5.00%	Run Count: 1
April 18, 2023 2:37:23 PM	Start	Execution	Signal to Noise EI - Injection Tower, Front MM, SQ - Source: EI - Inert using Flamelet 2 - L: >= 320	None

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

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

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

Function: DC voltage measurement	Range: 2000 mV		
Standard Value	UUC* Reading	Error	Uncertainty
(mV)	(mV)	(mV)	(± µV)
-200.0000	-199.9	0.1	59
-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.

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a 1183422



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2717-8000-29 FAX: 0-2719-9484



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.Pluakdaeng,
Rayong 21140, Thailand
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with standard
voltage calibrator and direct measurement with
certified reference material (CRM)
- CP-CH8 by comparison with standard thermometer

Calibrated by : Warakorn Lemgagrakul

Approved by :
Approved Signatory

() Sathip Meangmai
() Warakorn Lemgagrakul
(x) Ponpan Palpim

Issue Date : 19 December 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 & Equipment Calibration and Testing Services

A U061696



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 6.986	CPA chem	931859	01 Oct 2024
pH 9.997	CPA chem	940105	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
	pH	mV	mV	pH		
pH Meter S/N.: B834291445	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 1193852



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 : InLab®Expert 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



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhroi, Saraburi 18110, Thailand.

Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100

Bangkok Tel : +668 9205 6851 , +668 8247 2360

Website : www.scieco.co.th E-Mail : calibrate@scg.com

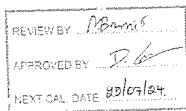


Certificate No. T230116

Page 1 of 4

Certificate of Calibration

Equipment : Chamber (Cooling Room)
Manufacturer : MODULAR
Model : IREVCOHCOO
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.Pluakdaeng, Rayong 21140
Customer Location : Laboratory
Date of Receipt : 23 January 2023
Calibrated By : Atiphong Rongrat (Technician)
Approved By : Boonchai Suriyawong (Site Calibration Manager)
Date of Issue : 07 FEB 2023



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 Metrological Center.

FM-L15-117-15-05-63



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhroi, Saraburi 18110, Thailand.



Certificate No. T230116

Page 2 of 4

Calibration Report

Equipment : Chamber (Cooling Room)
Date of Calibration : 25 January 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	TN141-TN150	T222123	5 October 2023
TC	TYPE T	TN151-TN160	T222123	5 October 2023
DATA LOGGER	34970A	T150	T222123	5 October 2023

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 : Boonchai Suriyawong

FM-L15-117-15-05-63



Metrological Center

SCI ECO Services Company Limited

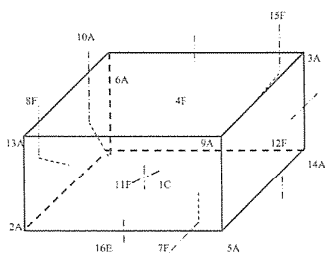
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Certificate No. T230116

Page 3 of 4

Calibration Report



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

1C = TN141	12F = TN152
2A = TN142	13A = TN153
3A = TN143	14A = TN154
4F = TN144	15F = TN155
5A = TN145	16E = TN156
6A = TN146	
7F = TN147	
8F = TN148	
9A = TN149	
10A = TN150	
11F = TN151	

Approved By : Boonchai Suriyawong

FM-L15-117-15-05-63



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Certificate No. T230116

Page 4 of 4

Calibration Report

Measurement Results

Calibration Point	Average Standard Reading at each position (°C)									
	TN141	TN142	TN143	TN144	TN145	TN146	TN147	TN148	TN149	TN150
3.0	3.03	3.16	3.15	3.19	3.45	3.47	3.21	3.35	3.54	3.45
	TN151	TN154	TN155	TN156						
	3.28	3.22	3.28	3.21						

Chamber (Cooling Room)			Temperature Distribution			
Setting (°C)	Reading (°C)		Stability (±°C)	Uniformity (°C)	Uncertainty (±°C)	Coverage Factor k
	Min.	Max				
3.0	2.8	4.1	3.5	1.20	1.20	2.07

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 : Boonchai Suriyawong

FM-L15-117-15-05-63

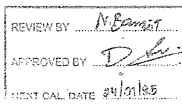


TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL: 0-2717-3090 FAX: 0-2719-9484

Cert.No.: 23TW169
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 5, 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 Azide Modification Method
Tested by : Waleek Sirinthesan
Approved by :
() Malee Butkruea
(x) Sathip Meangmai
() Warakorn Lemgagtrakul
Issue Date : 26 July 2023



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Cert.No.: 23TW168
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)	DO Meter Reading	Standard Deviation
(mg/L)	(mg/L)	(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)
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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2717-3090 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 : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : Preecha Hiahio
Approved by :
() Pornthippa Tamayakul
() Malee Butkruea
(x) Suwit Imjai
Issue Date : 31 July 2023

The Uncertainties are for a confidence probability of approximately 95%

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A 0053616



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

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

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-
- | Instrument | Serial No. | Cert. No. | Traceable | Due Date |
|------------------------|------------|-----------|-----------|-------------|
| 1) Digital Thermometer | 2188080 | 22H285 | 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



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534/4 PATTANAKARN ROAD 501 H. SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0 2717-3000-29 FAX. 0 2719-9484



Cert. No.: 23TM952
Page: 1 of 3

Certificate of Calibration

Equipment : Low Temp. Incubator
Manufacturer : Memmert
Model : IPP750
Serial No. : V818 0084
ID No. : RVG_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 : 29 May 2023
Calibration Date : 29 May 2023
Ambient Temperature : $(26 \pm 10) ^\circ\text{C}$
Relative Humidity : $(50 \pm 30) \%$
Calibrated by : Man Pattansongpaiboon
Approved by :
() Pornthippa Tameyskul
() Mailee Bulkrusa
() Suwit Imjai

Issue Date : 7 June 2023

The Uncertainties are for a confidence probability of approximately 95%

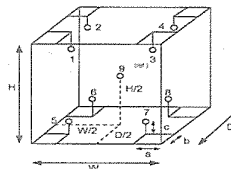
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approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.

A 0054967



Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2305-0898OC-2
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).
The temperature scale used was based on ITS-90.
Condition of this result of calibration
1. Reference standard instrument:-
Instrument Model Serial No. Cert. No. Due Date
1) Data Acquisition 34972A MY57013711 22LM93 02 Jul 2023
2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.
Result of Calibration : () Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 23TM952
Page: 2 of 3



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 = 0.75 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	23	23
REL.Humid. (%)	54	55
AC Supply (Volt)	223	222

Position :	Ref. Std. ID No.:
1	18-18RTD-01
2	18-18RTD-02
3	18-18RTD-03
4	18-18RTD-04
5	18-18RTD-05
6	18-18RTD-10
7	18-18RTD-07
8	22-18RTD-08
9 (ref.)	18-18RTD-09

A 1165130



Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2305-0898OC-2
Result of Calibration : () Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 23TM952
Page: 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation Factor k	Coverage
20.0	20.0	20.0	0.019	0.72	1.0	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	19.547	19.760	19.487	19.529	19.408	20.139	20.112	20.408	20.116	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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A 1165129



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534/4 PATTANAKARN ROAD 501 H. SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0 2717-3000-29 FAX. 0 2719-9484



Cert.No.: 23CG3704
Page: 1 of 2

Certificate of Calibration

Equipment : Burette
Capacity : 50 mL
Serial No. :
ID. No. : RVG_EN0215
Manufacturer : Witeg
Made in : Germany
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
Rayong Branch
616/10 Moo 5, T. Maenam Khu,
A. Pluakdaeng, Rayong 21140 Thailand
Ambient Temperature : $(20 \pm 2.5) ^\circ\text{C}$
Relative Humidity : $(50 \pm 10) \%$
Barometric Pressure : 756 mmHg
Calibration Procedure : ASTM E 542 - 01
Calibrated by : Srisuda Khamtha

Approved by :
Approved Signatory

() Porpan Paipim
() Srisuda Khamtha
() Sa-nguankam Wongsa

Issue Date : 28 September 2023

The Uncertainties are for a confidence probability of approximately 95%

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approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.

A 0058881



Equipment : Burette
Received Date : 19 September 2023
Condition As-Received : Used Item
Calibration Date : 25 September 2023
Reference : 2308-0635DSC-31

Cert.No.: 23CG3704
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	MS204TS	C226356983	140RC010	TH2068-012	METTLER	29 Sep 2023
2) Thermo-Hygrograph	THDX-CE	00016540	140EC001	23H1275	TPA	09 June 2024
3) Thermometer	-	1594592	140EC010	23I158	TPA	12 Feb 2024

This certification is traceable to SI Unit

- The certificate is valid only to the item calibrated on date and place of calibration.
- 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	10.0224	0.0082	2.00
20	20.0064	0.0085	2.00
30	29.9931	0.0089	2.00
40	39.9910	0.0094	2.00
50	49.9806	0.010	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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1182477

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2543 8361-6, e-mail: service.thailand@sartorius.com



SARTORIUS

NSG-TS-17025
CALIBRATION 0416

Certificate of Calibration

REVIEW BY: *Tharvit*
APPROVED BY: *D*
NEXT CAL DATE: 02/02/2025

Model Number : MSE224S-100-DU
Description : Analytical Balance
Serial Number : 0026207038
ID No. : RYG_EN0002
Manufacturer : Sartorius
Certificate No. : 24510089
Issued Date : Friday, February 23, 2024
Reference No. : 229195
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
Calibration Procedure No. : This calibration was conducted by Using in-house calibration procedure number (WI-003)
Based on UKAS LAB 14 : 2019

Metrological data :
Capacity : 220 g Readability : 0.0001 g
Ambient Conditions :
Temperature : 24.2 °C ± 5.0 °C
Humidity : 57.0 % RH ± 10.0 % RH
Pressure : ±
Reasons for calibration
☐ New Installation ☐ Service / Required ☒ 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/Balometer/Temp. Lutron MHB-382SD	DKSH	C19231845	23-Aug-2024

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

Mr.Chonchai Inthana (Technical Manager)
SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2543 8361-6 Fax: +66 2543 8367, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number : MSE224S-100-DU
Description : Analytical Balance
Serial Number : 0026207038
ID No. : RYG_EN0002
Manufacturer : Sartorius
Certificate No. : 24BC10069
Issued Date : Friday, February 23, 2024
Reference No. : 229195
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 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 practiced 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	199.9999	Nominal Value :	100	g
20 g	20.0000	200.0000	Tolerance	0.0004	g
Tolerance	0.0001 g	200.0000			
	20.0000	199.9999			
	20.0001	200.0000			
Nominal Value : (High Load)	19.9999	200.0000			
200 g	20.0000	200.0000			
Tolerance	0.0001 g	199.9999			
	19.9999	200.0001			
	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.

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



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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53/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2717-3000-23 FAX: 0-2719-9484



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. Pluakdaeng,
Rayong 21140 Thailand
Location : Oven Room
Received Order : 21 March 2024
Calibration Date : 21 March 2024
Ambient Temperature : (26 ± 1) °C
Relative Humidity : (50 ± 3) %
Calibrated by : Man Pattanapongpaiboon
Approved by : *Man Pattanapongpaiboon*
Approved Signatory
() Pormthippa Tameyakul
() Unnopphol Harachai
(✓) Suwit Imjai
Issue Date : 22 March 2024

REVIEW BY: *Tharvit*
APPROVED BY: *D*
NEXT CAL DATE: 21/09/25

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

Cert. No.: 24TM632
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.

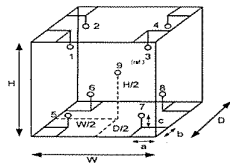
3. This certification is traceable to the International System of Unit.

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 = 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

Cert. No.: 24TM632
Page : 3 of 3

Result of Calibration :-

(*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

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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TEL. 0 2717 0000-29 FAX. 0 2719 9484



Cert.No.: 23CH1068
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 : 2309-00100SC-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 :

(✓) Sathip Meangmai
() Warakorn Lemgagrakul
() Ponpan Paipim

Issue Date : 7 September 2023

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the board of Corporate Services : Equipment Calibration and Testing Services

A 0050059



Cert.No.: 23CH1068
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	23435	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	885120	28 Mar 2024
1413.0 µS/cm	CPA Chem	913596	14 July 2024
12.880 mS/cm	CPA Chem	885123	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.: 5623251060

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
12.880 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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a 1178950



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. Pluskdaeng,
Rayong 21140 Thailand

Location : Oven Room
Received Order : 21 March 2024
Calibration Date : 21 - 22 March 2024
Ambient Temperature : $(26 \pm 10) ^\circ\text{C}$
Relative Humidity : $(50 \pm 30) \%$

Calibrated by : Man Pattanapongpaiboon

Approved by :

() Pornthippa Tamayakul
() Unnopphol Harachai
(✓) Suwit Imjai

Issue Date : 23 March 2024

The Uncertainties are for a confidence probability of approximately 95%

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REVIEW BY *Thanitak*
APPROVED BY *D. Kham*
NEXT CAL. DATE : 21/03/25



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2403-0563OC-3
Procedure Used :-

Cert. No.: 24TM634
Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument Serial No. Cert. No. Traceable Due Date
1) Data Acquisition MY57013711 23LM115 TPA 11 Jul 2024

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

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

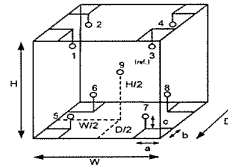
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration : () Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. (°C)	27	27
REL.Humid. (%)	59	59
AC Supply (Volt)	224	223



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

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	22-18RTD-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
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 Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
104.0	104.169	103.506	103.896	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 %.

-000-



Certificate of Calibration

Cert. No.: 24TM635
Page : 1 of 3

Equipment : Water Bath
Manufacturer : Memmert
Model : WNB22
Serial No. : L513.0648
ID No. : RYG_EN0081

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

Location : Wet Chemistry Lab

Received Order : 21 March 2024
Calibration Date : 21 March 2024
Ambient Temperature : $(26 \pm 10) ^\circ\text{C}$
Relative Humidity : $(50 \pm 30) \%$

Calibrated by : Man Pattanapongpaiboon

Approved by :

() Pornthippa Tamayakul
() Unnopphol Harachai
(✓) Suwit Imjai

Issue Date : 23 March 2024

REVIEW BY *Thanitak*
APPROVED BY *D. Kham*
NEXT CAL. DATE : 21/09/25

The Uncertainties are for a confidence probability of approximately 95%

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



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2403-0563OC-4
Page : 2 of 3

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.

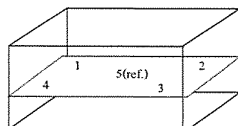
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- () Without Adjustment

Function of UUC* : Temperature Source

Heat transfer medium used : Water

	Environmental		AC Voltage Supply
	(°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
Page : 3 of 3

Result of Calibration :- () Without Adjustment
Function of UUC* : Temperature Source

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C)					Uncertainty (± °C)
			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 %.

-00-



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
574/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2717 8009-29 FAX: 0-2710 9954



Cert.No.: 23CH830
Page: 1 of 3

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : Seven2Go S2
Serial No. : C221115514
ID No. : RYG_FS0596
Condition As-Received : Used Item
Received Date : 30 June 2023
Calibration Date : 03 July 2023
Reference : 2305-094DSC-6
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch
616/10 Moo 5, T.Maenam Khu.
A.Pluksaeng, 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 Lernagatrakul

Approved by :

() Malee Butkruea
() Sathip Meangmai
() Warakorn Lernagatrakul

Issue Date : 6 July 2023

The Uncertainties are for a confidence probability of approximately 95 %

This certificate may not be reproduced without prior written consent of the issuer.
Approval of the Board of Corporate Services :

A 0055865



Cert.No.: 23CH830
Page: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument :-

Instrument Serial No. ID No. Cert. No. Due Date
1) Document Process Calibrator 54030049 130RC116 22E2769 24 Aug 2023
2) Ref. Standard Thermometer 4982054 110RC044 2211306 27 Oct 2023

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

2. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1635

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	863932	28 Dec 2024
pH 6.985	CPA chem	863933	28 Dec 2023
pH 10.010	CPA chem	863935	28 Dec 2023

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input		Actual Reading		Uncertainty of Measurement (± mV)	Coverage factor k
		pH	mV	mV	pH		
pH Meter	4.00	177.48	178	4.00	0.58	2.00	
S/N: C221115514	7.00	0.00	0	7.00	0.58	2.00	
	10.00	-177.48	-178	10.00	0.58	2.00	

a 1169603



Cert.No.: 23CH930
Page.: 3 of 3

Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (\pm)	Coverage factor k
pH Electrode S/N.: 2465853	4.008 6.986 10.010	4.01 6.99 10.01	182 10 -169	0.0085 0.0099 0.0095	2.05 2.00 2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe:

- Model : InLab®Expert Go-ISM
- Serial No. : 2465853
Dimension of probe:
- Length : 120 mm
- Diameter : 12 mm
- Immersion Depth : 100 mm

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (\pm °C)	Coverage factor k
25.0	25.003	25.2	0.197	0.13	2.00
30.0	30.002	30.2	0.198	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 %.

-000-

Valu.

n 1169602



Certificate of Calibration

Represent to Certificate of Calibration No. C29240007

Equipment: Block Digestion Unit
Model: KT-20s
Serial No. (or ID.): 5720210009/5770200073
Manufacturer: Gerhardt
Condition: In Condition
Certificate No.: C29240011
Issued Date: 22 March 2024
Job No.: WO-00020429
Page: 1 of 4
Digestion Block: 20 holes.

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

Environment Condition: Temperature: 25 °C \pm 0.7 °C
Humidity: 54 %RH \pm 4.1 %RH
Voltage: 225 VAC \pm 1.7 VAC

REVIEW BY	N. Bunt
APPROVED BY	[Signature]
NEXT CAL DATE	11/09/25

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

Calibration By: Mr. Thanathorn Phunook

Calibration Date: 11 March 2024

The Method used: In house method, base on by comparison with standard

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through N.M. Technical Center Laboratory (NTL)
Certificate No.: TC22/0080

[Signature]

(Mr. Thanathorn Phunook)
Person in charge

[Signature]

(Mr. Udon Srichana)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standards 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. This report shall not be reproduced except in full without approval of DKSH Technology Limited.

Lab Address: 2533 Sukhumvit Road, Bangkok, Thailand 10260
DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Thailand 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific/india
Delivering Growth - in Asia and Beyond

CAL-FM-C29-07: 20 Jul 2022



Certificate No.: C29240011

Page: 2 of 4

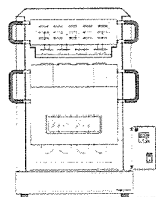
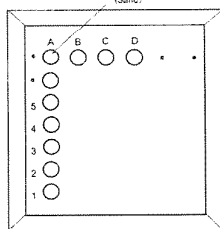


Fig. 1: Front view



Location of standard

Fig. 2: Digestion block

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the Digestion Block.

Measured Temperature: The average reading of working standard at any positions or location

Lab Address: 2533 Sukhumvit Road, Bangkok, Thailand 10260
DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Thailand 10260
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CAL-FM-C29-07: 20 Jul 2022



Certificate No.: C29240011

Page: 3 of 4

Calibration Results:

Pre Calibration

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (\pm °C)
A1				401.5	21.5	1.5
A2				401.2	21.2	1.5
A3				399.1	19.1	1.5
A4				397.8	17.8	1.5
A5				385.1	15.1	1.5
B1				396.6	16.6	1.5
B2				396.1	16.1	1.5
B3				392.9	12.9	1.5
B4				391.6	11.6	1.5
B5				390.7	10.7	1.5
C1	360	360	360	395.3	15.3	1.5
C2				395.6	15.6	1.5
C3				392.8	12.8	1.5
C4				391.7	11.7	1.5
C5				390.3	10.3	1.5
D1				397.6	17.6	1.5
D2				396.6	16.6	1.5
D3				395.0	15.0	1.5
D4				394.2	14.2	1.5
D5				393.6	13.6	1.5

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CAL-FM-C29-07: 20 Jul 2022

Calibration Results: Without adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	380	365	365	382.5	17.5	1.5
A2				382.4	17.4	1.5
A3				382.1	17.1	1.5
A4				379.7	14.7	1.5
A5				378.3	13.3	1.5
B1				380.1	15.1	1.5
B2				380.1	15.1	1.5
B3				378.5	13.5	1.5
B4				378.3	13.3	1.5
B5				379.1	14.1	1.5
C1				380.1	15.1	1.5
C2				380.1	15.1	1.5
C3				378.9	13.9	1.5
C4				378.2	13.2	1.5
C5				377.3	12.3	1.5
D1				380.5	15.5	1.5
D2				380.6	15.6	1.5
D3				378.1	13.1	1.5
D4				378.7	13.7	1.5
D5				377.7	12.7	1.5

The End of Certificate

DKSH Technology (Thailand) Co., Ltd.
DKSH Technology Limited
2533 ถนนสุขุมวิท ซอย 11 แขวงคลองตันเหนือ กรุงเทพมหานคร 10250
2533 Sukhumvit Road, Bangkok, Thailand, Bangkok 10250
Phone: +66 2639 7000 Email: info@calibration.dksh.com Website: www.dksh.com/en/thailand
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CAL-FM-C29-07 20 Jul 2022

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 type="checkbox"/>	<input type="checkbox"/>	6. สภาพฝาปิด	<input type="checkbox"/>	<input type="checkbox"/>	ไม่มี
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. สภาพตัวเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	8. สภาพแวดล้อม ณ สถานที่ตั้งเครื่อง	<input type="checkbox"/>	<input type="checkbox"/>	

ชื่อแนบมา :

Mr. Thanathorn Phunook
Service Engineer

DKSH Technology (Thailand) Co., Ltd.
DKSH Technology Limited
2533 ถนนสุขุมวิท ซอย 11 แขวงคลองตันเหนือ กรุงเทพมหานคร 10250
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BKK_EN0284

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Certificate of System Qualification

GC-00 + GCMS-00

System ID: GM-10
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Pathanakarn 40, Pathanakarn Rd., Kwang Suan Luang, Khet Suan Luang, Bangkok 10250

Date: May 25, 2023 11:05:07 AM
EQP Name: AgilentRecommended, AgilentRecommended
EQP Revision: GC.02.52, GCMS.02.51
Overall Qualification Status: Pass

REVIEW BY: Suchada T.
APPROVED BY: Watt S.
EFFECTIVE DATE: 25.05.23

CDS Logon Verification - GC

Logon: SESSIONNAME

Overall CDS Logon Verification - GC Test Status

Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Accuracy

Name: 7890
Front MMF

Setpoint Status: Pass

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

Date: May 25, 2023 11:05:07 AM
System ID: GM-10

Page 1 / 17

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Agilent CrossLab Compliance Services

Overall Inlet Pressure Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 230.0 230.0 °C

Accuracy: 0.0 °C

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

<= 1.0 % setpoint in K (5.0 °C)

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 100.0 100.0 °C

Accuracy: 0.0 °C

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

<= 1.0 % setpoint in K (3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: 7890

Setpoint Status: Pass

Setpoint/Average

Temperature: 100.0 100.0333 °C

Stability: 0.1 °C

Agilent Recommended: <= 0.5

Overall GC Oven Temperature Stability Test Status

Pass

Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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Tune EI

Tested Combination1

Front MMI / External TQ

Name: 7600D

Setpoint Status:

Pass

Filament:

1

Setpoint Status:

Pass

Filament:

2

Overall Tune EI Test Status

Pass

Scouting Run

Tested Combination1

Front MMI / External TQ

Name: Injection Tower

Source: 7693A

Source: EI - Extractor

Setpoint Status:

Completed

Injection Volume on Column:

1.0 µL

Overall Scouting Run Status

Completed

Instrument Detection Limit

Tested Combination1

Front MMI / External TQ

Name: Injection Tower

Source: 7693A

Source: EI - Extractor

Date: May 25, 2023 11:05:07 AM
System ID: GM-10

Page 3 / 17

Setpoint Status:

Pass

Injection Volume on Column:

1.0 µL

Minimum RSD:

10.98 %

Agilent Recommended:

<= 12.00

Status:

Pass

Instrument Detection Limit:

3.69552 µg

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: 7693A

Source: EI - Extractor

Setpoint Status:

Pass

Injection Volume on Column:

1.0 µL

RSD:

3.22 %

Agilent Recommended:

<= 15.00

Status:

Pass

Overall Mass Ratio Precision Test Status

Pass

Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

System ID GM-10
Manufacturer Agilent Technologies
Name 7690
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 CN18180003
Firmware Revision A.11.02
Usage Sample Injection
Location Front
Syringe Volume (µL) 10Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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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 7690
Model Number G3442B
Serial Number CN18153080
Firmware Revision B.02.05
Oven Type Standard

Inlet 1

Manufacturer Agilent Technologies
Name 7690
Type MMI
Location Front
Carrier Gas Helium
Control Type Electronic Pressure Control (EPC)
Purged Inlet Yes

Inlet 2

Manufacturer Agilent Technologies
Name 7690
Type SSL
Location Back
Carrier Gas Helium
Control Type Electronic Pressure Control (EPC)
Purged Inlet YesDate: May 25, 2023 11:05:07 AM
System ID: GM-10

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Detector 1

Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External

Mass Spectrometer 1

Manufacturer	Agilent Technologies
Type	TQ
Name	7000D
Serial Number	US1626U108
Firmware Revision	G.7000.085A
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 25, 2023 11:05:07 AM
System ID: GM-10

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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: Nattapat Hengcharoen
Logged On User Name: nattapat.hengcharoen@agilent.com
Signature Creation Date: May 25, 2023
Reason for Signature: Executed protocol and published this original version of document

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: May 25, 2023 11:05:07 AM
System ID: GM-10

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User Name: nattapat.hengcharoen System ID: GM-10
Hostname: ASBKXWQ269 Print Date: May 25, 2023 11:05:08 AM

ALS_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 1:32:30 PM	Audit	Session Created	Session	None
May 22, 2023 1:32:30 PM	Start	Configuration	Session	None
May 22, 2023 1:32:30 PM	Audit	End Session	Session	User is Final Engineer and does not require an unlock code
May 22, 2023 1:37:48 PM	Audit	Exp. Loaded	Session	EDP details for primary technique [24] - File path: [ProtocolPacks\GSM\Configurations\02.51\GSM-02.51.eop] EDP File Name: [GSM-02.51.eop] EDP Name: [AgilentRecommended]Pressure Reviewer [GSM-02.51] EDP details for hyphenated technique [GSM] - File path: [ProtocolPacks\GSM\Configurations\02.51\GSM-02.51.eop] EDP File Name: [GSM-02.51.eop] EDP Name: [AgilentRecommended]
May 22, 2023 1:37:52 PM	End	Configuration	Session	None
May 22, 2023 1:37:55 PM	Start	Configuration	Session	OO
May 22, 2023 1:37:55 PM	Start	Execution	CDS Login Verification - GC	None - Qualitative test
May 22, 2023 2:02:27 PM	Start	Execution	CDS Login Verification - GC	None - Qualitative test
May 22, 2023 2:02:29 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MUR, TO	None - Source - EI - Extractor - RSD L (Acq) <= 12.00% - RSD L (Int. Time) <= 1.00%

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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User Name: nattapat.hengcharoen System ID: GM-10
Hostname: ASBKXWQ269 Print Date: May 25, 2023 11:05:08 AM

ALS_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 2:02:37 PM	Start	Execution	CDS Login Verification - GC	None - Qualitative test
May 22, 2023 2:03:33 PM	End	Execution	CDS Login Verification - GC	Run Count: 1 - Qualitative test
May 22, 2023 2:34:48 PM	Start	Execution	System Inspection and Basic Safety and Operation - T800 - Qualitative Test - No reports associated	None
May 22, 2023 2:35:02 PM	End	Execution	System Inspection and Basic Safety and Operation - T800 - Qualitative Test - No reports associated	Run Count: 1
May 22, 2023 2:35:17 PM	Start	Execution	Inlet Pressure Accuracy - Front MUR - Pressure Controlled Inlet	None - S: 25.0 psi - L: <= 1.2 psi
May 22, 2023 2:35:22 PM	End	Execution	Inlet Pressure Accuracy - Front MUR - Pressure Controlled Inlet	Run Count: 1 - S: 25.0 psi - L: <= 1.2 psi
May 22, 2023 2:35:24 PM	Start	Execution	GC Oven Temperature Accuracy - T800 - Temperature	None - Oven - S: 225.0°C - L: <= -1.0 AND <= 1.0 % setpoint in K
May 22, 2023 2:35:48 PM	Audit	Data	GC Oven Temperature Accuracy - T800 - Temperature	Manual Data Entry - Oven - S: 225.0°C - L: <= -1.0 AND <= 1.0 % setpoint in K
May 22, 2023 2:35:54 PM	End	Execution	GC Oven Temperature Accuracy - T800 - Temperature	Run Count: 1 - Oven - S: 225.0°C - L: <= -1.0 AND <= 1.0 % setpoint in K

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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User Name: natipasthengcharoen
Host Name: ASB00W2265System ID: GM-10
Print Date: May 25, 2023 11:05:09 AM

ALS_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 2:35:45 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
May 22, 2023 2:59:09 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.0% - RSD L (Rel. Time): <= 1.00%	None
May 22, 2023 3:08:09 PM	Start	Execution	Scouting Run - Injection Tower, Front MM, TQ - Source - EI - Extractor - Part of GCMS System Preparation	None
May 22, 2023 3:10:34 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.0% - RSD L (Rel. Time): <= 1.00%	None
May 22, 2023 3:12:01 PM	Start	Execution	Mass Ratio Prediction - Injection Tower, Front MM, TQ - Source - EI - Extractor - L (RSD): <= 5.00%	None
May 22, 2023 3:17:49 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
May 22, 2023 3:17:55 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
May 22, 2023 3:18:06 PM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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User Name: natipasthengcharoen
Host Name: ASB00W2265System ID: GM-10
Print Date: May 25, 2023 11:05:09 AM

ALS_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 22, 2023 3:18:07 PM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
May 22, 2023 3:29:07 PM	Start	Execution	Scouting Run - Injection Tower, Front MM, TQ - Source - EI - Extractor - Part of GCMS System Preparation	None
May 22, 2023 3:39:10 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.0% - RSD L (Rel. Time): <= 1.00%	None
May 22, 2023 4:02:09 PM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.0% - RSD L (Rel. Time): <= 1.00%	None
May 22, 2023 4:03:06 PM	Start	Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
May 22, 2023 4:03:52 PM	Audit	Data	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
May 22, 2023 4:03:54 PM	End	Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count: 1
May 23, 2023 3:58:15 PM	Audit	AcqClosed	Session	None
May 24, 2023 4:03:19 PM	Audit	AcqRestarted	Session	None
May 24, 2023 4:14:45 PM	Audit	AcqClosed	Session	None
May 25, 2023 10:13:57 AM	Audit	AcqRestarted	Session	None
May 25, 2023 10:27:12 AM	Audit	SessionReloaded	Session	None

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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User Name: natipasthengcharoen
Host Name: ASB00W2265System ID: GM-10
Print Date: May 25, 2023 11:05:09 AM

ALS_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 12:27:13 AM	Start	Qualification	Session	OQ
May 25, 2023 12:27:16 AM	Start	Execution	Tune EI - 70000 TQ - Source - None EI - Extractor Element 1 (Qualitative - No setpoints associated)	None
May 25, 2023 12:27:42 AM	Start	Execution	Tune EI - 70000 TQ - Source - None EI - Extractor Element 1 (Qualitative - No setpoints associated)	None
May 25, 2023 12:27:56 AM	End	Execution	Tune EI - 70000 TQ - Source - None EI - Extractor Element 1 (Qualitative - No setpoints associated)	Run Count: 1
May 25, 2023 12:27:57 AM	Start	Execution	Tune EI - 70000 TQ - Source - None EI - Extractor Element 2 (Qualitative - No setpoints associated)	None
May 25, 2023 12:28:07 AM	End	Execution	Tune EI - 70000 TQ - Source - None EI - Extractor Element 2 (Qualitative - No setpoints associated)	Run Count: 1
May 25, 2023 12:28:08 AM	Start	Execution	Scouting Run - Injection Tower, Front MM, TQ - Source - EI - Extractor - Part of GCMS System Preparation	None
May 25, 2023 12:28:17 AM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.0% - RSD L (Rel. Time): <= 1.00%	None
May 25, 2023 12:28:20 AM	Start	Execution	Scouting Run - Injection Tower, Front MM, TQ - Source - EI - Extractor - Part of GCMS System Preparation	None

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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User Name: natipasthengcharoen
Host Name: ASB00W2265System ID: GM-10
Print Date: May 25, 2023 11:05:09 AM

ALS_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:28:58 AM	Audit	Data	Scouting Run - Injection Tower, Front MM, TQ - Source - EI - Extractor - Part of GCMS System Preparation	Data File Path: D:\MassHunter\GCMSR\data\AgilentGC_2023\DCI_01.D
May 25, 2023 10:29:24 AM	End	Execution	Scouting Run - Injection Tower, Front MM, TQ - Source - EI - Extractor - Part of GCMS System Preparation	Run Count: 1
May 25, 2023 10:29:25 AM	Start	Execution	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.0% - RSD L (Rel. Time): <= 1.00%	None
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.0% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMSR\data\AgilentGC_2023\DCI_01.D
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.0% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMSR\data\AgilentGC_2023\DCI_02.D
May 25, 2023 10:30:59 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.0% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMSR\data\AgilentGC_2023\DCI_03.D
May 25, 2023 10:30:59 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - Source - EI - Extractor - RSD L (Area): <= 12.0% - RSD L (Rel. Time): <= 1.00%	Data File Path: D:\MassHunter\GCMSR\data\AgilentGC_2023\DCI_04.D

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Date: May 25, 2023 11:05:07 AM
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User Name: natipatchangcharoen
Hostname: ABBK009255System ID: GM-10
Print Date: May 25, 2023 11:05:06 AM

ALS_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:30:00 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - D:\MassHunter\GCMS1\data - Source: EI - Extractor - RSD - L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Data File Path: Vagler\GC_2023\01_05.D
May 25, 2023 10:30:03 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - D:\MassHunter\GCMS1\data - Source: EI - Extractor - RSD - L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Data File Path: Vagler\GC_2023\01_06.D
May 25, 2023 10:30:05 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - D:\MassHunter\GCMS1\data - Source: EI - Extractor - RSD - L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Data File Path: Vagler\GC_2023\01_067.D
May 25, 2023 10:30:09 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - D:\MassHunter\GCMS1\data - Source: EI - Extractor - RSD - L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Data File Path: Vagler\GC_2023\01_059.D
May 25, 2023 10:30:06 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - D:\MassHunter\GCMS1\data - Source: EI - Extractor - RSD - L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Data File Path: Vagler\GC_2023\01_059.D
May 25, 2023 10:30:51 AM	Audit	Data	Instrument Detection Limit - Injection Tower, Front MM, TQ - D:\MassHunter\GCMS1\data - Source: EI - Extractor - RSD - L (Area) <= 12.00% - RSD L (Rel. Time) <= 1.00%	Data File Path: Vagler\GC_2023\01_110.D
May 25, 2023 10:30:19 AM	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

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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User Name: natipatchangcharoen
Hostname: ABBK009255System ID: GM-10
Print Date: May 25, 2023 11:05:08 AM

ALS_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:30:22 AM	Start	Execution	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source: EI - Extractor - L (RSD) <= 5.00%	None
May 25, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - D:\MassHunter\GCMS1\data - Source: EI - Extractor - L (RSD) <= 5.00%	Data File Path: Vagler\GC_2023\MRP_81.D
May 25, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - D:\MassHunter\GCMS1\data - Source: EI - Extractor - L (RSD) <= 5.00%	Data File Path: Vagler\GC_2023\MRP_82.D
May 25, 2023 10:30:42 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - D:\MassHunter\GCMS1\data - Source: EI - Extractor - L (RSD) <= 5.00%	Data File Path: Vagler\GC_2023\MRP_83.D
May 25, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - D:\MassHunter\GCMS1\data - Source: EI - Extractor - L (RSD) <= 5.00%	Data File Path: Vagler\GC_2023\MRP_84.D
May 25, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - D:\MassHunter\GCMS1\data - Source: EI - Extractor - L (RSD) <= 5.00%	Data File Path: Vagler\GC_2023\MRP_85.D
May 25, 2023 10:30:49 AM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MM, TQ - D:\MassHunter\GCMS1\data - Source: EI - Extractor - L (RSD) <= 5.00%	Data File Path: Vagler\GC_2023\MRP_86.D
May 25, 2023 10:30:57 AM	End	Execution	Mass Ratio Precision - Injection Tower, Front MM, TQ - Source: EI - Extractor - L (RSD) <= 5.00%	Run Count: 1
May 25, 2023 10:31:02 AM	End	Qualification	Session	OO

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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User Name: natipatchangcharoen
Hostname: ABBK009255System ID: GM-10
Print Date: May 25, 2023 11:05:08 AM

ALS_GM-10 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
May 25, 2023 10:31:02 AM	Start	Reporting	Session	None
May 25, 2023 11:04:34 AM	Audit	Reporting	Session	Report Generated: Certificate

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Date: May 25, 2023 11:05:07 AM
System ID: GM-10

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Bara Scientific Co., Ltd.
908 U Chu Liang Building Floor 7 Rama4 Road
Siam Bangkok Bangkok Thailand 10500
Tel: 02-6324300 Fax: 02-6375496-7
www.barscientific.com

Certificate of Calibration

Number of Page(s) 1 of 3

Certificate No. BSQC-UV-307/23
Equipment UV-Vis Spectrophotometer
Model UV-1800
Manufacturer Shimadzu
Serial No. A11454908533CD
ID No. BKK_EN0018
Date of receipt 15 September 2023
Date of calibration 15 September 2023
Date of issue 27 September 2023Customer name ALS Laboratory Group (Thailand) Co., Ltd.
Address 104 Soi Phantakan 40, Phantakan Road, Phantakan, Suan Luang, Bangkok 10250Temperature (23.4 - 24.7) °C (On site)
Humidity (55.5 - 61.2) %RH (On site)

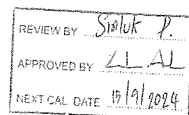
Equipment condition Good Operation

Calibration Location Organic Prep

Calibration Procedure In-house method W-UV-702-01 based on ASTM E275-01

Traceability Wavelength Accuracy is traceable to certificate No 95917 and 95918
Photometric Accuracy is traceable to certificate No 95937 and 95924
Stray Light is traceable to certificate No 95908
The above certificate are traceable to SI unit through Sarna Scientific Ltd (UKAS accredited calibration laboratory NO 0659)

Calibrated by Mr Wanchana Janioey

Approved by
Mr. Kanchit Choothep
Technical ManagerThe above results are valid exclusively for the calibrated item as shown in this report. Certificate
Authorizing the return of Certificate and custody of the results are prohibited and also shall not be reproduced
except in full, without written approval of the Bara Scientific Co., Ltd.



Bara Scientific Co., Ltd.
905 U Chu Liang Building Floor 7 Ramat Road
Siam Bangkok Bangkok Thailand 10500
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www.barscientific.com



Certificate of Calibration

Certificate No. BSCC-UV-367/23 Number of Page(s) 2 of 3

Calibration Results:

1. Wavelength Accuracy

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty (±nm)
241.70	241.67	-0.03	0.18
334.02	334.03	0.01	0.18
418.53	418.59	0.06	0.18
572.99	573.14	0.15	0.18
879.41	879.21	-0.20	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
	0.7467	0.7469	-0.0007	0.0075
257	0.0000	0.0000	0.0000	0.0075
	0.8562	0.8546	-0.0016	0.0075
313	0.0000	0.0000	0.0000	0.0075
	0.2904	0.2908	0.0004	0.0075
350	0.0000	0.0001	0.0001	0.0075
	0.6429	0.6415	-0.0014	0.0075

*CNR = Customer not request

The above results are valid exclusively for the calibrated items as mentioned in this report. Certificate Advertising the report. Certificate and validity of the results are prohibited and also shall not be reproduced except in full, without written approval of the Bara Scientific Co., Ltd.

FM-UV-700-02 Rev 01 (23/01/63)



Bara Scientific Co., Ltd.
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Siam Bangkok Bangkok Thailand 10500
Tel: 02-6324300 Fax: 02-6375496-7
www.barscientific.com



Certificate of Calibration

Certificate No. BSCC-UV-367/23 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
	0.5783	0.5793	0.0010	0.0042
	0.7628	0.7624	-0.0004	0.0042
	1.0295	1.0216	-0.0079	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.5621	0.5625	0.0004	0.0042
	0.7455	0.7452	-0.0003	0.0042
	0.9935	0.9959	0.0024	0.0042
465.0	0.0000	0.0000	0.0000	0.0042
	0.5227	0.5229	0.0002	0.0042
	0.6880	0.6873	-0.0007	0.0042
	0.8487	0.8486	-0.0001	0.0042
546.1	0.0000	0.0000	0.0000	0.0042
	0.5207	0.5211	0.0004	0.0042
	0.6973	0.6960	-0.0013	0.0042
	0.9559	0.9544	-0.0015	0.0042
590.0	0.0000	0.0000	0.0000	0.0042
	0.5544	0.5538	-0.0006	0.0042
	0.7253	0.7236	-0.0017	0.0042
	1.0942	1.0925	-0.0017	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	0.5616	0.5612	-0.0004	0.0042
	0.6927	0.6909	-0.0018	0.0042
	1.0881	1.0856	-0.0025	0.0042

*CNR = Customer not request

4. Stray Light*

Standard cut-off wavelength (nm)	Wavelength (nm)	Transmission (%T)	Absorbance (A)
200 96±0.1 nm	200.55	0.9770	2.0104

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 based 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 items as mentioned in this report. Certificate Advertising the report. Certificate and validity of the results are prohibited and also shall not be reproduced except in full, without written approval of the Bara Scientific Co., Ltd.

FM-UV-700-02 Rev 01 (23/01/63)

BKK_EL0026

Agilent Technologies

Agilent Technologies (Thailand) Limited
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905 RAMA 4 ROAD SILEM BANGRAK
Bangkok 10500 Thailand

Tel: +662 637 6300
Fax: +662 632 4334
Email: ccc.asia@agilent.com
Website: www.agilent.com/thai

Service Confirmation Number: 6905338201
Service Confirmation Date: 12.12.2023

Customer Contact:

ALC Laboratory Group (Thailand) Co.
Ltd.
Head Office
104 Phatthanakan 40 Phatthanakan Rd
Khuang Phatthanakan Khet Suan
TAX ID: 0105540004859
Chanattagarn Inc.thai@agilent.com
27803058

Invoice To:

ALC Laboratory Group (Thailand) Co.
Ltd.
Head Office
104 Phatthanakan 40 Phatthanakan Rd
Khuang Phatthanakan Khet Suan

Delivery Site:

ALC Laboratory Group (Thailand) Co.
Ltd.
Head Office
104 Phatthanakan 40 Phatthanakan Rd
Khuang Phatthanakan Khet Suan

Location:
Room:
Bldg:
Lab:
Dept:

SERVICE REPORT

Customer Purchase Order Number: 70371013
Customer Number: 70371013
Service Request: Service Request Date:
Service Order: 6905338201
Service Confirmation: 6905338201

REVIEW BY: Suphanna M.
APPROVED BY: Suphanna M.
NEXT CAL. DATE: 12/06/2025

Direct Inquiries to:

Contact Name: Customer Contact Center
Contact E-mail: ccc.asia@agilent.com
Contact Telephone: +662 637 6383
Contact Fax: +662 632 4334

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
G1328B	1260 Standard Autosampler	DEAAC11088	ICP MS 7700 (HPLC)	SYS-IM-7700-E
G1311B	1260 Quaternary Pump	DEAB704280	ICP MS 7700 (HPLC)	SYS-IM-7700-E
G3281A	Agilent 7700x ICP-MS	JP12051612	ICP MS 7700 (HPLC)	SYS-IM-7700-E

Service Items:

Item	Service/Part #	Description	Qty	Entitlement	Service Start	Service End
1000	EQC	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:

Products | Applications | Software | Service

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Agilent Technologies (Thailand) Limited Head Office
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905 Ram 4 Road, Siam Bangkok
Bangkok 10500 Thailand
Tax ID: 0105540004859

Central N.A. Bangkok Branch
305 Interchange 21 Building, Sukhumvit Road, Khlongtoey New
Sukhumvit, Wattana District, Bangkok 10110 Thailand
Acc. No: 612-4453-027
TMB Krung Thai Bank PCL
Siam Square Bx 416-1 2 Rama 1 Rd, Pathumwan BKK 10330
Thailand

CHG0144

Service Confirmation Number: 585338201
Service Confirmation Date: 12.12.2023

Service Information:

Problem Description: WU-DG-IN/HPLC-7780-5001143313		
Service Provided: Perform OQ Hardware control test CSD Ilogon, Autosample, ISIS, Auto tune, BG and Stability. After done the instrument BKK_EL0326 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: Panthep Kerasathain	Customer Field Service Representative Signature: 	Date: 12 Dec 2023
Customer Name: Supakwan Mak	Customer Signature: 	Date: 12 Dec 2023
Additional Comments:		

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Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoh, Saraburi 18110

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

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., Khwaeng 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 Nakkakred (Site Calibration Manager)
Date of Issue : 26 SEP 2023

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

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FM-L12 109 30-05-57



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoh, Saraburi 18110

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

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 :

- 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 .
- 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
- This certificate is traceable to :
National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244)
- 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
- Adjustment :
() without adjustment (X) after adjustment

Approved By:

FM-L12 109 30-05-57



Metrological Center

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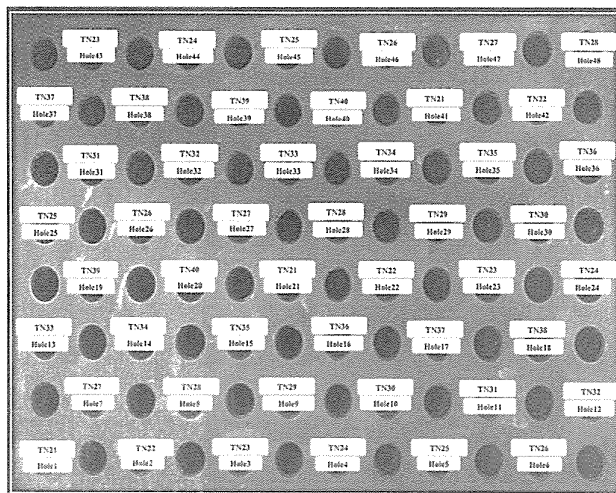
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Certificate No. T231676

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	TN26
CAL POINT	Max	95.01	94.41	95.20	95.41	94.51
	Min	94.57	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	TN32
	Max	95.36	95.43	95.19	95.16	95.35
	Min	94.94	94.05	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	TN38
	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	TN24
	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	TN30
	Max	95.19	95.38	92.93	95.30	95.14
	Min	94.83	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	TN36
	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	TN22
	Max	94.30	94.44	94.04	93.81	94.89
	Min	93.95	94.05	93.67	93.48	94.29
	Average	94.13	94.24	93.86	93.65	94.64
R8 Hole43-Hole48	TN23	TN24	TN25	TN26	TN27	TN28
	Max	95.99	95.63	95.28	95.29	95.45
	Min	95.57	95.15	94.82	94.84	94.99
	Average	95.78	95.39	95.05	95.07	95.22

Approved By: _____

FM-L13 108 30-05-57



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Certificate No T231676

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Calibration Report

Measurement Results

Calibration Point	Average Standard Reading at each position (°C)					
R1 Hole1-Hole6	TN21	TN22	TN23	TN24	TN25	TN26
CAL POINT	Max	105.23	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	TN32
	Max	105.20	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	TN38
	Max	105.37	105.63	105.02	104.80	104.69
	Min	105.17	105.37	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	TN24
	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	TN30
	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	TN36
	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	TN22
	Max	104.30	104.90	104.85	104.65	104.88
	Min	104.09	104.72	104.66	104.49	104.63
	Average	104.19	104.81	104.75	104.57	104.76
R8 Hole43-Hole48	TN23	TN24	TN25	TN26	TN27	TN28
	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



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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	0.81
107.0	107.0, 107.1	107.1	0.19	0.78

* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item

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

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

Approved By: _____

FM-L13 108 30-05-57



Metrology

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoh, Saraburi 18110, Thailand.
Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100
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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_ENU167

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 : _____ / Boonchar 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 119/18-08-66



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 W1-120 (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 30 Minute At 3 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

(X) without adjustment () after adjustment

Approved By.

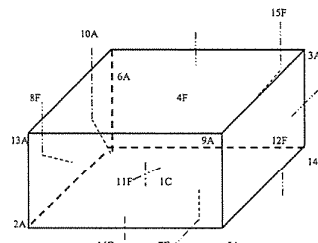
FM-L15 118/18-08-66



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 118/18-08-66



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	Average					
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-L15 118/18-08-66

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.
113 Soi Ekachai 44, Ekachai Road
Khlong Bang Phran, Bangbon
Bangkok 10150 Thailand

Certified by
Thunraphol Sakdayos
Service Engineer



Automation Service Co.,Ltd.

Head Office : 929/9291 Soi Pattanakarn 30,
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www.automation.co.th

Sales & Service Center
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Lamphun : 122/5 M 4, Ban Klang, Muang, Lamphun [T. 053-581-876]
Prachinburi : 688 M 10, Thatum, Srinakharinwirot, Prachinburi [T. 037-209-830]

MTOC : L-1113/2023

Report No. : ALS-799/02

ASI Maintenance Report

Instrument : Automatic Sample Injector Measuring : Vial 40 mL
Model : ASH-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, Khet Suan Luang,
Bangkok 10250 Thailand

Date of Maintenance : 10 / 11 / 2023

Ambient Condition : Temperature 26.0 ± 5 °C

Humidifier 60 ± 15 %RH

Maintenance By : Peerapong Sangpan
(Mr. Peerapong Sangpan)
Technician

Approved By : N. Phongsomsak
(Mr. Nipon Phongsomsak)
Technician Manager

User Name : Sinluk P.
(Mr.)

SHIMADZU ANALYZER
1/3



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Prachinburi : 688 M 10, Thatum, Srinakharinwirot, Prachinburi [T. 037-209-830]

MTOC : L-1113/2023

Report No. : ALS-799/02

Maintenance Sheet

Customer : ALS Laboratory Date : 10 / 11 / 2023
Model : ASH-L Serial No. H57415200799

Item	Carry out maintenance work	Result	Exchange	Comment
1.	Arm Drive section Check Arm Drive Belt for wear and tension Check grease of Screw Arm Drive	O.K. O.K. O.K.		
2.	Rinse pump (only ASI-V 24mL, 40mL) Check pump rate(>40mL/min) Check pump and tube connection for leakage	O.K. O.K. O.K.		
3.	Check if outlet flow is in proper condition Check and if necessary exchange consumable, Maintenance parts	O.K. 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 : Peerapong Sangpan
(Mr. Peerapong Sangpan)
Technician

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MTOC : L-1113/2023

Report No. : ALS-799/02

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
8.	638-41450-01	Needle for Suspended Particles,* 0.8mm (only ASI-V 24mL, 40mL)	N/A		(may cut to origin length 600mm)
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 : Peerapong Sangpan
(Mr. Peerapong Sangpan)
Technician

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Prachinburi : 688 M 10, Thatum, Srinakharinwirot, Prachinburi [T. 037-209-830]

MTOC : L-1112/2023

Report No. : ALS-416/02

TOC-L Maintenance Report

Instrument : Total Organic Carbon Analyzer Measuring : TC 0 - 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 : 10 / 11 / 2023

Ambient Condition : Temperature 26.0 ± 5 °C

Humidifier 60 ± 15 %RH

Maintenance By : Peerapong Sangpan
(Mr. Peerapong Sangpan)
Technician

Approved By : N. Phongsomsak
(Mr. Nipon Phongsomsak)
Technician Manager

User Name : Sinluk P.
()

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