

ภาคผนวกที่ 4

เอกสารสอบเทียบความถูกต้องของเครื่องมือตรวจวัดคุณภาพสิ่งแวดล้อม

**ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม**

รายการตรวจวัด	เครื่องมือเก็บตัวอย่าง	เครื่องมือตรวจวิเคราะห์
	ชื่อเครื่องมือ	ชื่อเครื่องมือ
1. คุณภาพอากาศจากปล่อง Total Suspended Particulate	Console No. B04 Pitot Tube No. B04	Digital Balance
Oxides of Nitrogen (NO _x)	Vacuum Gauge	Spectrophotometer
Carbon Monoxide	Personal Pump SKC No. B06 Rotameter No. H-B09	CO Analyzer No. B01
Aluminium	Console No. B04 Pitot Tube No. B04	ICP
VOCs	Personal Pump SKC No. B17 Rotameter No. L-B09	-
2. คุณภาพอากาศในบรรยากาศ Total Suspended Particulate	High Volume Air Sampler Rec No. B15, Blow No. B15	Digital Balance
PM ₁₀	High Volume PM ₁₀ Air Sampler Rec No. B01, Blow No. B01	Digital Balance
Nitrogen Dioxide	NO ₂ Analyzer No. B22	NO ₂ Analyzer No. B22
Carbon Monoxide	CO Analyzer No. B02	CO Analyzer No. B02
Aluminium	High Volume Air Sampler Rec No. B15, Blow No. B15	ICP
3. ระดับเสียงบริเวณแนวรั้วโรงงาน L _{eq} 24 hr, L _{max} และ L ₉₀	Acoustic Calibrator Sound Level Meter No. ACO-B07, B17, B26, B28 CR-B03, B05, B06, B09	-
4. คุณภาพน้ำ pH	-	pH Meter
Total Dissolved Solids	-	Digital Balance
Total Suspended Solids	-	Digital Balance
BOD ₅	-	BOD Analyzer
Grease & Oil	-	Digital Balance
Lead	-	ICP
Aluminum	-	ICP
5. คุณภาพอากาศในสถานประกอบการ Total Dust	Personal Pump SKC No. B81, B83, B86, B93 Rotameter No. H-B03	Digital Balance
Respirable Dust	Personal Pump SKC No. B61, B67, B81, B86 Rotameter No. H-B03	Digital Balance
Aluminium	Personal Pump SKC No. B59, B87, B93 Rotameter No. H-B03	ICP
Hydrogen Fluoride	Personal Pump SKC No. B61, B61 Rotameter No. L-B03	Ion Chromatography
Hydrogen Chloride	Personal Pump SKC No. B80, B83 Rotameter No. L-B03	Ion Chromatography

ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม (ต่อ)

รายการตรวจวัด	เครื่องมือเก็บตัวอย่าง	เครื่องมือตรวจวิเคราะห์
	ชื่อเครื่องมือ	ชื่อเครื่องมือ
6. ระดับเสียงในสถานประกอบการ L _{eq} 8 hr, L _{max} และ Noise Dose	Acoustic Calibrator Sound Level Meter ACO No. B18, R29, B33, B36	-
7. ปริมาณเสียงสะสมแบบติดตัวบุคคล L _{eq} 8 hr, L _{max} และ Noise Dose	Acoustic Calibrator Sound Level Meter NMD No. B09, B10	-
8. ระดับความร้อนในสถานประกอบการ WBGT	Heat Stress WBGT Meter No. B05, B12, B17, B21, B28, B30, B32, B33	-
9. กลิ่นในสถานประกอบการ Ammonia	Personal Pump SKC No. B86 Rotameteer No. H-B03	Spectrophotometer

คุณภาพอากาศจากปล่อง



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7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

Console Calibration Report

Calibration Method

Critical Orifices

Calibration Data

Console Data		Calibration Data		
No.	Serial No.	Date	y	DH _g (mmH ₂ O)
B01	1563	04/09/2023	0.997	50.11
B02	8002514	06/09/2023	1.002	49.25
B03	1503016	05/09/2023	0.998	50.44
B04	00006659	05/09/2023	1.004	49.37
B05	00007428	05/09/2023	0.996	49.77
R01	1561	06/09/2023	1.004	49.86
R02	8002513	08/09/2023	1.005	50.36
R03	1570	07/09/2023	0.997	49.55
R04	8002519	04/09/2023	1.004	49.69
R05	1503015	07/09/2023	0.999	50.08

Remark : Accept Value of y (test) is $0.97 < y < 1.03$

Accept Value of DH_g (test) is 46.7 ± 6.4 (mmH₂O)

(Mr. Adul Dangklom)

(Mr. Peera Detudom)



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Pitot Tube Calibration Report

Calibration Method

Standard Pitot Tube

Calibration Data

Pitot Tube Data			Calibration Data		
No.	Type of Pitot	Coefficient of Standard Pitot	Date	Avg. of Cp (test)	
				Side A	Side B
B03	S	0.99	01/11/2023	0.84	0.85
B04	S	0.99	01/11/2023	0.84	0.84
B05	S	0.99	01/11/2023	0.85	0.84
B07	S	0.99	01/11/2023	0.84	0.83
B08	S	0.99	02/11/2023	0.85	0.84
B09	S	0.99	02/11/2023	0.84	0.84
B11	S	0.99	02/11/2023	0.85	0.84
B16	S	0.99	03/11/2023	0.84	0.84
B18	S	0.99	03/11/2023	0.84	0.85
B19	S	0.99	03/11/2023	0.84	0.85
B21	S	0.99	02/11/2023	0.84	0.84
B24	S	0.99	02/11/2023	0.84	0.83
B27	S	0.99	02/11/2023	0.85	0.84
B30	S	0.99	01/11/2023	0.84	0.85
B31	S	0.99	02/11/2023	0.84	0.84
B33	S	0.99	02/11/2023	0.84	0.85
B35	S	0.99	02/11/2023	0.84	0.84

Remark : Accept value of Cp (test) is 0.84 ± 0.01

(Mr. Adul Dangklom)

(Mr. Peera Detudom)

CERTIFICATE OF CALIBRATION FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : HI-LIGHT
MODEL / TYPE : N/A
SERIAL NO. : N/A[64-220066-4]
CLID. NO. : 212201115
JOB CONTROL NO. : 230725081568

CUSTOMER : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24 ROAD., JOMPOL,
CHATUCHAK, BANGKOK 10900

DATE OF RECEIVED : 25 July 2023

DATE OF ISSUED : 31 July 2023

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

Calibrated By : Sittipong Pimdee
Calibration Engineer

Approved By :

Authorized Signatory

31 July 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. Q23081568

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REPORT OF CALIBRATION FOR

NOMENCLATURE	:	VACUUM GAUGE
MANUFACTURER	:	HI-LIGHT
MODEL / TYPE	:	N/A
SERIAL NO.	:	N/A[64-220066-4]
DATE OF CALIBRATION	:	26 July 2023
DUE DATE OF CALIBRATION	:	26 July 2024

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 741B S/N. 8295020 with Pressure Module Model 700PD5 S/N. 89404505.

TRACEABILITY :

The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand).
Certificate No. MP-0035-23, Due Date 02 February 2024.

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. **Q23081568**

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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 (kPa)		Conversion to inHg		Correction (inHg)	
	Up	Down	Up	Down	Up	Down
0	0.00	0.00	0.0	0.0	0.0	0.0
-5	-17.61	-17.95	-5.2	-5.3	-0.2	-0.3
-10	-34.54	-34.54	-10.2	-10.2	-0.2	-0.2
-15	-51.13	-51.47	-15.1	-15.2	-0.1	-0.2
-20	-67.72	-68.06	-20.0	-20.1	0.0	-0.1
-25	-84.31	-84.31	-24.9	-24.9	+0.1	+0.1
-30	-101.24	-101.24	-29.9	-29.9	+0.1	+0.1

Uncertainty of measurement ± 0.2 inHg

Transmitting fluid : Air.

Technical Note. Conversion factor 1 kPa ; 0.2953003 inHg

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. Q23081568

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@clccalibration



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Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature : 25 \pm 3 $^{\circ}$ C
Pressure : 1010 \pm 15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R ²
B01	SKC	224-PCXR4	262101	02/10/2023	1,000	1,500	2,000	997	1,494	1,995	0.998x - 5.198	1.000
B02	SKC	224-PCXR4	626166	02/10/2023	1,000	1,500	2,000	995	1,491	1,987	0.995x - 0.239	1.000
B03	SKC	224-PCXR4	612968	02/10/2023	1,000	1,500	2,000	994	1,498	1,996	1.004x - 17.211	0.999
B04	SKC	224-PCXR4	602804	03/10/2023	1,000	1,500	2,000	1,001	1,502	1,997	0.999x - 3.961	1.000
B05	SKC	224-PCXR4	612693	03/10/2023	1,000	1,500	2,000	1,000	1,500	1,998	1.008x - 19.564	0.999
B06	SKC	224-PCXR4	262188	04/10/2023	1,000	1,500	2,000	999	1,497	1,998	1.005x - 13.275	1.000
B07	SKC	224-PCXR4	626262	04/10/2023	1,000	1,500	2,000	997	1,491	1,992	0.995x + 0.103	1.000
B08	SKC	224-PCXR4	626100	03/10/2023	1,000	1,500	2,000	995	1,490	1,994	0.999x - 3.162	1.000
B09	SKC	224-PCXR4	626479	04/10/2023	1,000	1,500	2,000	1,012	1,500	2,001	0.998x + 1.604	0.999
B10	SKC	224-PCXR4	091950	05/10/2023	1,000	1,500	2,000	992	1,486	1,994	1.002x - 11.842	1.000
B11	SKC	224-PCXR8	564315	05/10/2023	1,000	1,500	2,000	993	1,501	1,996	1.010x - 26.335	0.999
B12	SKC	224-PCXR4	034656	05/10/2023	1,000	1,500	2,000	1,000	1,496	1,998	1.007x - 17.721	0.999
B13	SKC	224-PCXR4	602073	04/10/2023	1,000	1,500	2,000	1,000	1,488	1,987	0.986x + 13.398	1.000
B14	SKC	224-PCXR4	626313	04/10/2023	1,000	1,500	2,000	996	1,493	1,996	0.999x - 2.380	1.000
B15	SKC	224-PCXR4	626474	06/10/2023	1,000	1,500	2,000	1,000	1,498	1,998	1.007x - 16.567	0.999
B16	SKC	224-PCXR4	626477	06/10/2023	1,000	1,500	2,000	1,001	1,498	1,999	1.010x - 21.673	0.999
B17	SKC	224-PCXR4	626860	06/10/2023	1,000	1,500	2,000	1,000	1,492	1,998	0.997x - 1.859	1.000
B18	SKC	224-PCXR4	691484	03/10/2023	1,000	1,500	2,000	995	1,494	1,992	1.000x - 5.493	1.000
B19	SKC	224-PCXR4	691599	02/10/2023	1,000	1,500	2,000	991	1,500	1,998	1.015x - 32.922	0.999
B20	SKC	224-PCXR4	691587	02/10/2023	1,000	1,500	2,000	1,001	1,496	1,999	1.010x - 23.222	0.999
B21	SKC	224-PCXR4	691531	03/10/2023	1,000	1,500	2,000	994	1,491	1,997	1.004x - 12.881	1.000
B22	SKC	224-PCXR4	691654	03/10/2023	1,000	1,500	2,000	991	1,492	1,994	1.002x - 9.860	1.000
B23	SKC	224-PCXR4	798393	02/10/2023	1,000	1,500	2,000	991	1,498	1,997	1.014x - 33.810	0.999
B24	SKC	224-PCXR4	626363	02/10/2023	1,000	1,500	2,000	1,001	1,499	2,001	1.011x - 23.676	0.999
B25	SKC	224-PCXR4	798489	04/10/2023	1,000	1,500	2,000	996	1,497	1,989	0.991x + 6.619	1.000
B26	SKC	224-PCXR4	798479	05/10/2023	1,000	1,500	2,000	996	1,492	1,990	0.996x - 1.146	1.000
B27	SKC	224-PCXR4	691673	09/10/2023	1,000	1,500	2,000	989	1,506	1,998	1.016x - 34.646	0.999
B28	SKC	224-PCXR4	691570	09/10/2023	1,000	1,500	2,000	992	1,487	1,996	1.006x - 16.996	1.000
B29	SKC	224-PCXR4	626472	09/10/2023	1,000	1,500	2,000	998	1,495	1,992	0.997x - 0.693	1.000
B30	SKC	224-PCXR4	691489	03/10/2023	1,000	1,500	2,000	993	1,490	1,990	0.999x - 7.320	1.000
B31	SKC	224-PCXR4	691509	03/10/2023	1,000	1,500	2,000	1,001	1,497	1,997	1.007x - 18.788	0.999
B32	SKC	224-PCXR4	091567	04/10/2023	1,000	1,500	2,000	998	1,499	1,996	1.009x - 22.780	0.999
B33	SKC	224-PCXR4	091756	05/10/2023	1,000	1,500	2,000	1,000	1,489	1,994	0.995x - 0.223	1.000
B34	SKC	224-PCXR4	612962	05/10/2023	1,000	1,500	2,000	992	1,501	1,997	1.013x - 31.362	0.999
B35	SKC	224-PCXR4	602682	03/10/2023	1,000	1,500	2,000	998	1,496	1,998	0.998x - 7.157	0.999
B36	SKC	224-PCXR4	626164	07/10/2023	1,000	1,500	2,000	995	1,487	1,990	0.991x + 3.901	1.000
B37	SKC	224-PCXR4	626256	02/10/2023	1,000	1,500	2,000	990	1,500	1,993	1.000x - 6.520	1.000
B38	SKC	224-PCXR4	626167	03/10/2023	1,000	1,500	2,000	989	1,498	1,995	1.015x - 35.470	0.999
B39	SKC	224-PCXR4	034637	09/10/2023	1,000	1,500	2,000	991	1,495	1,994	1.004x - 14.572	1.000
B40	SKC	224-PCXR4	798349	07/10/2023	1,000	1,500	2,000	999	1,497	1,996	1.008x - 21.526	0.999

(Mr. Adul Dangklom)

(Mr. Peera Detudom)



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Rotameter Calibration Report (For Personal Pump Low Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Rotameter Data			Calibration Data								
No.	Brand	Model	Date	Flow Rate (mL/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	y	R ²
L-B01	Dwyer	VFA-21	02/10/2023	50	100	200	50.2	100.3	202.6	0.997x + 0.475	0.999
L-B02	Dwyer	VFA-21	03/10/2023	50	100	200	50.5	98.9	201.1	1.001x - 0.121	1.000
L-B03	Dwyer	VFA-21	02/10/2023	50	100	200	50.1	100.7	200.2	1.007x - 1.206	0.999
L-B04	Dwyer	VFA-21	04/10/2023	50	100	200	50.4	99.6	201.9	1.006x - 0.142	1.000
L-B05	Dwyer	VFA-21	03/10/2023	50	100	200	49.7	101.1	197.7	0.997x - 0.218	1.000
L-B06	Dwyer	VFA-21	05/10/2023	50	100	200	50.3	101.5	200.1	1.003x - 0.332	0.999
L-B07	Dwyer	VFA-21	04/10/2023	50	100	200	50.9	100.4	202.4	0.990x + 2.441	1.000
L-B08	Dwyer	VFA-21	05/10/2023	50	100	200	50.7	99.8	197.9	1.005x - 1.343	0.999
L-B09	Dwyer	VFA-21	03/10/2023	50	100	200	50.2	100.3	203.0	1.007x + 0.375	1.000
L-B10	Dwyer	VFA-21	07/10/2023	50	100	200	49.5	99.4	200.3	1.009x - 1.182	1.000

(Mr. Adul Dangklom)

(Mr. Peera Detudom)



QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com



CERTIFICATE No : 23M2441

REFERENCE No : 68471-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS105DU

SERIAL No : 1126422905

ID No : BA 05/50

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 10-Mar-23

APPROVED BY :

ISSUED DATE : 16-Mar-23

RECEIVED DATE : 10-Mar-23

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.



CERTIFICATE No : 23M2441

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS105DU
MANUFACTURER : METTLER TOLEDO S/N : 1126422905
ID No : BA 05/50 RECEIVED DATE : 10-Mar-23
AIR PRESSURE : 1010mbar \pm 1mbar CALIBRATION DATE : 10-Mar-23
AMBIENT TEMPERATURE : 23° C \pm 1° C RELATIVE HUMIDITY : 49 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD WEIGHT SET	E2	QK-I-151	M2302013S	02-Feb-25
2) STANDARD WEIGHT	E2	15843	M2302014S	02-Feb-25

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.00000	0.00000	0.000039
0.02	0.02000	0.00000	0.000039
0.10	0.10000	0.00000	0.000039
0.20	0.20001	-0.00001	0.000040
0.50	0.50001	-0.00001	0.000040
1.00	1.00000	0.00000	0.000041
2.00	2.00003	-0.00003	0.000042
5.00	5.00001	-0.00001	0.000046
10.00	10.00003	-0.00003	0.000053
20.00	20.00005	-0.00005	0.000067
50.00	50.00001	-0.00001	0.00011
100.00	100.00001	-0.00001	0.00019
200.00	200.00001	-0.00001	0.00032

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.0000
2	50.0001
3	50.0000
4	50.0000
5	49.9999
OFF-CENTER LOADING	0.0001

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR $k=2$, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



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

NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : SP23016

Pages : 1 of 3

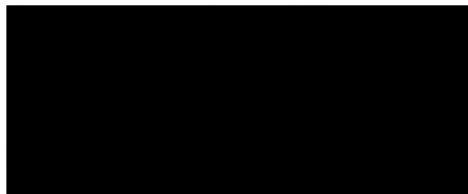
Calibration Certificate

Equipment :	UV-VIS SPECTROPHOTOMETER
Manufacturer :	PERKINELMER
Model :	LAMBDA 25
Serial No.:	501S14123010
ID No.:	SP03/58
Calibration Mode :	WAVELENGTH ACCURACY PHOTOMETRIC ACCURACY
Condition As Found :	GOOD
Customer :	S.P.S. CONSULTING SERVICE CO., LTD. 7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN ROAD, CHOMPHON, CHATUCHAK, BANGKOK 10900, THAILAND.
Location :	ORGANIC LABORATORY IV
Ambient Temperature :	(25.0 ± 5) °C
Relative Humidity :	(48.4 ± 25) %
Received Date :	30 AUGUST 2023
Calibration Date :	30 AUGUST 2023
Date of Issue :	31 AUGUST 2023

Calibrated by :

Nathakorn Pisutpaisan

Approved by :



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

Continuation of Calibration Certificate

Cert. No. : SP23016

Job No. : VC66SP0014

Pages : 2 of 3

Calibration Method :

This instrument was calibrated by using on-site calibration procedure In-house method : CP-SP-01

The calibration procedure to direct measurement wavelength accuracy by using wavelength standard solution, Photometric accuracy by using absorbance standard filter and absorbance standard solution

The calibration procedure used was based on ASTM E275-01,ASTM E925-02

Condition of this result of calibration :

1. Certified reference materials

<u>Material</u>	<u>Ref. type</u>	<u>Cell serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Holmium liquid	RM-HL	29706	106864	01/11/2024
Didymium liquid	RM-DL	28912	106905	02/11/2024
Neutral density filter	RM-1N2N3N	13877	106918	03/11/2024
Potassium dichromate solutions	RM-0204060810	14204	106902	02/11/2024
Potassium Iodide solution	-	KI-0701-001	CI-0090-22	08/04/2024

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

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

3.1 The UK National Physical Laboratory (NPL)

3.2 The National Institute of Standards and Technology, NIST.

Result of calibration : Wavelength Accuracy

(Without adjustment)

<u>Material</u>	<u>Certified Values of Reference Material (nm)</u>	<u>UUC* Reading (nm)</u>	<u>Error (nm)</u>	<u>Uncertainty ± (nm)</u>	<u>k Factor</u>
RM-HL	278.13	278.3	0.17	0.16	2.00
	361.25	361.3	0.05	0.16	2.00
	467.82	468.0	0.18	0.16	2.00
	536.56	536.6	0.04	0.16	2.00
	640.50	640.4	-0.10	0.16	2.00
RM-DL	740.09	740.0	-0.09	0.16	2.00
	864.94	865.0	0.06	0.16	2.00

UUC* = Unit Under Calibration

Continuation of Calibration Certificate

Cert. No. : SP23016
Job No. : VC66SP0014
Pages : 3 of 3

Result of calibration : Photometric Accuracy

(Without adjustment)

Material	Wavelength (nm)	Filter S/N	Nominal Absorbance (A)	Certified Absorbance (A)	UUC* Reading Absorbance (A)	Error (A)	Uncertainty ± (A)	k Factor
Neutral Density glass filter	440.0	29360	1.0	1.0517	1.0564	0.0047	0.0031	2.00
		29914	0.7	0.7445	0.7460	0.0015	0.0032	2.00
		29381	0.5	0.5416	0.5429	0.0013	0.0032	2.00
	546.1	29360	1.0	0.9821	0.9849	0.0028	0.0030	2.00
		29914	0.7	0.6961	0.6961	0.0000	0.0030	2.00
		29381	0.5	0.5073	0.5073	0.0000	0.0030	2.00
	590.0	29360	1.0	1.0222	1.0244	0.0022	0.0030	2.00
		29914	0.7	0.7237	0.7234	-0.0003	0.0030	2.00
		29381	0.5	0.5361	0.5360	-0.0001	0.0031	2.00
	635.0	29360	1.0	0.9753	0.9775	0.0022	0.0030	2.00
		29914	0.7	0.6910	0.6910	0.0000	0.0030	2.00
		29381	0.5	0.5211	0.5210	-0.0001	0.0032	2.00
Material	Wavelength (nm)	Solution (mg/l)	Certified Absorbance (A)	UUC* Reading Absorbance (A)	Error (A)	Uncertainty ± (A)	k Factor	
RM-0204060810	235.0	20	0.2422	0.2462	0.0040	0.0101	2.00	
		40	0.4866	0.4900	0.0034	0.0115	2.00	
		60	0.7414	0.7390	-0.0024	0.0068	2.00	
		80	0.9858	0.9871	0.0013	0.0093	2.00	
		100	1.2442	1.2480	0.0038	0.0087	2.00	

UUC* = Unit Under Calibration

Condition of this result of calibration : Spectrophotometer PERKINELMER Model Lambda 25 S/N 501S141230

Resolution of Wavelength Mode 0.1 nm
Resolution of Photometric Mode 0.0001 A
Parameter Setting
Measurement Mode Wavelength, Absorbance
Wavelength Scan 1100 nm-190 nm
Scanning Speed 7.5 nm/min
Data Pitch 0.1 nm
Band width(Wavelength) 1.0 nm
Band width(Vis) 1.0 nm
Band width(Uv) 1.0 nm

Stray Light** UUC* Reading at 220 nm	
Transimission T(%)	Absorbance(A)
0.0111	3.9564

**Specific Acceptance :

Transmission \leq 1.0 T(%), Absorbance \geq 2.0 A

**Stray light not TISI Accredited

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

End of Calibration Certificate



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

Calibration Report					
Non-Dispersive Infrared CO Analyzer					
Date :	01 November 2023	Brand :	API	Model :	300E
No.	CO-B01			Serial No.	782
Calibrator (Dilution System)					
Brand : API			Model : 700		
Last Cal. Date : 08 August 2023			Serial No. : 911		
Reference Standard Gas					
Standard Gas : Carbon Monoxide (CO)			Cylinder No. : D196045		
Certified Date : 16 April 2022		Expired Date : 15 April 2024		Cylinder Conc. : 4,570 ppm	
Calibrating Condition					
Pressure : 1011 mmbar		Temp. : 24.5 °C		% RH : 48	
Calibration Setting					
Span	Initial Reading (Before Adj.), PPM			Final Reading (After Adj.), PPM	
Set Point	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	
Zero	0	-0.10	-	0	
CO Span	40.00	39.95	-0.125	40.00	
API Model 300E CO Analyzer Check List					
Parameter	Observed Value	Units	Nominal Range		
Range	50	PPM	0-1000 ppm		
Stability	0.10	PPM	< 1 ppm With Zero Air		
CO Measure	4015.8	mV	2500-4800 mV		
CO Reference	3947.3	mV	2500-4800 mV		
Measure/Reference Ratio	1.180	-	1.1-1.3 W/Zero Air		
Sample Pressure	28.7	In-Hg-A	~2" < Ambient Absolute Pressure		
Sample Flow	811	CC/Min	800 ± 10%		
Sample Temperature	48.2	°C	48 ± 4		
Bench Temperature	48.0	°C	48 ± 2		
Wheel Temperature	68.4	°C	68 ± 2		
Box Temperature	30.9	°C	Ambient Temp + 7 ± 10		
Photo-Drive	3027.1	mV	250 mV to 4750 mV		
Slope	1.017	-	1.0 ± 0.3		
Offset	0.2	-	0 ± 0.3		

(Mr.Adul Dangklom)

(Mr. Peera Detudom)



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

Customer : <u>S.P.S.Consulting Service Co.,Ltd</u>	Date Tested: <u>July 6, 2023</u>	
	Recommendation Recertification	
Address : <u>7 Soi Phaholyothin 24</u>	Period <u>6</u> Months	
<u>Paholyothin Road</u>	Recertification Due: <u>January 6, 2024</u>	
<u>Jompol Chatuchak, Bangkok 1090</u>	Date Last Certified: <u>January 11, 2023</u>	
User Name: <u>K.Phenpha Vipasthawatt</u>	Visit Number: <u>1 of 2</u>	
Phone: <u>083-9269252</u>	PerkinElmer Phone: <u>02-719-6420 ext 206</u>	
Fax: <u>02-513-4221</u>	PerkinElmer Fax: <u>02-318-5597</u>	

CONFIGURATION TESTED		ACCESSORIES/COMPONENT NOT INCLUDED
MODEL	SERIAL NUMBER	
<u>OPTIMA 5300DV</u>	<u>077C7042401</u>	
TESTED EQUIPMENT	CALIBRATION NUMBER	EXPIRATION
<u>IPV Methods</u>		
TEST STANDARD USED	PART NUMBER	EXPIRATION DATE
<u>Multielement Standard</u>	<u>N069-1579</u>	<u>October 30, 2023</u>
<u>Wavecal Solution</u>	<u>N058-2152</u>	<u>September 30, 2023</u>
<u>VIS Wavecal solution</u>	<u>N930-2946</u>	<u>August 30, 2023</u>
<u>Instrument Cal. STD4</u>	<u>N930-0221</u>	<u>November 30, 2023</u>
CUSTOMER SUPPLIED	COMMENTS	CUSTOMER INITIALS
<u>2 % HNO3</u>		
<u>10 % HNO3</u>		



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401**DATE TESTED** July 6, 2023**1. MECHANICAL CHECKS**

- | | |
|--|-----------------------------|
| A. Inspect and clean all fans and filters. | <input type="checkbox"/> OK |
| B. Inspect and replace as necessary, all torch components including the RF coil. | <input type="checkbox"/> OK |
| C. Inspect all tubing for sign of clacking or leaking. | <input type="checkbox"/> OK |
| D. Adjust water and gas pressure regulator settings. | <input type="checkbox"/> OK |
| E. Inspect and leak check pneumatics drawers. | <input type="checkbox"/> OK |
| F. Clean the exterior of the instrument. | <input type="checkbox"/> OK |

2. OPTICAL CHECKS

- | | |
|---|-----------------------------|
| A. Inspect and clean all optical components. | <input type="checkbox"/> OK |
| B. As required, check and replace all purgefilters. | <input type="checkbox"/> OK |
| C. Recheck optical alignment. | <input type="checkbox"/> OK |

3. COOLING SYSTEM CHECKS

- | | |
|---|------------------------------|
| A. Perform preventive maintenance on chiller. | <input type="checkbox"/> OK |
| B. Flush out the chiller every year. | <input type="checkbox"/> N/A |

4. PERFORMANCE CHECKS

- | | |
|----------------------------|-----------------------------|
| A. Torch View Alignment. | <input type="checkbox"/> OK |
| B. Wavelength Calibration. | <input type="checkbox"/> OK |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER : 077C7042401DATE TESTED : July 6, 2023

PARAMETER	SPECIFICATION			FINAL VALUE
Spectral Resolution : UV	As 193.696 nm	≤ 0.007		<u>0.00534</u>
	Ni 231.604 nm	≤ 0.008		<u>0.00682</u>
	Ni 341.476 nm	≤ 0.012		<u>0.00794</u>
Spectral Resolution : VIS	La 408.672 nm	≤ 0.020		<u>0.01613</u>
	Ba 455.403 nm	≤ 0.025		<u>0.02282</u>
Precision				
	As 193.656 nm	% RSD < 1.0		<u>0.23</u> %
	Zn 213.856 nm	% RSD < 1.0		<u>0.09</u> %
	Mn 257.610 nm	% RSD < 1.0		<u>0.58</u> %
	La 379.478 nm	% RSD < 1.0		<u>0.38</u> %
	Ba 455.403 nm	% RSD < 1.0		<u>0.42</u> %
	Ba 493.408 nm	% RSD < 1.0		<u>0.41</u> %
Detection Limits : Axial	Tl 190.080 nm	3(sd)		<u>2.37</u> ppb
	As 193.696 nm	3(sd)		<u>6.78</u> ppb
	Pb 220.353 nm	3(sd)		<u>0.82</u> ppb
Detection Limits : Radial	As 193.696 nm	3(sd)		<u>23.56</u> ppb
	Zn 213.856 nm	3(sd)		<u>2.85</u> ppb
	Mn 257.610 nm	3(sd)		<u>3.66</u> ppb
	La 379.478 nm	3(sd)		<u>5.10</u> ppb
	Ba 455.403 nm	3(sd)		<u>0.12</u> ppb
	Ba 493.408 nm	3(sd)		<u>1.17</u> ppb
BEC : Axial (IB X 500)/(IS-IB)	Cd 226.502 nm	≤ 150 ppb		<u>117.07</u>
BEC : Radial (IB X 1000)/(IS-IB)	Mn 257.610 nm	≤ 45 ppb		<u>22.09</u>



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401**DATE TESTED** July 6, 2023**Remarks :**

Commissioning follow as commissioning performance sheets.

This is to certify that the above tests have been performed and the configuration tested



meets



does not meet

the PerkinElmer Specifications listed on this certificate.

This certificate does not modify PerkinElmer's standard terms and condition of sale, including warranty terms.

Service Department PerkinElmer Ltd.

Authorized Representative:

Service Engineer

Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID: GC_MS_03_52_CN10925102
Organization Name: S.P.S Consulting service
Organization Location: 7 Soi Phaholyothin Road, Ladyao, Khet Jatujak, Bangkok 10900

Date: March 31, 2023 12:15:52 PM
EQF Name: AgilentRecommended, AgilentRecommended
EQF Revision: GC.02.50, GCMS.02.50
Overall Qualification Status: Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Decay

Name: 7890

Front SSL

Setpoint Status:

Pressure: 25.0 psi

Pressure Change: -0.1 psi /5 minutes

Agilent Recommended: >= -2.0 and <= 0.5

Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7890

Front SSL

Date: March 31, 2023 12:15:52 PM

System ID: GC_MS_03_52_CN10925102

Setpoint Status:

Inlet Pressure: 25.0 psi

Accuracy: 0.0 psi

Agilent Recommended: <= 1.2

Overall Inlet Pressure Accuracy Test Status

Pass

Inlet Pressure Accuracy

Name: 7890

Back SSL

Setpoint Status:

Inlet Pressure: 25.0 psi

Accuracy: 0.2 psi

Agilent Recommended: <= 1.2

Overall Inlet Pressure Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890

Front FID

Setpoint Status:

Flow Type: Fuel

Setpoint: 30.0 mL/min

Accuracy: 0.3 mL/min

Agilent Recommended: <= 10.0 % setpoint

Measured Flow: 30.3 mL/min

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

Date: March 31, 2023 12:15:52 PM

System ID: GC_MS_03_52_CN10925102

Setpoint Status: Pass
Flow Type: Oxidizer
Setpoint: 400.0 mL/min
Measured Flow: 396.2 mL/min
Accuracy: 3.8 mL/min
Agilent Recommended: ≤ 10.0 mL/min
Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Setpoint Status: Pass
Flow Type: Makeup
Setpoint: 25.0 mL/min
Measured Flow: 25.1 mL/min
Accuracy: 0.1 mL/min
Agilent Recommended: ≤ 10.0 mL/min
Limit is percentage of setpoint or 0.5 mL/minute, whichever is largest.

Overall Detector Flow Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890
Setpoint Status: Pass
Zone: Oven
Setpoint/Actual: 230.0 230.6 °C
Accuracy: 0.6 °C
Agilent Recommended: ≥ -1.0 °C
≤ 1.0 °C

Date: March 31, 2023 12:14:52 PM
System ID: GC_MS_03_52_CN10925102

Setpoint Status: Pass
Zone: Oven
Setpoint/Actual: 100.0 100.4 °C
Accuracy: 0.4 °C
Agilent Recommended: ≥ -1.0 °C
≤ 1.0 °C

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability**Name:** 7890**Setpoint Status:** Pass**Setpoint/Average:****Temperature:** 100.0 100.3833 °C**Stability:** 0.1 °C**Agilent Recommended:** ≤ 0.5 °C**Overall GC Oven Temperature Stability Test Status**

Pass

Scouting Run**Tested Combination1:** Front SSL / Front FID**Name:** Manual Injection**Setpoint Status:** Not applicable**Injection Volume on Column:** Completed 1.0 µL**Overall Scouting Run Status**

Completed

Noise and Drift**Tested Combination1:** Front SSL / Front FID

Date: March 31, 2023 12:14:52 PM
System ID: GC_MS_03_52_CN10925102

Name:	7890
Setpoint Status:	Pass
Base Signal:	89800 /Ab
ASTM Noise	counts
	285.31
Agilent Recommended:	<= 1768.00
Status:	Pass
Drift	counts/hr
	96.04
Agilent Recommended:	<= 18200.00
Status:	Pass

Overall Noise and Drift Test Status

Signal to Noise	Pass			
Tested Combination1	Front	SSL	Front	FID
Name:	Manual Injection	7890		
Setpoint Status:	Pass			
Signal to Noise:	3814254			
Agilent Recommended:	>= 300000			

Overall Signal to Noise Test Status

Log Amp	Pass			
Tested Combination2	Back	SSL	External	SQ
Name:	5975C			
Setpoint Status:	Pass			
Overall Log Amp Test Status	Pass			
RFPA				

Tested Combination2	Back	SSL	External	SQ
Name:	5975C			
Setpoint Status:	Pass			
Amu:	1050	m/z		
Drift After Five Minutes:	1	mV		
Agilent Recommended:	>= -100	and	<= 100	
RFPA Voltage:	479	mV		
Agilent Recommended:	<= 1100			
Overall RFPA Test Status	Pass			

Tune EI

Tested Combination2	Back	SSL	External	SQ
Name:	5975C			
Setpoint Status:	Pass			
Filament:	1			
Setpoint Status:	Pass			
Filament:	2			
Overall Tune EI Test Status	Pass			

Signal to Noise EI

Tested Combination2	Back	SSL	External	SQ
Name:	5975C			
Source:	EI - Inert	Filament:	1	
Setpoint Status:	Pass			
Signal to Noise:	425			
Agilent Recommended:	>= 180			

Source:	El - Inert	Flamelet:	2
Setpoint Status:	Pass		
Signal to Noise:	566		
Agilent Recommended:	>= 160		
Overall Signal to Noise EI Test Status	Pass		

Instrument Details

Purpose:

This section describes the as found system configuration.

Details

System	GC_MS_03_52_CN10925102
System ID	Agilent Technologies
Manufacturer	7890
Name	
Tested Combination1	
Injection Technique	Manual Injection
Sampler Identifier	Sampler 1
Inlet	Front
Detector	Front
LTM Included?	No
Tested Combination2	
Injection Technique	Manual Injection
Sampler Identifier	Sampler 2
Inlet	Back
Detector	External
LTM Included?	No
Sampler 1	
Manufacturer	Agilent Technologies
Type	Manual Injection
Usage	Sample Injection
Syringe Volume (µL)	10
Sampler 2	
Manufacturer	Agilent Technologies
Type	Manual Injection
Usage	Sample Injection
Syringe Volume (µL)	10

Mainframe 1

Manufacturer	Agilent Technologies
Name	7890
Model Number	G3440A
Serial Number	CN10325120
Firmware Revision	A.C1.10.3
Oven Type	Standard

Inlet 1

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

Inlet 2

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

Detector 1

Manufacturer	Agilent Technologies
Name	7850
Type	FID
Adapter	Capillary
Control Type	Electronic Pressure Control (EPC)
Location	Front
Makeup Gas	Nitrogen

Detector 2

Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External

Mass Spectrometer 1

Manufacturer	Agilent Technologies
Type	SQ
Name	5975C
Serial Number	US91732743
Firmware Revision	5975 5.02.07
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN Std

MS EI Source 1

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

Electronic Signature

Purpose:

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Details

Full Name of Signer: Saengulhal Tarak
Logged On User Name: saengulhal.tarak@hion.agilent.com
Signature Creation Date: March 31, 2023
Reason for Signature: Executed protocol and published this original version of document

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User Name: saengulhal.tarak
Hostname: LAPTOP-SC395K0JNV

System ID: GC_MS_03_52_CN10925102
Print Date: March 31, 2023 1:21:53 PM

GC_MS_03_52_CN10925102 transaction log :

Time	Transaction State	Activity Performance	Type of Transaction	Optional Information
March 31, 2023 9:12:29 AM	Auth	SessionCreated	Session	None
March 31, 2023 9:12:29 AM	Start	Configuration	Session	None
March 31, 2023 9:12:29 AM	Auth	Establishment	Joining	User is negotiating and does not require an unlock code
March 31, 2023 9:20:14 AM	Auth	Establishment	Session	EQP status for primary technician [cc] - File path: [ProtocolPack\Gc\Conf\Gcal\lonell\59\Gc_02.50.eeq] EQP File Name: [Gc_02.50.eeq], EQP Name: [Asm\Recommended] Proto- col Revision: [Gc_02.50] EQP status for implemented technique [cc] - File path: [ProtocolPack\Gc\Conf\Gcal\lonell\59\Gc_02.50.eeq] EQP File Name: [Gc_02.50.eeq], EQP Name: [Gc_02.50.eeq], EQP Name: [Asm\Recommended]
March 31, 2023 9:20:17 AM	End	Configuration	Session	None
March 31, 2023 9:20:27 AM	Start	Qualification	Session	UU
March 31, 2023 9:20:27 AM	Start	Execution	System inspection and Basic Safety and Operation - 789C - Qualifying Test - No reports associated	None
March 31, 2023 9:21:32 AM	End	Execution	System inspection and Basic Safety and Operation - 789D - Qualifying Test - No reports associated	Run Count: 1

User Name: saas@agilent.com
Host Name: LATOP-QC35K01M

System ID: GC_MS_03_52_CN10925102
Print Date: March 31, 2023 1:21:51 PM

GC_MS_03_52_CN10925102 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
March 31, 2023 9:21:55 AM Start		Execution	Inlet Pressure Decay - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi	None
March 31, 2023 9:21:51 AM End		Execution	Inlet Pressure Display - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi	Run Count: 1
March 31, 2023 9:21:51 AM Start		Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
March 31, 2023 9:21:50 AM End		Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count: 1
March 31, 2023 9:22:02 AM Start		Execution	Inlet Pressure Accuracy - Back SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
March 31, 2023 9:22:07 AM End		Execution	Inlet Pressure Accuracy - Back SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count: 1
March 31, 2023 9:22:09 AM Start		Execution	Detector Flow Accuracy - Front FID - Type: FID - S: 30.0 mL/min - L: <= 10.0% setpoint	None
March 31, 2023 9:22:20 AM End		Execution	Detector Flow Accuracy - Front FID - Type: FID - S: 30.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
March 31, 2023 9:22:30 AM Start		Execution	Detector Flow Accuracy - Front FID - Type: Quad - S: 400.0 mL/min - L: <= 10.0% setpoint	None
March 31, 2023 9:22:41 AM End		Execution	Detector Flow Accuracy - Front FID - Type: Quad - S: 400.0 mL/min - L: <= 10.0% setpoint	Run Count: 1

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Date: March 31, 2023 1:21:52 PM
System ID: GC_MS_03_52_CN10925102

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User Name: saas@agilent.com
Host Name: LATOP-QC35K01M

System ID: GC_MS_03_52_CN10925102
Print Date: March 31, 2023 1:21:53 PM

GC_MS_03_52_CN10925102 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
March 31, 2023 9:22:42 AM Start		Execution	Detector Flow Accuracy - Front FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	None
March 31, 2023 9:22:46 AM End		Execution	Detector Flow Accuracy - Front FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
March 31, 2023 9:22:49 AM Start		Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
March 31, 2023 9:23:31 AM Start		Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
March 31, 2023 9:23:34 AM End		Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
March 31, 2023 9:23:37 AM Start		Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
March 31, 2023 9:24:00 AM Start		Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
March 31, 2023 9:25:03 AM End		Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count: 1
March 31, 2023 9:26:05 AM Start		Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.2°C	None

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Date: March 31, 2023 1:21:52 PM
System ID: GC_MS_03_52_CN10925102

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User Name: xanquahd@rock
Hostname: LAPTOP-Q035K0M6

System ID: GC_MS_03_52_CN10925102
Print Date: March 31, 2023 1:21:53 PM

GC_MS_03_52_CN10925102 Transaction log

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
March 31, 2023 9:26:42 AM	Start	Execution	GC Oven Temperature Stability - 7890 - Temperature - Open - S: 100.0°C - L: ce 0.5°C	None
March 31, 2023 9:27:36 AM	Audit	Data	GC Oven Temperature Stability - 7890 - Temperature - Open - S: 100.0°C - L: ce 0.5°C	Manual Data Entry
March 31, 2023 9:27:46 AM	End	Execution	GC Oven Temperature Stability - 7890 - Temperature - Open - S: 100.0°C - L: ce 0.5°C	Run Output 1
March 31, 2023 9:27:51 AM	Start	Execution	GC Sealing Run - Manual Injection, Front SSL, Front FID - Part of System Preparation - No limits associated	None
March 31, 2023 9:44:35 AM	Start	Execution	Log App - 5975C SQ - Source: EI EI - Inert	None
March 31, 2023 9:45:09 AM	Start	Execution	HPA - 5975C SQ - Source: EI EI - Inert	None
March 31, 2023 10:23:19 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Back SSL, SQ - Source: EI - Inert using Flameless 1 - L: ce 100	None
March 31, 2023 10:37:23 AM	Start	Execution	Tune EI - 5975C SQ - Source: EI EI - Inert Flameless 1 (Qualitative - No signals associated)	None
March 31, 2023 10:38:04 AM	Start	Execution	Tune EI - 5975C SQ - Source: EI EI - Inert Flameless 2 (Qualitative - No signals associated)	None
March 31, 2023 10:38:11 AM	Start	Execution	Tune EI - 5975C SQ - Source: EI EI - Inert Flameless 1 (Qualitative - No signals associated)	None

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Date: March 31, 2023 1:21:52 PM
System ID: GC_MS_03_52_CN10925102

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User Name: xanquahd@rock
Hostname: LAPTOP-Q035K0M6

System ID: GC_MS_03_52_CN10925102
Print Date: March 31, 2023 1:21:53 PM

GC_MS_03_52_CN10925102 Transaction log

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
March 31, 2023 10:38:14 AM	Start	Execution	Noise and Dist - Front FID - Detector FID - L (Noise) - ce 0.10 pA - L (Dist) - ce 2.50 pA/Hz	None
March 31, 2023 10:38:17 AM	Start	Execution	GC Sealing Run - Manual Injection, Front SSL, Front FID - Part of System Preparation - No limits associated	None
March 31, 2023 10:45:20 AM	Audit	Data	GC Sealing Run - Manual Injection, Front SSL, Front FID - Part of System Preparation - No limits associated	Data has Path: FID=SSQ_FID_ZEPHRA.01
March 31, 2023 10:47:01 AM	End	Execution	GC Sealing Run - Manual Injection, Front SSL, Front FID - Part of System Preparation - No limits associated	Run Count: 1
March 31, 2023 10:50:27 AM	Start	Execution	Noise and Dist - Front FID - Detector FID - L (Noise) - ce 0.10 pA - L (Dist) - ce 2.50 pA/Hz	None
March 31, 2023 10:58:52 AM	Audit	Data	Noise and Dist - Front FID - Detector FID - L (Noise) - ce 0.10 pA - L (Dist) - ce 2.50 pA/Hz	Data has Path: FID=SSQ_FID_ZEPHRA.01
March 31, 2023 11:00:53 AM	Start	Execution	Noise and Dist - Front FID - Detector FID - L (Noise) - ce 0.10 pA - L (Dist) - ce 2.50 pA/Hz	Run Count: 1
March 31, 2023 11:02:02 AM	Start	Execution	Signal to Noise - Manual Injection, Front SSL, Front FID - Detector FID - L: ce 200000	None
March 31, 2023 11:14:32 AM	Audit	Acc-Closed	Session	None

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Date: March 31, 2023 1:21:52 PM
System ID: GC_MS_03_52_CN10925102

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User Name: vaniguthu,boak
Workname: LAMP-Q33KCONY

System ID: GC_MS_03_52_CN10925102
Print Date: March 31, 2023 1:21:52 PM

GC_MS_03_52_CN10925102 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
March 31, 2023 1:00:43 PM Start		Execution	Signal to Noise EI - Liquid Injection, Back SSI, SQ - Source EI - Inertialing Flarewell 2 - L, >= 100	None
March 31, 2023 1:01:52 PM Audit		Data	Signal to Noise EI - Liquid Injection, Back SSI, SQ - Source EI - Inertialing Flarewell 2 - L, >= 100	Data file Path : F:\SN_F2_01\DATA\SNM.V
March 31, 2023 1:02:06 PM End		Execution	Signal to Noise EI - Liquid Injection, Back SSI, SQ - Source EI - Inertialing Flarewell 2 - L, >= 100	Run Count : 1
March 31, 2023 1:02:13 PM End		Dual/Location	Session	CQ
March 31, 2023 1:02:13 PM Start		Reporting	Session	None
March 31, 2023 1:20:27 PM Audit		Recording	Session	Report Generated : Certificate

คุณภาพอากาศในบรรยากาศ



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High Volume Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

Calibration Data

High Volume Air Sampler Data		Calibration Data		
Recorder No.	Blower No.	Date	Actual Flowrate (ft ³ /min)	R ²
B01	B01	01/08/2023	y = 1.289x-5.689	0.999
B02	B02	02/08/2023	y = 1.106x+2.666	0.999
B03	B03	01/08/2023	y = 1.126x-0.852	0.997
B04	B04	01/08/2023	y = 1.294x-8.235	0.998
B05	B05	04/08/2023	y = 1.279x-7.416	0.996
B06	B06	01/08/2023	y = 1.280x-7.015	0.999
B07	B07	01/08/2023	y = 1.220x-6.249	0.998
B08	B08	01/08/2023	y = 1.268x-7.621	0.999
B09	B09	01/08/2023	y = 1.258x-5.982	1.000
B10	B10	04/08/2023	y = 1.142x+0.294	0.999
B11	B11	04/08/2023	y = 1.165x-3.050	0.998
B12	B12	04/08/2023	y = 1.227x-5.594	0.999
B13	B13	04/08/2023	y = 1.282x-7.522	0.998
B14	B14	04/08/2023	y = 1.298x-7.713	0.999
B15	B15	02/08/2023	y = 1.176x-3.322	0.997
B16	B16	02/08/2023	y = 1.316x-9.126	0.997
B17	B17	02/08/2023	y = 1.235x-5.694	1.000
B18	B18	02/08/2023	y = 1.323x-10.629	0.998
B19	B19	02/08/2023	y = 1.277x-8.109	0.997
B20	B20	02/08/2023	y = 1.297x-8.466	0.998
B21	B21	03/08/2023	y = 1.186x-3.582	1.000
B22	B22	03/08/2023	y = 1.274x-8.729	0.998
B23	B23	03/08/2023	y = 1.224x-5.880	0.995
B24	B24	03/08/2023	y = 1.185x-3.773	0.999
B25	B25	01/08/2023	y = 1.075x+1.295	0.998
B26	B26	01/08/2023	y = 1.282x-7.798	0.997
B27	B27	01/08/2023	y = 1.248x-7.408	0.997
B28	B28	01/08/2023	y = 1.279x-8.370	0.999
B29	B29	04/08/2023	y = 1.292x-7.541	0.999
B30	B30	04/08/2023	y = 1.270x-8.142	0.995
B31	B31	04/08/2023	y = 1.284x-8.212	0.999
B32	B32	04/08/2023	y = 1.294x-6.759	0.999
B33	B33	04/08/2023	y = 1.252x-5.024	0.999
B34	B34	04/08/2023	y = 1.262x-7.362	0.998

(Mr.Adul Dangklom)

(Mr. Peera Detudom)



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High Volume Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

Calibration Data

High Volume Air Sampler Data		Calibration Data		
Recorder No.	Blower No.	Date	Actual Flowrate (ft ³ /min)	R ²
B01	B01	01/11/2023	y = 1.234x-3.561	0.997
B02	B02	02/11/2023	y = 1.168x-0.261	0.999
B03	B03	02/11/2023	y = 1.171x-3.628	0.998
B04	B04	02/11/2023	y = 1.271x-7.126	0.999
B05	B05	03/11/2023	y = 1.223x-6.612	0.998
B06	B06	01/11/2023	y = 1.235x-6.018	0.997
B07	B07	01/11/2023	y = 1.206x-6.272	0.999
B08	B08	01/11/2023	y = 1.280x-8.017	0.996
B09	B09	02/11/2023	y = 1.268x-7.075	0.999
B10	B10	03/11/2023	y = 1.114x+1.255	0.998
B11	B11	03/11/2023	y = 1.147x-2.182	0.999
B12	B12	03/11/2023	y = 1.243x-6.434	0.998
B13	B13	02/11/2023	y = 1.188x-3.203	0.996
B14	B14	02/11/2023	y = 1.241x-6.190	0.998
B15	B15	09/11/2023	y = 1.228x-4.962	0.996
B16	B16	01/11/2023	y = 1.288x-7.889	0.998
B17	B17	01/11/2023	y = 1.194x-2.803	0.999
B18	B18	02/11/2023	y = 1.234x-7.054	0.999
B19	B19	02/11/2023	y = 1.224x-7.673	0.997
B20	B20	01/11/2023	y = 1.194x-5.352	0.998
B21	B21	01/11/2023	y = 1.127x-2.428	0.999
B22	B22	03/11/2023	y = 1.235x-8.410	0.999
B23	B23	03/11/2023	y = 1.198x-5.314	0.997
B24	B24	04/11/2023	y = 1.127x-2.077	0.999
B25	B25	04/11/2023	y = 1.115x+0.218	0.999
B26	B26	04/11/2023	y = 1.240x-6.806	0.996
B27	B27	01/11/2023	y = 1.196x-5.906	0.999
B28	B28	01/11/2023	y = 1.209x-5.372	0.997
B29	B29	01/11/2023	y = 1.251x-4.843	0.996
B30	B30	02/11/2023	y = 1.191x-3.112	0.996
B31	B31	02/11/2023	y = 1.172x-3.363	0.997
B32	B32	01/11/2023	y = 1.245x-4.270	0.999
B33	B33	01/11/2023	y = 1.222x-4.224	0.996
B34	B34	02/11/2023	y = 1.195x-4.827	0.998

(Mr. Adul Dangklom)

(Mr. Peera Detudom)



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High Volume PM-10 Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

Calibration Data

High Volume PM-10 Data		Calibration Data		
Recorder No.	Blower No.	Date	Actual Flowrate (ft ³ /min)	R ²
R01	R01	01/08/2023	y = 1.244x-6.482	0.998
R02	R02	01/08/2023	y = 1.274x-6.620	0.998
R03	R03	02/08/2023	y = 1.268x-7.028	0.999
R04	R04	02/08/2023	y = 1.259x-8.726	0.998
R05	R05	02/08/2023	y = 1.210x-5.918	0.999
R06	R06	02/08/2023	y = 1.246x-5.062	0.998
R07	R07	02/08/2023	y = 1.222x-4.950	0.999
R08	R08	02/08/2023	y = 1.287x-8.890	0.998
R09	R09	02/08/2023	y = 1.245x-8.340	0.998
R10	R10	02/08/2023	y = 1.228x-6.133	0.999
R11	R11	04/08/2023	y = 1.282x-6.014	0.997
R12	R12	04/08/2023	y = 1.303x-9.748	0.998
R13	R13	04/08/2023	y = 1.305x-8.462	0.997
R14	R14	04/08/2023	y = 1.299x-7.936	0.997
R15	R15	02/08/2023	y = 1.291x-7.250	0.999
R16	R16	02/08/2023	y = 1.275x-7.402	0.995
R17	R17	02/08/2023	y = 1.292x-8.739	0.999
R18	R18	02/08/2023	y = 1.215x-5.881	0.998
R19	R19	02/08/2023	y = 1.273x-7.472	0.999
R20	R20	02/08/2023	y = 1.288x-10.306	0.997

(Mr. Abdul Dangklom)

(Mr. Peera Detudom)



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High Volume PM-10 Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

Calibration Data

High Volume PM-10 Data		Calibration Data		
Recorder No.	Blower No.	Date	Actual Flowrate (ft^3/min)	R^2
R01	R01	01/11/2023	$y = 1.166x - 2.827$	0.999
R02	R02	01/11/2023	$y = 1.140x + 0.079$	0.998
R03	R03	02/11/2023	$y = 1.176x - 2.983$	0.999
R04	R04	01/11/2023	$y = 1.155x - 3.417$	0.996
R05	R05	01/11/2023	$y = 1.193x - 5.553$	0.998
R06	R06	08/11/2023	$y = 1.173x - 2.245$	0.998
R07	R07	08/11/2023	$y = 1.183x - 3.521$	0.999
R08	R08	06/11/2023	$y = 1.195x - 5.732$	0.997
R09	R09	01/11/2023	$y = 1.161x - 3.857$	0.995
R10	R10	09/11/2023	$y = 1.181x - 4.105$	0.998
R11	R11	09/11/2023	$y = 1.155x - 0.430$	0.996
R12	R12	09/11/2023	$y = 1.196x - 4.411$	0.999
R13	R13	09/11/2023	$y = 1.188x - 3.031$	0.996
R14	R14	01/11/2023	$y = 1.167x - 2.357$	0.998
R15	R15	02/11/2023	$y = 1.186x - 3.860$	0.998
R16	R16	02/11/2023	$y = 1.187x - 2.636$	0.999
R17	R17	02/11/2023	$y = 1.169x - 3.318$	0.996
R18	R18	03/11/2023	$y = 1.190x - 4.826$	0.997
R19	R19	01/11/2023	$y = 1.152x - 2.131$	0.996
R20	R20	01/11/2023	$y = 1.183x - 4.568$	0.997

(Mr. Adul Dangklom)

(Mr. Peera Detudom)



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72. Fax : (662) 513-4221. E-mail : sale@spscon.com, www.spscon.com

CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 31 October 2023

BRAND : API

MODEL : TML-41M

NO. NOX-B22

SERIAL NO. NO1618

Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 08 August 2023

Serial No. : 911

Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : A00726SV

Certified Date : 05 January 2023

Expired Date : 05 January 2026

Cylinder Conc. : 48.8 ppm

CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 49

CALIBRATION SETTING

Span Set Point	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	0.11	-	0	-
NO Span	400	400.1	0.025	400.0	1.008
NO _x Span	400	400.2	0.050	400.0	1.011

API Model TML-41M NO_x Analyzer Check List

Test Values	Observed Value	Units	Nominal Range
RANGE	500	PPB	500 standard
STABILITY (Zero Gas)	0.1	PPB	< 2 with zero air
SAMPLE FLOW	508	cc/min	500 ± 50
OZONE FLOW	78	cc/min	80 ± 15
PMT	103.3	mV	-20 - 150
AZERO	94.0	mV	-20 - 150
HVPS	673	V	420 - 900 constant
RCELL TEMP	50.4	°C	50 ± 1
BOX TEMP	29.3	°C	8 - 48
PMT TEMP	7.2	°C	7 ± 2
MOLY TEMP	314.8	°C	315 ± 5
RCELL PRESS	8.5	IN-Hg-A	2 - 10 constant
SAMPLE PRESS	28.7	IN-Hg-A	25 - 30 constant
NO Span Conc	400	PPB	20 - 20,000
NO _x Span Conc	400	PPB	20 - 20,000
NO Slope	1.008	-	1.0 ± 0.3
NO _x Slope	1.011	-	1.0 ± 0.3
NO Offset	1.7	mV	-20 to +150
NO _x Offset	1.0	mV	-20 to 150
Stability at Zero	0.1	PPB	< 0.2
Stability at Span	0.2	PPB	< 2 ppb @ 400 ppb span gas

Calibrated by :

Approved by :



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

S.P.S. CONSULTING SERVICE CO., LTD.

7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900

7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900

Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

CALIBRATION REPORT

NON-DISPERSIVE INFRARED CO ANALYZER

DATE : 31 October 2023

BRAND : API

MODEL : 300E

NO. CO-B02

SERIAL NO. 965

Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 08 August 2023

Serial No. : 911

Reference Standard Gas

Standard Gas : Carbon Monoxide (CO)

Cylinder No. : D196045

Certified Date : 16 April 2022

Expired Date : 15 April 2024

Cylinder Conc. : 4,570 PPM

CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 49

CALIBRATION SETTING

Span Set Point	Initial Reading (Before Adj.), PPM			Final Reading (After Adj.), PPM
	Expected Concentration	Analyzer Response	%Dif	Analyzer Response
Zero	0	-0.10	-	0
CO Span	40.00	40.04	0.100	40.00

API Model 300E CO Analyzer Check list

Parameter	Observed Value	Units	Nominal Range
RANGE	50	PPM	0-1000 ppm
STABILITY	0.10	PPM	< 1 ppm with zero air
CO MEASURE	4016.1	mV	2500-4800 mV
CO REFERENCE	3948.7	mV	2500-4800 mV
MEASURE/REFERENCE RATIO	1.180	-	1.1-1.3 w/zero air
SAMPLE PRESSURE	28.5	In-Hg-A	~2" < ambient absolute pressure
SAMPLE FLOW	804	cc/min	800 ± 10%
SAMPLE TEMPERATURE	48.3	°C	48 ± 4
BENCH TEMPERATURE	48.0	°C	48 ± 2
WHEEL TEMPERATURE	68.5	°C	68 ± 2
BOX TEMPERATURE	30.8	°C	Ambient temp + 7 ± 10
PHOTO-DRIVE	3034.5	mV	250 mV to 4750 mV
SLOPE	1.017	-	1.0 ± 0.3
OFFSET	0.2	-	0 ± 0.3

Calibrated by :

Approved by :

**QUALITY CALIBRATION CO.,LTD.**

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com

CERTIFICATE No : 23M2441

REFERENCE No : 68471-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS105DU

SERIAL No : 1126422905

ID No : BA 05/50

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 10-Mar-23

APPROVED BY : 

ISSUED DATE : 16-Mar-23

RECEIVED DATE : 10-Mar-23

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.



CERTIFICATE No : 23M2441

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS105DU
MANUFACTURER : METTLER TOLEDO S/N : 1126422905
ID No : BA 05/50 RECEIVED DATE : 10-Mar-23
AIR PRESSURE : 1010mbar \pm 1mbar CALIBRATION DATE : 10-Mar-23
AMBIENT TEMPERATURE : 23° C \pm 1° C RELATIVE HUMIDITY : 49 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD WEIGHT SET	E2	QK-I-151	M2302013S	02-Feb-25
2) STANDARD WEIGHT	E2	15843	M2302014S	02-Feb-25

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.00000	0.00000	0.000039
0.02	0.02000	0.00000	0.000039
0.10	0.10000	0.00000	0.000039
0.20	0.20001	-0.00001	0.000040
0.50	0.50001	-0.00001	0.000040
1.00	1.00000	0.00000	0.000041
2.00	2.00003	-0.00003	0.000042
5.00	5.00001	-0.00001	0.000046
10.00	10.00003	-0.00003	0.000053
20.00	20.00005	-0.00005	0.000067
50.00	50.00001	-0.00001	0.00011
100.00	100.00001	-0.00001	0.00019
200.00	200.00001	-0.00001	0.00032

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.0000
2	50.0001
3	50.0000
4	50.0000
5	49.9999
OFF-CENTER LOADING	0.0001

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR $k=2$, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

Customer : <u>S.P.S.Consulting Service Co.,Ltd</u>	Date Tested: <u>July 6, 2023</u>	
	Recommendation Recertification	
Address : <u>7 Soi Phaholyothin 24</u>	Period <u>6</u> Months	
<u>Paholyothin Road</u>	Recertification Due: <u>January 6, 2024</u>	
<u>Jompol Chatuchak, Bangkok 1090</u>	Date Last Certified: <u>January 11, 2023</u>	
User Name: <u>K.Phenpha Vipasthawatt</u>	Visit Number: <u>1 of 2</u>	
Phone: <u>083-9269252</u>	PerkinElmer Phone: <u>02-719-6420 ext 206</u>	
Fax: <u>02-513-4221</u>	PerkinElmer Fax: <u>02-318-5597</u>	

CONFIGURATION TESTED		ACCESSORIES/COMPONENT NOT INCLUDED
MODEL	SERIAL NUMBER	
<u>OPTIMA 5300DV</u>	<u>077C7042401</u>	
TESTED EQUIPMENT	CALIBRATION NUMBER	EXPIRATION
<u>IPV Methods</u>		
TEST STANDARD USED	PART NUMBER	EXPIRATION DATE
<u>Multielement Standard</u>	<u>N069-1579</u>	<u>October 30, 2023</u>
<u>Wavecal Solution</u>	<u>N058-2152</u>	<u>September 30, 2023</u>
<u>VIS Wavecal solution</u>	<u>N930-2946</u>	<u>August 30, 2023</u>
<u>Instrument Cal. STD4</u>	<u>N930-0221</u>	<u>November 30, 2023</u>
CUSTOMER SUPPLIED	COMMENTS	CUSTOMER INITIALS
<u>2 % HNO3</u>		
<u>10 % HNO3</u>		



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401**DATE TESTED** July 6, 2023**1. MECHANICAL CHECKS**

- | | |
|--|-----------------------------|
| A. Inspect and clean all fans and filters. | <input type="checkbox"/> OK |
| B. Inspect and replace as necessary, all torch components including the RF coil. | <input type="checkbox"/> OK |
| C. Inspect all tubing for sign of clacking or leaking. | <input type="checkbox"/> OK |
| D. Adjust water and gas pressure regulator settings. | <input type="checkbox"/> OK |
| E. Inspect and leak check pneumatics drawers. | <input type="checkbox"/> OK |
| F. Clean the exterior of the instrument. | <input type="checkbox"/> OK |

2. OPTICAL CHECKS

- | | |
|---|-----------------------------|
| A. Inspect and clean all optical components. | <input type="checkbox"/> OK |
| B. As required, check and replace all purgefilters. | <input type="checkbox"/> OK |
| C. Recheck optical alignment. | <input type="checkbox"/> OK |

3. COOLING SYSTEM CHECKS

- | | |
|---|------------------------------|
| A. Perform preventive maintenance on chiller. | <input type="checkbox"/> OK |
| B. Flush out the chiller every year. | <input type="checkbox"/> N/A |

4. PERFORMANCE CHECKS

- | | |
|----------------------------|-----------------------------|
| A. Torch View Alignment. | <input type="checkbox"/> OK |
| B. Wavelength Calibration. | <input type="checkbox"/> OK |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER : 077C7042401
DATE TESTED : July 6, 2023

PARAMETER		SPECIFICATION		FINAL VALUE	
Spectral Resolution : UV	As 193.696 nm	≤ 0.007		0.00534	
	Ni 231.604 nm	≤ 0.008		0.00682	
	Ni 341.476 nm	≤ 0.012		0.00794	
Spectral Resolution : VIS	La 408.672 nm	≤ 0.020		0.01613	
	Ba 455.403 nm	≤ 0.025		0.02282	
Precision					
	As 193.656 nm	% RSD	< 1.0	0.23	%
	Zn 213.856 nm	% RSD	< 1.0	0.09	%
	Mn 257.610 nm	% RSD	< 1.0	0.58	%
	La 379.478 nm	% RSD	< 1.0	0.38	%
	Ba 455.403 nm	% RSD	< 1.0	0.42	%
	Ba 493.408 nm	% RSD	< 1.0	0.41	%
Detection Limits : Axial	Tl 190.080 nm	3(sd)		2.37	ppb
	As 193.696 nm	3(sd)		6.78	ppb
	Pb 220.353 nm	3(sd)		0.82	ppb
Detection Limits : Radial	As 193.696 nm	3(sd)		23.56	ppb
	Zn 213.856 nm	3(sd)		2.85	ppb
	Mn 257.610 nm	3(sd)		3.66	ppb
	La 379.478 nm	3(sd)		5.10	ppb
	Ba 455.403 nm	3(sd)		0.12	ppb
	Ba 493.408 nm	3(sd)		1.17	ppb
BEC : Axial (IB X 500)/(IS-IB)	Cd 226.502 nm	≤ 150 ppb		117.07	
BEC : Radial (IB X 1000)/(IS-IB)	Mn 257.610 nm	≤ 45 ppb		22.09	



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401DATE TESTED July 6, 2023**Remarks :**

Commissioning follow as commissioning performance sheets.

This is to certify that the above tests have been performed and the configuration tested



meets



does not meet

the PerkinElmer Specifications listed on this certificate.

This certificate does not modify PerkinElmer's standard terms and condition of sale,
including warranty terms.

Service Department PerkinElmer Ltd.

Authorized Representative:



(Mr. Wiphan Promlumda)

Service Engineer

ระดับเสียงบริเวณริมรั้วโรงงาน



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (ITSTR)

Request No. 21-66/0413 MTC No. EEL. BP. 109/0366

CALIBRATION CERTIFICATE

Submitted by : S.P.S. Consulting Service Co., Ltd.
Address : 7 Soi Phaholyothin 24, Phaholyothin Road, Jompol, Chatuchak, Bangkok 10900.
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
: Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang Samutprakan 10280.

Instrument Calibrated :
Description : Sound Calibrator
Manufacturer : ACO
Model : 2127
Serial No. : 130006

Ambient Environment
Temperature : $(23 \pm 3) ^\circ\text{C}$
Relative Humidity : $(50 \pm 15) \%$
Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$

Standards used :
1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.
3. Programmable Attenuator Tamagawa TPA-300A S/N OF 2214.
4. Digital Multimeter Agilent 34401A S/N MY44/05560.
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
6. Audio Analyzer Keithley 2015-P S/N 4106495.
7. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.

Calibration Procedure: CP-1C2-04 based on IEC 60942:2003. The sound pressure level of instrument was 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 : 27 Mar. 2023
Date of Calibration : 29 Mar. 2023

1/2

The results relate only to the items tested/calibrated and value assigned. Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of ITSTR.

Head Office 35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang, Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : tump@itstr.or.th Website: www.itstr.or.th

Office 196 Phaholyothin Road, Chatuchak, Bangkok 10900, Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
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E-mail : sum@itstr.or.th

Head Office 35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang, Changwat Pathumthani 12120, Thailand
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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (ITSTR)

Request No. 21-66/0413 MTC No. EEL. BP. 109/0366

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

Nominal Output of Unit Under Test = 94 dB re 20 μPa at 1000 Hz
Acoustic Output in dB re 20 μPa , Corrected to Reference Conditions: 101.325 kPa, 23.0 $^\circ\text{C}$ 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 Brüel&Kjær 4180	93.94	-0.06	± 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 Brüel&Kjær 4180	999.9	-0.1	± 1.5	$\pm 1.0\%$

3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjær 4180	1.80	± 0.50	$\pm 3.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by : [Redacted]



Director

Date of Calibration : 29 Mar. 2023
Date of Issue : 30 Mar. 2023
Ref : 2011266032701228001

End of Certificate

2 / 2

The results relate only to the items tested/calibrated and value assigned. Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of ITSTR.

Head Office 35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang, Changwat Pathumthani 12120, Thailand
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Office 196 Phaholyothin Road, Chatuchak, Bangkok 10900, Thailand
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Fax. (66) 0 2579 8592
E-mail : sum@itstr.or.th



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72 Fax : (662) 513-4221 E-mail : sale@spscon.com, www.spscon.com

Noise B_345/23

Sound Level Meter Calibration Report

Acoustic Calibrator Data

Brand	ACO	Number	AC 03/56
Model	2127	Serial No.	130006
Calibration Range	94 dB, 1000 Hz	Last Calibration	29 March 2023
		Due Date	29 March 2024

Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
ACO-B07	ACO	6236	00142004	31 August 2023	94.0	94.0
ACO-B17	ACO	6236	00172042	31 August 2023	94.0	94.0
ACO-B26	ACO	6236	00182007	31 August 2023	93.9	94.0
ACO-B28	ACO	6236	00182009	31 August 2023	94.0	94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.94 ± 0.10 dB	

(Mr. Adul Dangklom)

(Mr. Peera Detudom)



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0358 MTC No. EEL-B/ 22/0366

CALIBRATION CERTIFICATE

Submitted by : S.P.S. Consulting Service Co., Ltd.
Address : 7 Soi Phatolyothin 24, Phaholyothin Road, Jompo, Chutuchak, Bangkok 10900
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280

Instrument Calibrated :

Description : Sound Calibrator
Manufacturer : Cirrus
Model : CR-515
Serial No. : 92002
Ambient Environment
Temperature : $(23 \pm 3)^\circ\text{C}$
Relative Humidity : $(50 \pm 15) \%$
Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$

Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 127037.
2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484
3. Programmable Attenuator Tamagawa TPA-303A S/N QF 2214
4. Digital Multimeter Agilent 34401A S/N MY44105560
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001
6. Audio Analyzer Keithley 2015-P S/N 4106495
7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871

Calibration Procedure : CP-102-04 based on IEC 60942-2003. The sound pressure level of instrument was 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 : 3 Mar. 2023

Date of Calibration : 13 Mar. 2023

1 / 2

The results relate only to the items tested/calibrated of value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

Head Office 35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang, Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpal@tistr.or.th Website: www.tistr.or.th

Office/Laboratory Soi 1C, Bangpoo Industrial Estate, Samutprakan, Thailand
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtcc@tistr.or.th

Office 186 Phaholyothin Road, Chutuchak, Bangkok 10900, Thailand
Tel. (66) 0 2579 1121-30 ext. 5211, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sun@tistr.or.th

FMAL/MTC/002 Rev.4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0358

MTC No. EEL-B/ 22/0366

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

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

Acoustic Output in dB re 20 μPa , Corrected to Reference Conditions: 101.325 kPa, 23.0 $^\circ\text{C}$ and 50 %RH.

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC 60942:2003 Class I
1/2 inch Bruel&Kjaer 4180	93.99	-0.01	± 0.10	$\pm 0.40 \text{ dB}$

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC 60942:2003 Class I
1/2 inch Bruel&Kjaer 4180	900.3	0.3	± 1.5	$\pm 1.0 \%$

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC 60942:2003 Class I
1/2 inch Bruel&Kjaer 4180	1.39	± 0.50	$\pm 3.0 \%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

Approved by :



Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 13 Mar. 2023

Ref : 2011266030300928001

2 / 2

Date of Issue : 14 Mar. 2023

End of Certificate

The results relate only to the items tested/calibrated of value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

Head Office 35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang, Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpal@tistr.or.th Website: www.tistr.or.th

Office/Laboratory Soi 1C, Bangpoo Industrial Estate, Samutprakan, Thailand
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtcc@tistr.or.th

Office 186 Phaholyothin Road, Chutuchak, Bangkok 10900, Thailand
Tel. (66) 0 2579 1121-30 ext. 5211, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sun@tistr.or.th

FMAL/MTC/002 Rev.4



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72 Fax : (662) 513-4221 E-mail : sale@spscon.com, www.spscon.com

Noise B_456/23

Sound Level Meter Calibration Report

Acoustic Calibrator Data

Brand	CIRRUS	Number	AC-CR01/63
Model	CR515	Serial No.	92002
Calibration Range	94 dB, 1000 Hz	Last Calibration	13 March 2023
		Due Date	13 March 2024

Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
CR-B03	Cirrus	CR161B	G301155	04 December 2023	94.0	94.0
CR-B05	Cirrus	CR161B	G301134	04 December 2023	93.9	94.0
CR-B06	Cirrus	CR161B	G301151	04 December 2023	93.9	94.0
CR-B09	Cirrus	CR161B	G301401	04 December 2023	94.0	94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.99 ± 0.10 dB	

(Mr. Adul Dangklom)

(Mr. Peera Detudom)

คุณภาพน้ำ



QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkhae, Bangkok 10160
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584



CERTIFICATE No : 23E8494
REFERENCE No : 70413-1

PAGE : 1 OF 3

Certificate of Calibration

EQUIPMENT : pH METER
MANUFACTURER : HANNA
MODEL : HI 3512
SERIAL No : TH118035
ID No : pH04/56
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 06-Sep-23

APPROVED BY : 

ISSUED DATE : 06-Sep-23

RECEIVED DATE : 31-Aug-23

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.



QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

CERTIFICATE No : 23E8494

PAGE : 2 OF 3

Calibration Report

EQUIPMENT : pH METER
MANUFACTURER : HANNA
ID No : pH04/56
RECEIVED DATE : 31-Aug-23
AMBIENT TEMPERATURE : 23 ° C ± 3 ° C
MODEL : HI 3512
SERIAL NUMBER : TH118035
CALIBRATION DATE : 06-Sep-23
RELATIVE HUMIDITY : 50 % RH ± 10% RH

CONDITION OF THIS RESULTS OF CALIBRATION

- THIS INSTRUMENT WAS CALIBRATED BY DIRECT MEASUREMENT METHOD BASED ON WI-TQ-062 AND WI-TQ-063. THE DISPLAY UNIT WAS TESTED BY GENERATING STANDARD VOLTAGE TO THE UNIT AND READ THE VALUE COMPARED WITH CALCULATED VALUE. THE DISPLAY AND ELECTRODE WAS CALIBRATED BY USING STANDARD pH BUFFER
- REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No/ LOT No	CERTIFICATE No	DUE DATE
1) pH STANDARD SOLUTION	00651-06	CC767907	4880-13836406	29-Dec-24
2) pH STANDARD SOLUTION	00651-08	CC765602	4881-13757019	18-Nov-24
3) pH STANDARD SOLUTION	00651-10	CC767180	4882-13813369	14-Dec-24
4) PROCESS CALIBRATOR	CA150	91S6079	23E1312	19-Apr-24
5) BATH	260014	1247 48074	22T9870	13-Sep-23
6) THERMOMETER WITH PROBE	421504	55000379	22T9904	13-Sep-23

- THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
- THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
- THIS CERTIFICATE IS TRACEABLE TO SI UNIT MAINTAINED AT :-
 - NATIONAL INSTITUTE OF STANDARD AND TECHNOLOGY, USA.
 - NATIONAL INSTITUTE OF METROLOGY (THAILAND)

RESULT OF CALIBRATION : ADJUSTMENT

1. DISPLAY UNIT ONLY

SLOPE FACTOR $k = 2.303 \text{ RT/F} = 59 \text{ mV/pH}$

mV APPLIED	UUC READING (mV)	CORRECTION (mV)	UUC READING (pH)	UNCERTAINTY OF MEASUREMENT (± mV)	COVERAGE FACTOR k
414.11	414.6	-0.49	-0.290	0.15	2.00
354.95	355.4	-0.45	0.741	0.15	2.00
295.80	296.3	-0.50	1.773	0.15	2.00
236.64	237.1	-0.46	2.804	0.15	2.00
177.48	177.9	-0.42	3.835	0.15	2.00
118.32	118.7	-0.38	4.867	0.15	2.00
59.16	59.6	-0.44	5.898	0.15	2.00
0.00	0.4	-0.40	6.930	0.15	2.00
-59.16	-58.8	-0.36	7.961	0.15	2.00
-118.32	-117.9	-0.42	8.992	0.15	2.00
-177.48	-177.1	-0.38	10.024	0.15	2.00
-236.64	-236.3	-0.34	11.055	0.15	2.00
-295.80	-295.5	-0.30	12.087	0.15	2.00
-354.95	-354.6	-0.35	13.118	0.15	2.00
-414.11	-413.8	-0.31	14.149	0.15	2.00

END OF CALIBRATION REPORT PAGE 2 OF 3



QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

CERTIFICATE No : 23E8494

PAGE : 3 OF 3

Calibration Report

RESULT OF CALIBRATION (CONTINUE) :

2. DISPLAY UNIT WITH pH ELECTRODE S/N: 09081C6M

STANDARD pH BUFFER SOLUTION (pH)	UUC READING (pH)	CORRECTION (pH)	VALUE BEFORE ADJUSTMENT	UNCERTAINTY OF MEASUREMENT (\pm pH)	COVERAGE FACTOR k
4.006	4.006	0.000	4.015	0.012	2.00
7.000	7.000	0.000	6.914	0.012	2.00
10.008	10.010	-0.002	9.996	0.014	2.00

3. DISPLAY UNIT WITH TEMPERATURE

STANDARD READING ($^{\circ}$ C)	UUC READING ($^{\circ}$ C)	CORRECTION ($^{\circ}$ C)	VALUE BEFORE ADJUSTMENT	UNCERTAINTY OF MEASUREMENT (\pm $^{\circ}$ C)	COVERAGE FACTOR k
25.005	25.0	0.005	---	0.0085	2.00

4. PERCENT SLOPE 100%

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 APPROXIMATELY 95%.

END OF CALIBRATION REPORT



CERTIFICATE No : 23M2442

REFERENCE No : 68471-2

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : SARTORIUS

MODEL : BSA224S-CW

SERIAL No : 36591843

ID No : BA 09/61

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 10-Mar-23

APPROVED BY : 

ISSUED DATE : 16-Mar-23

RECEIVED DATE : 10-Mar-23



CERTIFICATE No : 23M2442

PAGE : 2 OF 2

Calibration Report

EQUIPMENT	:	DIGITAL BALANCE	MODEL	:	BSA224S-CW
MANUFACTURER	:	SARTORIUS	S/N	:	36591843
ID No	:	BA 09/61	RECEIVED DATE	:	10-Mar-23
AIR PRESSURE	:	1010mbar \pm 1mbar	CALIBRATION DATE	:	10-Mar-23
AMBIENT TEMPERATURE	:	23° C \pm 1° C	RELATIVE HUMIDITY	:	49 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD WEIGHT SET	E2	QK-I-151	M2302013S	02-Feb-25
2) STANDARD WEIGHT	E2	15843	M2302014S	02-Feb-25

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

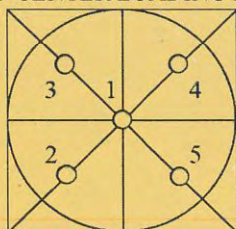
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.0	0.0000	0.0000	0.000058
0.1	0.1000	0.0000	0.000059
0.2	0.2000	0.0000	0.000059
0.5	0.5000	0.0000	0.000060
1.0	1.0000	0.0000	0.000060
2.0	2.0000	0.0000	0.000061
5.0	5.0000	0.0000	0.000063
10.0	10.0000	0.0000	0.000067
20.0	20.0001	-0.0001	0.000073
50.0	50.0000	0.0000	0.00011
100.0	100.0001	-0.0001	0.00019
200.0	200.0000	0.0000	0.00032

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	100.0000
2	99.9999
3	99.9998
4	100.0001
5	100.0000
OFF-CENTER LOADING	0.0002

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR $k=2$, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT

CERT.No.: HS-U017D

Calibration Date : 3 Apr 23
Submitted by : S.P.S CONSULTING SERVICE CO.,LTD
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol,
Chatuchak, Bangkok, Thailand 10900

Avg Room Temp : 20 °C
Avg Water Temp : 20 °C
Air Pressure : 760.00 mmHg
Salinity : 0 ppt

Model : YSI 5000
S/N : 15B100751
Probe : YSI 5010
S/N : 22D100097
ID NO. : -
Air Temp ref : S/N. E00522
Barometric ref : S/N. E00522
Water Temp ref : S/N. 11431
Technician : Kittipong M.

Calibration Details

Calibration Point	100% air sat. (@20 °C, DO = 9.09 mg/l)	(status)	(status)
Measurement 1 (mg/l)	9.08	(PASS)	-
Measurement 2 (mg/l)	9.08	(PASS)	-
Measurement 3 (mg/l)	9.08	(PASS)	-
Measurement 4 (mg/l)	9.08	(PASS)	-
Measurement 5 (mg/l)	9.08	(PASS)	-
Measurement 6 (mg/l)	9.08	(PASS)	-
Measurement 7 (mg/l)	9.08	(PASS)	-
Measurement 8 (mg/l)	9.08	(PASS)	-
Measurement 9 (mg/l)	9.08	(PASS)	-
Measurement 10 (mg/l)	9.08	(PASS)	-

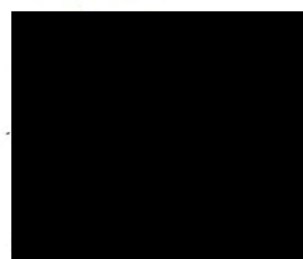
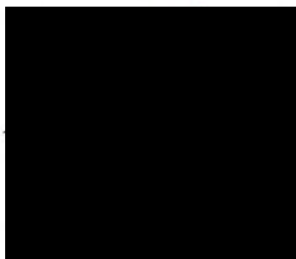
Mean Measurement	9.08	mg/l	-	-
Inaccuracy	0.01	mg/l	-	-

Overall Status (PASS)

Manufacturer Specification

Accuracy = +/- 0.02 mg/l

- 1) This certificate is issued based on the result that are found as shown on date and place of test only.
- 2) The calibration procedure followed in accordance with Harikul Science Co., Ltd.
- 3) This result shall not be used for advertising purpose.





MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

Customer : <u>S.P.S.Consulting Service Co.,Ltd</u>	Date Tested: <u>July 6, 2023</u>	
	Recommendation Recertification	
Address : <u>7 Soi Phaholyothin 24</u>	Period <u>6</u> Months	
<u>Paholyothin Road</u>	Recertification Due: <u>January 6, 2024</u>	
<u>Jompol Chatuchak, Bangkok 1090</u>	Date Last Certified: <u>January 11, 2023</u>	
User Name: <u>K.Phenpha Vipasthawatt</u>	Visit Number: <u>1 of 2</u>	
Phone: <u>083-9269252</u>	PerkinElmer Phone: <u>02-719-6420 ext 206</u>	
Fax: <u>02-513-4221</u>	PerkinElmer Fax: <u>02-318-5597</u>	

CONFIGURATION TESTED		ACCESSORIES/COMPONENT NOT INCLUDED
MODEL	SERIAL NUMBER	
<u>OPTIMA 5300DV</u>	<u>077C7042401</u>	
TESTED EQUIPMENT	CALIBRATION NUMBER	EXPIRATION
<u>IPV Methods</u>		
TEST STANDARD USED	PART NUMBER	EXPIRATION DATE
<u>Multielement Standard</u>	<u>N069-1579</u>	<u>October 30, 2023</u>
<u>Wavecal Solution</u>	<u>N058-2152</u>	<u>September 30, 2023</u>
<u>VIS Wavecal solution</u>	<u>N930-2946</u>	<u>August 30, 2023</u>
<u>Instrument Cal. STD4</u>	<u>N930-0221</u>	<u>November 30, 2023</u>
CUSTOMER SUPPLIED	COMMENTS	CUSTOMER INITIALS
<u>2 % HNO3</u>		
<u>10 % HNO3</u>		



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401
DATE TESTED July 6, 2023
1. MECHANICAL CHECKS

A. Inspect and clean all fans and filters.

☐ OK

B. Inspect and replace as necessary, all torch components including the RF coil.

☐ OK

C. Inspect all tubing for sign of clacking or leaking.

☐ OK

D. Adjust water and gas pressure regulator settings.

☐ OK

E. Inspect and leak check pneumatics drawers.

☐ OK

F. Clean the exterior of the instrument.

☐ OK

2. OPTICAL CHECKS

A. Inspect and clean all optical components.

☐ OK

B. As required, check and replace all purgefilters.

☐ OK

C. Recheck optical alignment.

☐ OK

3. COOLING SYSTEM CHECKS

A. Perform preventive maintenance on chiller.

☐ OK

B. Flush out the chiller every year.

☐ N/A

4. PERFORMANCE CHECKS

A. Torch View Alignment.

☐ OK

B. Wavelength Calibration.

☐ OK



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER : 077C7042401
DATE TESTED : July 6, 2023

PARAMETER		SPECIFICATION		FINAL VALUE	
Spectral Resolution : UV	As 193.696 nm	≤ 0.007		0.00534	
	Ni 231.604 nm	≤ 0.008		0.00682	
	Ni 341.476 nm	≤ 0.012		0.00794	
Spectral Resolution : VIS	La 408.672 nm	≤ 0.020		0.01613	
	Ba 455.403 nm	≤ 0.025		0.02282	
Precision					
	As 193.656 nm	% RSD	< 1.0	0.23	%
	Zn 213.856 nm	% RSD	< 1.0	0.09	%
	Mn 257.610 nm	% RSD	< 1.0	0.58	%
	La 379.478 nm	% RSD	< 1.0	0.38	%
	Ba 455.403 nm	% RSD	< 1.0	0.42	%
	Ba 493.408 nm	% RSD	< 1.0	0.41	%
Detection Limits : Axial	Tl 190.080 nm	3(sd)		2.37	ppb
	As 193.696 nm	3(sd)		6.78	ppb
	Pb 220.353 nm	3(sd)		0.82	ppb
Detection Limits : Radial	As 193.696 nm	3(sd)		23.56	ppb
	Zn 213.856 nm	3(sd)		2.85	ppb
	Mn 257.610 nm	3(sd)		3.66	ppb
	La 379.478 nm	3(sd)		5.10	ppb
	Ba 455.403 nm	3(sd)		0.12	ppb
	Ba 493.408 nm	3(sd)		1.17	ppb
BEC : Axial (IB X 500)/(IS-IB)	Cd 226.502 nm	≤ 150 ppb		117.07	
BEC : Radial (IB X 1000)/(IS-IB)	Mn 257.610 nm	≤ 45 ppb		22.09	



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401**DATE TESTED** July 6, 2023**Remarks :**

Commissioning follow as commissioning performance sheets.

This is to certify that the above tests have been performed and the configuration tested

☒

meets

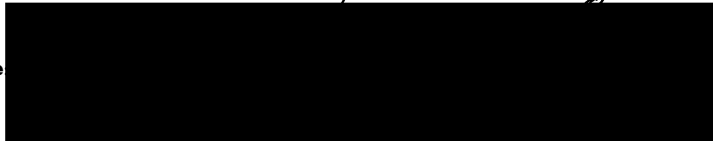
☐

does not meet

the PerkinElmer Specifications listed on this certificate.

This certificate does not modify PerkinElmer's standard terms and condition of sale,
including warranty terms.

Service Department PerkinElmer Ltd.

Authorized Representative

Service Engineer

คุณภาพอากาศในสถานประกอบการ



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature : 25 ± 3 °C
Pressure : 1010 ± 15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (mL/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R ²
B41	SKC	224-PCXR4	612669	10/10/2023	1,000	1,500	2,000	999	1,491	1,993	0.994x + 2.802	1.000
B42	SKC	224-PCXR4	626041	10/10/2023	1,000	1,500	2,000	994	1,490	1,989	0.995x - 1.759	1.000
B43	SKC	224-PCXR4	034636	07/10/2023	1,000	1,500	2,000	995	1,488	1,989	0.991x + 2.866	1.000
B44	SKC	224-PCXR8	529341	07/10/2023	1,000	1,500	2,000	992	1,503	1,998	1.009x - 23.051	0.999
B45	SKC	224-PCXR8	529594	10/10/2023	1,000	1,500	2,000	1,000	1,495	1,989	0.989x + 10.094	1.000
B46	SKC	224-PCXR8	566743	02/10/2023	1,000	1,500	2,000	1,000	1,500	1,998	1.008x - 19.564	0.999
B47	SKC	224-PCXR8	566747	02/10/2023	1,000	1,500	2,000	994	1,502	1,996	1.011x - 27.787	0.999
B48	SKC	224-PCXR8	566753	03/10/2023	1,000	1,500	2,000	1,000	1,495	2,000	1.005x - 13.577	1.000
B49	SKC	224-PCXR8	566780	02/10/2023	1,000	1,500	2,000	998	1,498	2,000	1.010x - 21.853	0.999
B50	SKC	224-PCXR8	500400	07/10/2023	1,000	1,500	2,000	999	1,495	1,989	0.991x + 5.640	1.000
B51	SKC	224-PCXR8	500363	07/10/2023	1,000	1,500	2,000	993	1,501	1,996	1.009x - 24.941	0.999
B52	SKC	224-PCXR8	093186	07/10/2023	1,000	1,500	2,000	994	1,500	1,991	0.996x + 2.910	1.000
B53	SKC	224-PCXR8	707670	06/10/2023	1,000	1,500	2,000	990	1,498	1,996	1.014x - 33.838	0.999
B54	SKC	224-PCXR3	509821	05/10/2023	1,000	1,500	2,000	991	1,499	1,995	1.012x - 30.494	0.999
B55	SKC	224-PCXR3	510710	05/10/2023	1,000	1,500	2,000	996	1,493	1,996	0.999x - 2.301	1.000
B56	SKC	224-PCXR3	511450	05/10/2023	1,000	1,500	2,000	992	1,487	1,996	1.006x - 16.797	1.000
B57	SKC	224-PCXR3	510798	04/10/2023	1,000	1,500	2,000	989	1,493	1,994	1.001x - 9.175	1.000
B58	SKC	224-PCXR3	509852	04/10/2023	1,000	1,500	2,000	1,000	1,497	1,997	1.009x - 21.172	0.999
B59	SKC	224-PCXR3	509862	04/10/2023	1,000	1,500	2,000	995	1,495	1,988	0.993x + 2.723	1.000
B60	SKC	224-PCXR3	512655	07/10/2023	1,000	1,500	2,000	992	1,498	1,997	1.013x - 31.979	0.999
B61	SKC	224-PCXR3	503915	07/10/2023	1,000	1,500	2,000	1,000	1,502	1,997	1.007x - 20.065	0.999
B62	SKC	224-PCXR3	505975	07/10/2023	1,000	1,500	2,000	996	1,489	1,991	0.990x + 6.791	1.000
B63	SKC	224-PCXR3	511432	07/10/2023	1,000	1,500	2,000	993	1,500	1,995	1.003x - 8.208	1.000
B64	SKC	224-PCXR3	508302	05/10/2023	1,000	1,500	2,000	991	1,496	1,988	0.998x - 5.262	1.000
B65	SKC	224-PCXR3	508310	05/10/2023	1,000	1,500	2,000	993	1,492	1,991	0.999x - 4.884	1.000
B66	SKC	224-PCXR3	509861	06/10/2023	1,000	1,500	2,000	996	1,493	1,985	0.992x + 2.675	1.000
B67	SKC	224-PCXR3	506295	04/10/2023	1,000	1,500	2,000	1,000	1,498	1,998	1.009x - 21.534	0.999
B68	SKC	224-PCXR3	505872	04/10/2023	1,000	1,500	2,000	994	1,493	1,987	0.993x + 3.176	1.000
B69	SKC	224-PCXR3	508375	07/10/2023	1,000	1,500	2,000	999	1,495	1,996	1.005x - 19.592	0.999
B70	SKC	224-PCXR3	510623	04/10/2023	1,000	1,500	2,000	992	1,486	1,995	1.002x - 11.762	1.000
B71	SKC	224-PCXR3	508367	05/10/2023	1,000	1,500	2,000	999	1,497	1,996	1.008x - 21.646	0.999
B72	SKC	224-PCXR3	505977	03/10/2023	1,000	1,500	2,000	993	1,490	1,990	0.997x - 4.295	1.000
B73	SKC	224-PCXR3	512606	05/10/2023	1,000	1,500	2,000	995	1,495	1,989	0.994x + 1.210	1.000
B74	SKC	224-PCXR3	505993	05/10/2023	1,000	1,500	2,000	997	1,496	1,986	0.987x + 12.602	1.000
B75	SKC	224-PCXR3	509820	05/10/2023	1,000	1,500	2,000	994	1,490	1,991	0.998x - 5.143	1.000
B76	SKC	224-PCXR3	509811	06/10/2023	1,000	1,500	2,000	1,000	1,497	1,999	1.010x - 23.063	0.999
B77	SKC	224-PCXR3	508301	06/10/2023	1,000	1,500	2,000	992	1,501	1,998	1.013x - 32.023	0.999
B78	SKC	224-PCXR3	510677	05/10/2023	1,000	1,500	2,000	1,001	1,498	1,997	1.007x - 18.549	0.999
B79	SKC	224-PCXR3	510920	03/10/2023	1,000	1,500	2,000	999	1,509	1,997	0.996x + 4.999	1.000

(Mr. Adul Dangklom)

(Mr. Peera Detudom)



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7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature : 25 \pm 3 $^{\circ}$ C
Pressure : 1010 \pm 15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (mL/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R ²
B80	SKC	224-PCXR3	504569	07/10/2023	1,000	1,500	2,000	1,001	1,497	2,000	1.007x - 19.202	0.999
B81	SKC	224-PCXR3	503480	07/10/2023	1,000	1,500	2,000	994	1,496	1,996	1.006x - 17.526	1.000
B82	SKC	224-PCXR3	505673	05/10/2023	1,000	1,500	2,000	992	1,495	1,992	1.002x - 11.742	1.000
B83	SKC	224-PCXR3	510785	05/10/2023	1,000	1,500	2,000	994	1,497	1,998	1.005x - 15.177	1.000
B84	SKC	224-PCXR3	508333	04/10/2023	1,000	1,500	2,000	1,000	1,498	1,999	1.003x - 16.041	0.999
B85	SKC	224-PCXR3	505757	04/10/2023	1,000	1,500	2,000	999	1,498	1,999	1.010x - 23.715	0.999
B86	SKC	224-PCXR3	512625	02/10/2023	1,000	1,500	2,000	1,000	1,493	1,989	0.994x + 1.568	1.000
B87	SKC	224-PCXR3	504324	09/10/2023	1,000	1,500	2,000	1,001	1,500	1,996	1.006x - 16.049	0.999
B88	SKC	224-PCXR3	508307	09/10/2023	1,000	1,500	2,000	1,000	1,496	1,990	0.990x + 9.617	1.000
B89	SKC	224-PCXR3	509860	05/10/2023	1,000	1,500	2,000	999	1,496	1,998	0.997x - 5.214	0.999
B90	SKC	224-PCXR3	508366	03/10/2023	1,000	1,500	2,000	992	1,495	1,992	0.999x - 5.095	1.000
B91	SKC	224-PCXR3	510919	10/10/2023	1,000	1,500	2,000	998	1,496	1,993	0.995x - 1.847	1.000
B92	SKC	224-PCXR3	510987	04/10/2023	1,000	1,500	2,000	1,001	1,496	1,997	1.009x - 22.028	0.999
B93	SKC	224-PCXR3	509845	04/10/2023	1,000	1,500	2,000	997	1,491	1,990	0.993x + 2.516	1.000
B94	SKC	224-PCXR8	A127871	04/10/2023	1,000	1,500	2,000	998	1,495	1,995	1.005x - 19.074	0.999
B95	SKC	224-PCXR8	A127921	09/10/2023	1,000	1,500	2,000	998	1,498	1,999	1.012x - 25.793	0.999
B96	SKC	224-PCXR8	A127942	09/10/2023	1,000	1,500	2,000	999	1,495	1,989	0.991x + 5.720	1.000
B97	SKC	224-PCXR8	A127955	09/10/2023	1,000	1,500	2,000	994	1,496	1,996	1.011x - 28.512	0.999
B98	SKC	224-PCXR8	A127956	10/10/2023	1,000	1,500	2,000	995	1,489	1,987	0.994x + 1.218	1.000

(Mr. Addt Dangklorn)

(Mr. Peera Detudom)



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Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

Rotameter Data			Calibration Data								
No.	Brand	Model	Date	Flow Rate (mL/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	y	R ²
H-B01	Dwyer	VFB-65	02/10/2023	500	1,000	2,000	500.1	992.7	1979.6	0.993x + 4.560	1.000
H-B02	Dwyer	VFB-65	03/10/2023	500	1,000	2,000	503.6	989.1	1983.1	0.991x + 6.131	1.000
H-B03	Dwyer	VFB-65	02/10/2023	500	1,000	2,000	498.7	991.6	2006.8	0.999x - 9.214	0.999
H-B04	Dwyer	VFB-65	04/10/2023	500	1,000	2,000	502.3	988.1	2003.7	1.000x - 2.013	1.000
H-B05	Dwyer	VFB-65	03/10/2023	500	1,000	2,000	497.8	989.1	1971.6	0.981x + 16.401	0.999
H-B06	Dwyer	VFB-65	05/10/2023	500	1,000	2,000	499.3	995.9	1979.0	0.988x + 11.304	1.000
H-B07	Dwyer	VFB-65	04/10/2023	500	1,000	2,000	495.1	995.8	1991.3	0.997x - 1.222	1.000
H-B08	Dwyer	VFB-65	05/10/2023	500	1,000	2,000	500.7	998.7	1975.8	0.990x + 5.555	0.999
H-B09	Dwyer	VFB-65	03/10/2023	500	1,000	2,000	496.9	998.5	1979.0	0.989x + 10.735	1.000
H-B10	Dwyer	VFB-65	07/10/2023	500	1,000	2,000	499.4	997.5	2004.6	0.998x - 1.062	1.000

(Mr.Adul Dangklom)

(Mr. Peera Detudom)



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Rotameter Calibration Report (For Personal Pump Low Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Rotameter Data			Calibration Data								
No.	Brand	Model	Date	Flow Rate (mL/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	y	R ²
L-B01	Dwyer	VFA-21	02/10/2023	50	100	200	50.2	100.3	202.6	0.997x + 0.475	0.999
L-B02	Dwyer	VFA-21	03/10/2023	50	100	200	50.5	98.9	201.1	1.001x - 0.121	1.000
L-B03	Dwyer	VFA-21	02/10/2023	50	100	200	50.1	100.7	200.2	1.007x - 1.206	0.999
L-B04	Dwyer	VFA-21	04/10/2023	50	100	200	50.4	99.6	201.9	1.006x - 0.142	1.000
L-B05	Dwyer	VFA-21	03/10/2023	50	100	200	49.7	101.1	197.7	0.997x - 0.218	1.000
L-B06	Dwyer	VFA-21	05/10/2023	50	100	200	50.3	101.5	200.1	1.003x - 0.332	0.999
L-B07	Dwyer	VFA-21	04/10/2023	50	100	200	50.9	100.4	202.4	0.990x + 2.441	1.000
L-B08	Dwyer	VFA-21	05/10/2023	50	100	200	50.7	99.8	197.9	1.005x - 1.343	0.999
L-B09	Dwyer	VFA-21	03/10/2023	50	100	200	50.2	100.3	203.0	1.007x + 0.375	1.000
L-B10	Dwyer	VFA-21	07/10/2023	50	100	200	49.5	99.4	200.3	1.009x - 1.182	1.000

(Mr. Adul Dangklom)

(Mr. Peera Detudom)



QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com



CERTIFICATE No : 23M2441

REFERENCE No : 68471-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS105DU

SERIAL No : 1126422905

ID No : BA 05/50

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 10-Mar-23

APPROVED BY : 

ISSUED DATE : 16-Mar-23

RECEIVED DATE : 10-Mar-23

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.



CERTIFICATE No : 23M2441

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS105DU
MANUFACTURER : METTLER TOLEDO S/N : 1126422905
ID No : BA 05/50 RECEIVED DATE : 10-Mar-23
AIR PRESSURE : 1010mbar \pm 1mbar CALIBRATION DATE : 10-Mar-23
AMBIENT TEMPERATURE : 23°C \pm 1°C RELATIVE HUMIDITY : 49 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD WEIGHT SET	E2	QK-I-151	M2302013S	02-Feb-25
2) STANDARD WEIGHT	E2	15843	M2302014S	02-Feb-25

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.00000	0.00000	0.000039
0.02	0.02000	0.00000	0.000039
0.10	0.10000	0.00000	0.000039
0.20	0.20001	-0.00001	0.000040
0.50	0.50001	-0.00001	0.000040
1.00	1.00000	0.00000	0.000041
2.00	2.00003	-0.00003	0.000042
5.00	5.00001	-0.00001	0.000046
10.00	10.00003	-0.00003	0.000053
20.00	20.00005	-0.00005	0.000067
50.00	50.00001	-0.00001	0.00011
100.00	100.00001	-0.00001	0.00019
200.00	200.00001	-0.00001	0.00032

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.0000
2	50.0001
3	50.0000
4	50.0000
5	49.9999
OFF-CENTER LOADING	0.0001

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA
THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY
COVERAGE FACTOR $k=2$, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

Customer : <u>S.P.S.Consulting Service Co.,Ltd</u>	Date Tested: <u>July 6, 2023</u>	
	Recommendation Recertification	
Address : <u>7 Soi Phaholyothin 24</u>	Period <u>6</u> Months	
<u>Paholyothin Road</u>	Recertification Due: <u>January 6, 2024</u>	
<u>Jompol Chatuchak, Bangkok 1090</u>	Date Last Certified: <u>January 11, 2023</u>	
User Name: <u>K.Phenpha Vipasthawatt</u>	Visit Number: <u>1 of 2</u>	
Phone: <u>083-9269252</u>	PerkinElmer Phone: <u>02-719-6420 ext 206</u>	
Fax: <u>02-513-4221</u>	PerkinElmer Fax: <u>02-318-5597</u>	

CONFIGURATION TESTED		ACCESSORIES/COMPONENT NOT INCLUDED
MODEL	SERIAL NUMBER	
<u>OPTIMA 5300DV</u>	<u>077C7042401</u>	
TESTED EQUIPMENT	CALIBRATION NUMBER	EXPIRATION
<u>IPV Methods</u>		
TEST STANDARD USED	PART NUMBER	EXPIRATION DATE
<u>Multielement Standard</u>	<u>N069-1579</u>	<u>October 30, 2023</u>
<u>Wavecal Solution</u>	<u>N058-2152</u>	<u>September 30, 2023</u>
<u>VIS Wavecal solution</u>	<u>N930-2946</u>	<u>August 30, 2023</u>
<u>Instrument Cal. STD4</u>	<u>N930-0221</u>	<u>November 30, 2023</u>
CUSTOMER SUPPLIED	COMMENTS	CUSTOMER INITIALS
<u>2 % HNO3</u>		
<u>10 % HNO3</u>		



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401
DATE TESTED July 6, 2023
1. MECHANICAL CHECKS

- | | |
|--|-----------------------------|
| A. Inspect and clean all fans and filters. | <input type="checkbox"/> OK |
| B. Inspect and replace as necessary, all torch components including the RF coil. | <input type="checkbox"/> OK |
| C. Inspect all tubing for sign of clacking or leaking. | <input type="checkbox"/> OK |
| D. Adjust water and gas pressure regulator settings. | <input type="checkbox"/> OK |
| E. Inspect and leak check pneumatics drawers. | <input type="checkbox"/> OK |
| F. Clean the exterior of the instrument. | <input type="checkbox"/> OK |

2. OPTICAL CHECKS

- | | |
|---|-----------------------------|
| A. Inspect and clean all optical components. | <input type="checkbox"/> OK |
| B. As required, check and replace all purgefilters. | <input type="checkbox"/> OK |
| C. Recheck optical alignment. | <input type="checkbox"/> OK |

3. COOLING SYSTEM CHECKS

- | | |
|---|------------------------------|
| A. Perform preventive maintenance on chiller. | <input type="checkbox"/> OK |
| B. Flush out the chiller every year. | <input type="checkbox"/> N/A |

4. PERFORMANCE CHECKS

- | | |
|----------------------------|-----------------------------|
| A. Torch View Alignment. | <input type="checkbox"/> OK |
| B. Wavelength Calibration. | <input type="checkbox"/> OK |



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER : 077C7042401
DATE TESTED : July 6, 2023

PARAMETER		SPECIFICATION		FINAL VALUE	
Spectral Resolution : UV	As	193.696 nm	≤ 0.007	<u>0.00534</u>	
	Ni	231.604 nm	≤ 0.008	<u>0.00682</u>	
	Ni	341.476 nm	≤ 0.012	<u>0.00794</u>	
Spectral Resolution : VIS	La	408.672 nm	≤ 0.020	<u>0.01613</u>	
	Ba	455.403 nm	≤ 0.025	<u>0.02282</u>	
Precision					
	As	193.656 nm	% RSD < 1.0	<u>0.23</u>	%
	Zn	213.856 nm	% RSD < 1.0	<u>0.09</u>	%
	Mn	257.610 nm	% RSD < 1.0	<u>0.58</u>	%
	La	379.478 nm	% RSD < 1.0	<u>0.38</u>	%
	Ba	455.403 nm	% RSD < 1.0	<u>0.42</u>	%
	Ba	493.408 nm	% RSD < 1.0	<u>0.41</u>	%
Detection Limits : Axial	Tl	190.080 nm	3(sd)	<u>2.37</u>	ppb
	As	193.696 nm	3(sd)	<u>6.78</u>	ppb
	Pb	220.353 nm	3(sd)	<u>0.82</u>	ppb
Detection Limits : Radial	As	193.696 nm	3(sd)	<u>23.56</u>	ppb
	Zn	213.856 nm	3(sd)	<u>2.85</u>	ppb
	Mn	257.610 nm	3(sd)	<u>3.66</u>	ppb
	La	379.478 nm	3(sd)	<u>5.10</u>	ppb
	Ba	455.403 nm	3(sd)	<u>0.12</u>	ppb
	Ba	493.408 nm	3(sd)	<u>1.17</u>	ppb
BEC : Axial (IB X 500)/(IS-IB)		Cd	226.502 nm	≤ 150 ppb	<u>117.07</u>
BEC : Radial (IB X 1000)/(IS-IB)		Mn	257.610 nm	≤ 45 ppb	<u>22.09</u>



MAINTENANCE AND TEST CERTIFICATE MODEL

OPTIMA 5300DV

SERIAL NUMBER 077C7042401**DATE TESTED** July 6, 2023**Remarks :**

Commissioning follow as commissioning performance sheets.

This is to certify that the above tests have been performed and the configuration tested



meets

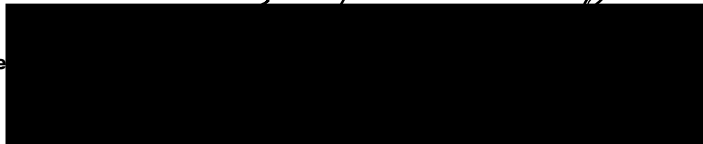


does not meet

the PerkinElmer Specifications listed on this certificate.

This certificate does not modify PerkinElmer's standard terms and condition of sale, including warranty terms.

Service Department PerkinElmer Ltd.

Authorized Representative

Service Engineer



Certificate of Calibration

Aquion : Anion (ID#894)

This certificate is to verify that instrument below are calibrated
by Archemica Lab Co.,Ltd.

AQUION S/N : 190840059

AS-DV S/N : 190915235

for

S.P.S. Consulting Service Co., Ltd.

ARCHEMICA LAB
บริษัท อาร์เคมีกา แล็บ จำกัด
ARCHEMICA LAB CO.,LTD

Operator Signatu

Date : Jul 3, 2023

Applications Chemist

ระดับเสียงในสถานประกอบการ



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413 MTC No. EEL. BP. 109/0366

CALIBRATION CERTIFICATE

Submitted by : S.P.S. Consulting Service Co., Ltd.
Address : 7 Soi Phaholyothin 24, Phaholyothin Road, Jompol, Chatuchak, Bangkok 10900.
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
: Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang Samutprakarn 10280.
Instrument Calibrated :
Description : Sound Calibrator
Manufacturer : ACO
Model : 2127
Serial No. : 130006
Ambient Environment
Temperature : $(23 \pm 3) ^\circ\text{C}$
Relative Humidity : $(50 \pm 15) \%$
Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$

Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.
3. Programmable Attenuator Tamagawa TPA-300A S/N OF 2214.
4. Digital Multimeter Agilent 34401A S/N MY44/05560.
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
6. Audio Analyzer Keithley 2015-P S/N 4106495
7. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.

Calibration Procedure : CP-1C2-04 based on IEC 60942:2003. The sound pressure level of instrument was 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 : 27 Mar. 2023
Date of Calibration : 29 Mar. 2023

The results relate only to the items tested/calibrated and value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413 MTC No. EEL. BP. 109/0366

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

Nominal Output of Unit Under Test = 94 dB re 20 μPa at 1000 Hz
Acoustic Output in dB re 20 μPa , Corrected to Reference Conditions: 101.325 kPa, 23.0 $^\circ\text{C}$ 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 Brüel&Kjær 4180	93.94	-0.06	± 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 Brüel&Kjær 4180	999.9	-0.1	± 1.5	$\pm 1.0\%$

3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjær 4180	1.80	± 0.50	$\pm 3.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :



Approved by :



Date of Calibration : 29 Mar. 2023
Date of Issue : 30 Mar. 2023
Ref : 2011266032701228001

End of Certificate

2 / 2

The results relate only to the items tested/calibrated and value assigned.

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บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

S.P.S. CONSULTING SERVICE CO., LTD.

7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900

7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900

Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Noise B_417/23

Sound Level Meter Calibration Report

Acoustic Calibrator Data

Brand	ACO	Number	AC 03/56
Model	2127	Serial No.	130006
Calibration Range	94 dB, 1000 Hz	Last Calibration	29 March 2023
		Due Date	29 March 2024

Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
ACO-B18	ACO	6236	00172048	01 November 2023	93.9	94.0
ACO-B29	ACO	6236	00182011	01 November 2023	94.1	94.0
ACO-B33	ACO	6236	00182015	01 November 2023	94.0	94.0
ACO-B36	ACO	6236	00192027	01 November 2023	94.0	94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.94 ± 0.10 dB	

(Mr. Abdul Dangklom)

(Mr. Peera Detudom)

ปริมาณเสียงสะสมแบบติดตัวบุคคล



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0639 MTC No. EEL_BP. 400866

CALIBRATION CERTIFICATE

Submitted by : S.P.S Consulting Services Co., Ltd.
Address : 7 Soi Phaholyothin 24, Phaholyothin Road, Jompol, Chatuchak, Bangkok 10900.
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
: Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang Samutprakan 10280.

Instrument Calibrated :
Description : Sound Calibrator
Manufacturer : SVANTEK
Model : SV34
Serial No. : 83820
Ambient Environment
Temperature : $(23 \pm 3) ^\circ\text{C}$
Relative Humidity : $(50 \pm 15) \%$
Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$

Standards used :
1. Digital Function Synthesizer NF Electronic DF-190A S/N 122037.
2. Measuring Amplifier Brüel&Kjær 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 T06S0001.
6. Audio Analyzer Panasonic VP-7722A S/N 041477D122.
7. Condenser Microphone Brüel&Kjær 4180 S/N 263526.

Calibration Procedure: CP-102 based on IEC 60942-2003. The sound pressure level of instrument was 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 is quoted refer to the measured values only.

Date of Receipt : 11 Aug. 2023

Date of Calibration : 22 Aug. 2023

1/2

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0639 MTC No. EEL_BP. 400866

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 = 114 dB re 20 μPa at 1000 Hz
Acoustic Output in dB re 20 μPa , Corrected to Reference Conditions : 101.325 kPa, 23.0°C and 50 % RH

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Brüel&Kjær 4180	114.01	0.01	± 0.10	$\pm 0.75 \text{ dB}$

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Brüel&Kjær 4180	1000.0	0.0	± 1.5	$\pm 2.0\%$

3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Brüel&Kjær 4180	0.19	± 0.50	$\pm 4.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by



Approved by



Director
TISTR

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 22 Aug. 2023

Date of Issue : 24 Aug. 2023

Ref : 2011266081103146003
End of Certificate

2 / 2

The results relate only to the items tested/calibrated or value assigned.

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

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FILBLMTC002 Rev.4



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S.P.S. CONSULTING SERVICE CO., LTD.
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Tel : (662) 939-4370-72. Fax : (662) 513-4221. E-mail : sale@spscon.com., www.spscon.com

Noise Dose B_418/23

Noise Dose Meter Calibration Report

Acoustic Calibrator Data

Brand	SVANTEK	Number	SV 03/60
Model	SV34	Serial No.	83820
Calibration Range	114 dB, 1000 Hz	Last Calibration	22 August 2023
		Due Date	22 August 2024

Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
NMD-B09	SVANTEK	SV-104IS	80829	01 November 2023	114.0	114.0
NMD-B10	SVANTEK	SV-104IS	80830	01 November 2023	114.0	114.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					114.01± 0.10 dB	

(Mr. Adul Dangklom)

(Mr. Peera Detudom)



Request No. 21-66/0344

MTC No. EEL, BP.

160/0266

CALIBRATION CERTIFICATE

Submitted by : S.P.S. Consulting Service Co., Ltd.

Address : 7 Soi Phaholyothin Rd., Jompol, Chatuchak, Bangkok, 10900.

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

Instrument Calibrated :

Description : Noise Dosimeter

Manufacturer : Svanek

Model : SV-104HS

Serial No. : 80829

Standards used :

Multifunction Acoustic Calibrator Brüel&Kjær 4226 S/N 2810358 with Compler UA0915 S/N 2810358.

Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

This instrument has been calibrated against standards maintained at the 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.

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

Date of Receipt : 27 Feb. 2023

Date of Calibration : 7 Mar. 2023

1 / 2

The results relate only to the items tested and are valid only if the items tested are handled in accordance with the instructions provided in the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

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FABL/MTC.002 Rev.4



Request No. 21-66/0344

MTC No. EEL, BP.

160/0266

Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
	A-weighting (dB)	C-weighting (dB)		
125	-0.2	-0.1	0.25	2.0
1 000	-0.1	-0.1	0.25	1.4
4 000	0.2	0.3	0.25	3.6

Note : 1) There was no adjustment.

2) The calibration was performed at a sound pressure level of 114 dB.

3) The measured values did not include the correction of microphone of UUT.

4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).

Calibrated by:

Approved by:



Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Ref : Z011266/022700826003

Date of Calibration : 7 Mar. 2023

Date of issue : 8 Mar. 2023

2 / 2

End of Certificate

The results relate only to the items tested and are valid only if the items tested are handled in accordance with the instructions provided in the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

Head Office

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FABL/MTC.002 Rev.4



TISTR

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0344

MTC No. EEL. BP.

161/0266

CALIBRATION CERTIFICATE

Submitted by : S.P.S. Consulting Service Co., Ltd.

Address : 7 Soi Phaholyothin 24, Phaholyothin Rd., Jompo, Chantarak, Bangkok, 10900.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,

Soi 1C, Bangpoo Industrial Estate, Sulhumvit Rd., Muang, Samulprakan 10280.

Instrument Calibrated :

Description : Noise Dosimeter

Manufacturer : Svanitek

Model : SV-1041S

Serial No. : 80830

Standards used :

Multifunction Acoustic Calibrator Brüel&Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810355.

Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2005). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

This instrument has been calibrated against standards maintained at the 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.

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

Date of Receipt : 27 Feb. 2023

Date of Calibration : 7 Mar. 2023

1 / 2

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RMBL/MTC-002 Rev.4



TISTR

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0344

MTC No. EEL. BP.

161/0266

Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
	A-weighting (dB)	C-weighting (dB)		
125	0.1	-0.3	0.25	2.0
1 000	0.0	-0.1	0.25	1.4
4 000	0.1	0.1	0.25	3.6

Note : 1) There was no adjustment.

2) The calibration was performed at a sound pressure level of 114 dB.

3) The measured values did not include the correction of microphone of UUT.

4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).

Calibrated by

Approved by

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Ref : 201266022700826004

Date of Calibration : 7 Mar. 2023

Date of issue : 8 Mar. 2023

2 / 2

End of Certificate

The results relate only to the items tested/calibrated or value assigned.
Advertising the Report/Certificate and publication of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

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RMBL/MTC-002 Rev.4

ระดับความร้อนในสถานประกอบการ



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 แขวงพญาไท เขตพญาไท กรุงเทพมหานคร 10900
Tel : (662) 939-0702 Fax : (662) 913-4221 E-mail : sales@spsc.com, www.spsc.com

Heat 098_1

Heat Stress WBGT Meter Verification Report				
Verification Data				
Heat Stress WBGT Meter No.	: B05	Verification Date	: 5 July 2023	
Brand	: 3M	Ambient Temp.	: 24.5 °C	
Model	: QUESTemp 34	Barometric Pressure	: 1011 mmbar	
Serial No.	: TEH060047	Relative Humidity	: 49 %	
Verification Module (Electronic Sensor Check) :				
Verification Module No. :	21	WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C		
Result of Verification : Without Adjustment				
Wet Probe Temperature Measurement				
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)	
12.5	12.5	0.0	± 0.5	
Dry Probe Temperature Measurement				
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)	
47.1	47.1	0.0	± 0.5	
Globe Probe Temperature Measurement				
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)	
69.3	69.2	0.1	± 0.5	
UUC* = UNIT UNDER CALIBRATION				

(Mr. Adul Dangklom)

(Mr. Peera Detudom)



CALIBRATION LABORATORY CO., LTD.
210/113-55 Soi Praset Mueang 23 Thua 4, Praset Mueang Rd, Luangprata Bangkok 10230
Tel: 02-578-0534 Fax: 02-578-2572 www.calibration.co.th Email: sales@calibration.co.th



ISO/IEC 17025
CALIBRATION 0659
-CL-

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
[THERMAL ENVIRONMENT MONITOR]
MANUFACTURER : 3M
MODEL / TYPE : QUESTemp 34
SERIAL NO. : TEH060047
CLID. NO. : 231802271
JOB CONTROL NO. : 221028109978

CUSTOMER : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24 ROAD, JOMPOL
CHATCHAK, BANGKOK 10900

DATE OF RECEIVED : 28 October 2022

DATE OF ISSUED : 31 October 2022

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

Calibrated By : Onnut Kamchatphai
Calibration Engineer

Approved By :

Authorized Signatory
31 October 2022

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. Q22109978

F3-011-04/01-12

page 4 of 3



Heat Stress WBGT Meter Verification Report					
Verification Data					
Heat Stress WBGT Meter No.	: B12	Verification Date	: 5 July 2023		
Brand	: 3M	Ambient Temp.	: 24.5 °C		
Model	: QUESTemp ³²	Barometric Pressure	: 1011 mmbar		
Serial No.	: TPA100010	Relative Humidity	: 49 %		
Verification Module (Electronic Sensor Check) :					
Verification Module No.:	21	WB = 12.5 °C,	DB = 47.1 °C,	G = 69.3 °C	
Result of Verification : Without Adjustment					
Wet Probe Temperature Measurement					
Verification Module Reading (°C)	12.5	UUC* Reading (°C)	12.7	Correction (°C)	-0.2
					Tolerance Limit (°C)
					± 0.5
Dry Probe Temperature Measurement					
Verification Module Reading (°C)	47.1	UUC* Reading (°C)	47.2	Correction (°C)	-0.1
					Tolerance Limit (°C)
					± 0.5
Globe Probe Temperature Measurement					
Verification Module Reading (°C)	69.3	UUC* Reading (°C)	69.2	Correction (°C)	0.1
					Tolerance Limit (°C)
					± 0.5
UUC* = UNIT UNDER CALIBRATION					

Verified by :

(Mr. Adut Dangklom)

(Mr. Peera Detudom)



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGROMETER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp[®] 32

SERIAL NO. : TPA100010

CLID. NO. : 231801938

JOB CONTROL NO. : 211028109975

CUSTOMER : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24 ROAD., JONGPOT,
CHUATHUAK, BANGKOK 10909

DATE OF RECEIVED : 28 October 2022

DATE OF ISSUED : 31 October 2022

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

Calibrated By :

Oranut Kamchatphai
Calibration Engineer

Approved By :

Authorized Signatory
31 October 2022

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. Q22109975

P3-011-04/01-12



TH08-107



REPORT OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)
MANUFACTURER : 3M
MODEL / TYPE : QUESTTemp^o32
SERIAL NO. : TPA100010
DATE OF CALIBRATION : 29 October 2022

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. WI-305-74. The calibration was performed by using

Chilled Mirror Hygrometer and Temperature & Humidity Chamber which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Chilled Mirror Hygrometer; EdgeTech Model Dew Master S/N: 44602.

Temperature & Humidity Chamber; PSC Model 9141-5116 S/N: 1304261.

TRACEABILITY :

The measurements are traceable to International System of Units (SI), through Thunders Scientific Corporation.

Certificate No. 19944, Due Date 26 January 2023.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%. It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-402 M2021)".

Certificate No. Q22109975

F3-011-04/01-12

Page 2 of 3



Certificate No. Q22109975

F3-011-04/01-12

End of Certificate

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

CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

The table in the following gives the calibration results and associated measurement uncertainties of the measuring digital thermohygro meter (thermal environment monitor).

CALIBRATION DATA

1. CORRECTION OF TEMPERATURE : WET

Test point ($^\circ\text{C}$)	Actual Temperature ($^\circ\text{C}$)	DUC Reading ($^\circ\text{C}$)	Correction ($^\circ\text{C}$)	Uncertainty \pm ($^\circ\text{C}$)
30.0	30.01	30.0	-0.01	0.40
35.0	35.00	34.8	+0.20	
40.0	40.01	39.9	+0.11	

2. CORRECTION OF TEMPERATURE : DRY

Test point ($^\circ\text{C}$)	Actual Temperature ($^\circ\text{C}$)	DUC Reading ($^\circ\text{C}$)	Correction ($^\circ\text{C}$)	Uncertainty \pm ($^\circ\text{C}$)
30.0	30.01	30.0	+0.01	0.40
35.0	35.00	35.1	-0.10	
40.0	40.01	40.1	-0.09	

3. CORRECTION OF TEMPERATURE : GLOBE BULB

Test point ($^\circ\text{C}$)	Actual Temperature ($^\circ\text{C}$)	DUC Reading ($^\circ\text{C}$)	Correction ($^\circ\text{C}$)	Uncertainty \pm ($^\circ\text{C}$)
30.0	30.01	30.2	-0.19	1.40
35.0	35.00	35.0	0.00	
40.0	40.01	40.0	+0.01	

Note: The Scope of Accredited TISI Certificate No. 19C087/0655 Issue 1 Page 36 of 111

Page 3 of 3





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 Soi Phaholyothin 24, Jompol, Chatuchak, Bangkok 10900
Tel: (662) 939-420-72 Fax: (662) 513-4221 E-mail: sales@spsc.com, www.spsc.com

Heat 098_4

Heat Stress WBGT Meter Verification Report					
Verification Data					
Heat Stress WBGT Meter No.	: B32	Verification Date	: 5 July 2023		
Brand	: Quest Technologies	Ambient Temp.	: 24.5 °C		
Model	: QUESTemp 32	Barometric Pressure	: 1011 mmbar		
Serial No.	: TPH050015	Relative Humidity	: 49 %		
Verification Module (Electronic Sensor Check) :					
Verification Module No. :	21	WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C			
Result of Verification : Without Adjustment					
Wet Probe Temperature Measurement					
Verification Module Reading (°C)	12.5	UUC* Reading (°C)	12.5	Correction (°C)	0.0
					Tolerance Limit (°C)
					± 0.5
Dry Probe Temperature Measurement					
Verification Module Reading (°C)	47.1	UUC* Reading (°C)	47.0	Correction (°C)	0.1
					Tolerance Limit (°C)
					± 0.5
Globe Probe Temperature Measurement					
Verification Module Reading (°C)	69.3	UUC* Reading (°C)	69.1	Correction (°C)	0.2
					Tolerance Limit (°C)
					± 0.5
UUC* = UNIT UNDER CALIBRATION					

(Mr. Adut Dangkom)

(Mr. Peera Detudom)



METROLOGY SYSTEM (THAILAND) CO.,LTD.



Certificate of Calibration

Certificate Number : SPR23030505-4 Page : 1 of 3
Customer : S.P.S. CONSULTING SERVICE CO.,LTD.
7 Soi Phaholyothin 24 Phaholyothin Road, Jompol, Chatuchak, Bangkok 10900

Equipment Name : Area Heat Stress Monitor
Manufacturer : Quest Technologies
Model : QUESTemp 32
Serial Number : TPH050015
ID. Number : B32
Environmental Conditions
Ambient Temperature : 23 °C ± 2 °C Received Date : 30 Mar 2023
Relative Humidity : 50 % ± 15 % Calibration Date : 31 Mar 2023
Location of Calibration : In-Lab Recommend Due Date : 31 Mar 2024
Calibration Procedure : SP-CPT-C4-13 Date of Issue : 01 Apr 2023

Method of Calibration

This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure. Standards used to perform this calibration are certified by NIST or equivalent. National metrology institute. Natural physical constants consensus standards. The result reported herein apply only to the calibration of the item described above as received. Our decision rule is to contact the customer if the item pass and fail calibration when the results include the uncertainties and the customer must determine if the results meets their needs. All calibrations are performed within manufacturer's specifications. The calibration certificate shall not be reproduced except in full without written approval of SP Metrology System (Thailand).

Calibrated by :

Approved by :

Authorized Signatory

SP-FM-Q4-15 rev.0



Calibration Report

Certificate Number : SPR23030505-4

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Humidity Chamber	TH-90S	N/A	SPR23010480-5	22 Feb. 2024
THERMO-HYGROMETER	502DA	A47046	QRE23-0176	26 Jan. 2024

Traceability

This certification is traceable to the International System of Unit maintained at :
SP Metrology - SP Metrology system (Thailand) Co.,Ltd.
Quality Reborn Co., Ltd



Result of Calibration

Certificate No. : SPR23030505-4

Page : 3 of 3

Temperature Accuracy in the Measurement (WET)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.013	30.1	0.087	0.50
35.0	35.010	35.1	0.090	0.50
40.0	40.015	40.1	0.085	0.50

Temperature Accuracy in the Measurement (DRY)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.013	30.1	0.087	0.50
35.0	35.010	35.1	0.090	0.50
40.0	40.015	40.1	0.085	0.50

Temperature Accuracy in the Measurement (GLOBE)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.013	30.2	0.187	0.50
35.0	35.010	35.2	0.190	0.50
40.0	40.015	40.2	0.185	0.50

Note:

The result of calibration was found accurate as show on data and place of calibration only.
This Certificate is not certified for any commercial transaction

Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor $k = 2$, providing a level of confidence approximately 95%

- End of Certificate -



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ถนนพหลโยธิน 24 แขวงพญาไท เขตพญาไท กรุงเทพมหานคร 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-070-72 Fax : (662) 513-4231 E-mail : sales@spscon.com, www.spscon.com

Heat 098_3

Heat Stress WBGT Meter Verification Report					
Verification Data					
Heat Stress WBGT Meter No.	: 833	Verification Date	: 5 July 2023		
Brand	: 3M	Ambient Temp.	: 24.5 °C		
Model	: QUESTemp ^{cm} 32	Barometric Pressure	: 1011 mmbar		
Serial No.	: TPK120034	Relative Humidity	: 49 %		
Verification Module (Electronic Sensor Check) :					
Verification Module No. :	21	WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C			
Result of Verification : Without Adjustment					
Wet Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
12.5	12.5	0.0	± 0.5		
Dry Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
47.1	47.3	-0.2	± 0.5		
Globe Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
69.3	69.3	0.0	± 0.5		
UUC* = UNIT UNDER CALIBRATION					

(Mr. Abdul Dangkhom)

(Mr. Peera Detudom)



CALIBRATION LABORATORY CO., LTD.
210-11, 14/59 Soi Prajant Manuwit 29 Yek-Ji, Prajant Manuwit Rd., Udonnarak, Bangkok 110
Tel : 08-578-0253-4 Fax : 02-578-02671 www.calibration.co.th E-mail : sales@calibration.co.th



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)
MANUFACTURER : 3M
MODEL / TYPE : QUESTemp[®] 32
SERIAL NO. : TPK120034
CLID. NO. : 231801948
JOB CONTROL NO. : 221108113507

CUSTOMER : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24 ROAD, JOMPOL,
CHATUCHAK, BANGKOK 10900

DATE OF RECEIVED : 08 November 2022

DATE OF ISSUED : 11 November 2022

Report of calibration, respecting (and) not be taken in part, Except complete, Without the approval of the Calibration Laboratory Co., Ltd.

Calibrated By :

Oranut Kamchaphai
Calibration Engineer

Approved By :

Authorized Signatory
11 November 2022

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. Q22113507

FS-011-047/01-12

Page 1 of 3





REPORT OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)
MANUFACTURER : 3M
MODEL / TYPE : QUESTemp®M32
SERIAL NO. : TPK120034
DATE OF CALIBRATION : 10 November 2022

ENVIRONMENT CONDITIONS :

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

PROCEDURE USED :

This instrument was calibrated under procedure No. WL-305-74. The calibration was performed by using Chilled Mirror Hygrometer and Temperature & Humidity Chamber which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, (Götesch Model) Dew Master S/N: 44602,
Temperature & Humidity Chamber, PCG Model 9141-3116 S/N: 1304261

TRACEABILITY :

The measurements are traceable to International System of Units (SI) through Thermo Scientific Corporation.
Certificate No. 19344, Date 26 January 2023.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2.00$ which for a normal distribution corresponds to a coverage probability of approximately 95 %.
It has been evaluated according to the "Evaluation of the Uncertainty of Measurement (EA-4:02, M:2021)".



CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (N) without adjustment () adjustment

The table in the following gives the calibration results and associated measurement uncertainties of the measuring digital thermohygrometer (thermal environment monitor).

CALIBRATION DATA

1. CORRECTION OF TEMPERATURE : WET

Test point ($^\circ\text{C}$)	Actual Temperature ($^\circ\text{C}$)	DUC Reading ($^\circ\text{C}$)	Correction ($^\circ\text{C}$)	Uncertainty \pm ($^\circ\text{C}$)
10.0	29.95	29.9	+0.05	0.41
35.0	34.99	34.9	+0.09	
40.0	40.01	39.9	+0.11	

2. CORRECTION OF TEMPERATURE : DRY

Test point ($^\circ\text{C}$)	Actual Temperature ($^\circ\text{C}$)	DUC Reading ($^\circ\text{C}$)	Correction ($^\circ\text{C}$)	Uncertainty \pm ($^\circ\text{C}$)
30.0	29.95	30.0	-0.05	0.41
35.0	34.99	35.0	-0.01	
40.0	40.01	40.0	+0.01	

3. CORRECTION OF TEMPERATURE : GLOBE BULB

Test point ($^\circ\text{C}$)	Actual Temperature ($^\circ\text{C}$)	DUC Reading ($^\circ\text{C}$)	Correction ($^\circ\text{C}$)	Uncertainty \pm ($^\circ\text{C}$)
30.0	29.95	29.8	+0.15	0.41
35.0	34.99	34.8	+0.19	
40.0	40.01	39.8	+0.21	

Note: The scope of Accredited TISI Certificate No. 19C0870655 Issue 1 Page 36 of 111

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

End of Certificate



Heat Stress WBGT Meter Verification Report			
Verification Data			
Heat Stress WBGT Meter No. : B17	Verification Date : 1 October 2023		
Brand : 3M	Ambient Temp. : 24.5 °C		
Model : QUESTemp [®] 34	Barometric Pressure : 1011 mmbar		
Serial No. : TEF050029	Relative Humidity : 49 %		
Verification Module (Electronic Sensor Check) :			
Verification Module No. : 21	WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C		
Result of Verification : Without Adjustment			
Wet Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
12.5	12.5	0.0	± 0.5
Dry Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
47.1	47.2	-0.1	± 0.5
Globe Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
69.3	69.2	0.1	± 0.5
UUC* = UNIT UNDER CALIBRATION			

(Mr. Adul Dangklorn)

(Mr. Peera Detudom)



CALIBRATION LABORATORY CO., LTD.

110-11, 14-55 Soi Praant Mitthani 28/2661, Preetan Manul Rd., Ladkrabang, Bangkok 10530
Tel : (662) 78-03514 Fax : (662) 576-2872 Website: www.spscc.com E-mail: sales@spscc.com



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGROMETER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp[®] 34

SERIAL NO. : TEF050029

CLID. NO. : 231802269

JOB CONTROL NO. : 231028109976

CUSTOMER : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAIHOLYOTHIN 24 ROAD, JONGPOL,
CHATUCHIAK, BANGKOK 10900

DATE OF RECEIVED : 28 October 2022

DATE OF ISSUED : 31 October 2022

Report of calibration is presented just not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

Calibrated By :

Oranut Kamchatphai
Calibration Engineer



Approved By :

Mongkol Yotsontorn
Authorized Signatory

31 October 2022

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. Q22109976

F3-01 1-04/01-12



REPORT OF CALIBRATION

FOR

NOMENCLATURE	:	DIGITAL THERMOHYGRO METER (THERMAL ENVIRONMENT MONITOR)
MANUFACTURER	:	3M
MODEL / TYPE	:	QUESTemp [®] 34
SERIAL NO.	:	TEF050029
DATE OF CALIBRATION	:	29 October 2027

ENVIRONMENT CONDITIONS :

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

PROCEDURE USED :

This instrument was calibrated under procedure No. WI-305-74. The calibration was performed by using

Chilled Mirror Hygrometer and Temperature & Humidity Chamber which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, Edgetech Model Dew Master S/N. 44602

Temperature & Humidity Chamber, PCC Model 9141-5116 S/N 1304261.

TRACEABILITY :

The measurements are traceable to International System of Units (SI), through Thunder Scientific Corporation Certificate No. 9944, Due Date 26 January 2023.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2.00$ which for a normal distribution corresponds to a coverage probability of approximately 95 %. It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (2-2012)"

Certificate No. 022100976

3-011-04/01-12

Page 2 of 3

Certificate No. 022109976

F3-011-0401-12

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

End of Certificate

page 3 of 3

CALIBRATION LABORATORY CO., LTD.

2/10-11 & 55 So. Front Street 21 York St. Boston, MA 02106
Tel: (617) 552-1883 Fax: (617) 552-1884 E-mail: info@biobase.com


$$C = 51.0300, \Delta T = 10.50^\circ$$

CONDITION OF CALIBRATION ITEM: GOOD

MEASUREMENT RESULTS: (X) without adjustment (adjustment)

The table in the following gives the calibration results and associated measurement uncertainties of the measuring digital thermohygro meter (thermal environment monitor).

CALIBRATION DATA

1. CORRECTION OF TEMPERATURE: WET

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
30.0	30.01	29.8	+0.21	0.50
35.0	35.00	34.9	+0.10	
40.0	40.01	39.8	+0.21	

2. CORRECTION OF TEMPERATURE : DRY

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
30.0	30.01	30.0	+0.01	0.40
35.0	35.00	35.2	-0.20	
40.0	40.01	40.1	-0.09	

4. CORRECTION OF TEMPERATURE : GLOBE BULB

Test point (°C)	Actual Temperature (°C)	DSC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
30.0	30.01	29.7	+0.31	0.40
35.0	35.00	34.8	+0.20	
40.0	40.0	39.8	+0.21	

Note: The Scope of Accredited TISI Certificate No. 19CD87/0655 Issue 1 Page 36 of 111



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ถนนพหลโยธิน 24 ถนนพหลโยธิน แขวงจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin Rd., Jompo, Chatuchak, Bangkok 10900
Tel: (662) 939-4394 Fax: (662) 513-4321 E-mail: sales@spsc.com, www.spcc.com

Heat 124_2

Heat Stress WBGT Meter Verification Report				
Verification Data				
Heat Stress WBGT Meter No.	: B21	Verification Date	: 1 October 2023	
Brand	: METROSNICS	Ambient Temp.	: 24.5 °C	
Model	: hs-32	Barometric Pressure	: 1011 mmbar	
Serial No.	: MCE030011	Relative Humidity	: 49 %	
Verification Module (Electronic Sensor Check) :				
Verification Module No. :	21	WB = 12.5 °C,	DB = 47.1 °C,	G = 69.3 °C
Result of Verification : Without Adjustment				
Wet Probe Temperature Measurement				
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)	
12.5	12.6	-0.1	± 0.5	
Dry Probe Temperature Measurement				
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)	
47.1	47.3	-0.2	± 0.5	
Globe Probe Temperature Measurement				
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)	
69.3	69.1	0.2	± 0.5	
UUC* = UNIT UNDER CALIBRATION				

(Mr. Jutit Dangsom)

(Mr. Peera Detadom)



METROLOGY SYSTEM (THAILAND) CO.,LTD.



Certificate of Calibration

Certificate Number : SPR23030505-2 Page : 1 of 3
Customer : S.P.S. CONSULTING SERVICE CO., LTD.
7 Soi Phaholyothin 24 Phaholyothin Road, Jompo, Chatuchak,
Bangkok 10900

Equipment Name : Area Heat Stress Monitor

Manufacturer : METROSNICS

Model : hs-32

Serial Number : MCE030011

ID. Number : B21

Environmental Conditions

Ambient Temperature : 23 °C ± 2 °C Received Date : 30 Mar 2023

Relative Humidity : 50 % ± 15 % Calibration Date : 31 Mar 2023

Location of Calibration : In-Lab Recommend Due Date : 31 Mar 2024

Calibration Procedure : SP-CPT-Q4-13 Date of Issue : 01 Apr 2023

Method of Calibration

This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure. Standards used to perform this calibration are certified by NIST or equivalent. National metrology institute, Natural physical constants consensus standards. The result reported herein apply only to the calibration of the item described above as received. Our decision rule is to contact the customer if his item pass and fail calibration when the results include the uncertainties and the customer must determine if the results meets their needs.
All calibrations are performed within manufacture's specifications. This calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by :

Approved by :

Authorized Signatory

SP-FM-Q4-15 rev.0



Calibration Report

Certificate Number : SPR23030505-2

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Humidity Chamber	TH-80S	N/A	SPR23010480-5	22 Feb 2024
THERMO-HYGROMETER	5020A	A47046	OR23-0176	28 Jan 2024

Traceability

This certification is traceable to the International System of Unit maintained at
SP Metrology - SP Metrology system (Thailand) Co.,Ltd.

Quality Reborn Co., Ltd



Result of Calibration

Certificate No. : SPR23030505-2

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.013	30.4	0.387	0.50
35.0	35.010	35.4	0.390	0.50
40.0	40.015	40.4	0.385	0.50

Temperature Accuracy in the Measurement. (DRY)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.013	30.5	0.487	0.50
35.0	35.010	35.5	0.490	0.50
40.0	40.015	40.5	0.485	0.50

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.013	30.4	0.387	0.50
35.0	35.010	35.4	0.390	0.50
40.0	40.015	40.4	0.385	0.50

Note:

The result of calibration was found accurate as show on date and place of calibration only.
This Certificate is not certified for any commercial transaction

Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor $k = 2$, providing a level of confidence approximately 95%

- End of Certificate -



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจตุจักร กรุงเทพฯ 10900
Tel : (662) 839-4374-72 Fax : (662) 513-4221 E-mail : sales@spsco.com, www.spsco.com

Heat 124_3

Heat Stress WBGT Meter Verification Report					
Verification Data					
Heat Stress WBGT Meter No.	: B28	Verification Date	: 1 October 2023		
Brand	: 3M	Ambient Temp.	: 24.5	°C	
Model	: QUESTemp ³²	Barometric Pressure	: 1011	mmbar	
Serial No.	: TPH050046	Relative Humidity	: 49	%	
Verification Module (Electronic Sensor Check) :					
Verification Module No. : 21 WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C					
Result of Verification : Without Adjustment					
Wet Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
12.5	12.7	-0.2	± 0.5		
Dry Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
47.1	47.2	-0.1	± 0.5		
Globe Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
69.3	69.3	0.0	± 0.5		
UUC* = UNIT UNDER CALIBRATION					

(Mr. Abdul Dangklom)

(Mr. Peera Detudom)



CALIBRATION LABORATORY CO., LTD.
410-11, 14 85 Soi Petchaburi 28, Petchaburi Rd., Lumpini, Bangkok 10250
Tel : (662) 578-0334-4 Fax : (662) 578-0372 www.calibration.co.th E-mail: sales@calibration.co.th



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp³²

SERIAL NO. : TPH050046

CLID. NO. : 231801943

JOB CONTROL NO. : 221028109979

CUSTOMER : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHLYOTHIN 24 ROAD., JOMPOL,
CHATCHUAK, BANGKOK 10900

DATE OF RECEIVED : 28 October 2022

DATE OF ISSUED : 31 October 2022

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

Calibrated By :

Oranut Kamchatphai
Calibration Engineer

Approved By :

Authorized Signatory
31 October 2022

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. Q22109979

F3-01 1-04/01-12

Page 1 of 3





CALIBRATION LABORATORY CO., LTD.

210-11-34-55 Soi Praset Muvall 21 Yvel 4, Praset Muvall Rd., Luangprabang, Bangkok 10230
Tel: 02-576-0354 Fax: 02-576-2572 www.calibration.com E-mail: info@calibration.com



ISO 17025
CALIBRATION LAB

REPORT OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)
MANUFACTURER : 3M
MODEL / TYPE : QUESTemp®32
SERIAL NO. : TPH050046
DATE OF CALIBRATION : 29 October 2022

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. WT-305-74. The calibration was performed by using

Chilled Mirror Hygrometer and Temperature & Humidity Chamber which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, Edgetech Model Dew Master S/N: 44602

Temperature & Humidity Chamber, PGC Model 9141-5116 S/N: 1304261

TRACEABILITY :

The measurements are traceable to International System of Units (SI), through Thunders Scientific Corporation.

Certificate No. 19944, Date 26 January 2023.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2.00$ which for a normal distribution corresponds to a coverage probability of approximately 95 %. It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2021)".

Certificate No. Q22109979

F3-011-04/01-12

page 2 of 3



CALIBRATION LABORATORY CO., LTD.

210-11-34-55 Soi Praset Muvall 21 Yvel 4, Praset Muvall Rd., Luangprabang, Bangkok 10230
Tel: 02-576-0354 Fax: 02-576-2572 www.calibration.com E-mail: info@calibration.com



ISO 17025
CALIBRATION LAB

CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

The table in the following gives the calibration results and associated measurement uncertainties of the measuring digital thermohygro meter (thermal environment monitor).

CALIBRATION DATA

1. CORRECTION OF TEMPERATURE : WET

Test point ($^{\circ}\text{C}$)	Actual Temperature ($^{\circ}\text{C}$)	DUC Reading ($^{\circ}\text{C}$)	Correction ($^{\circ}\text{C}$)	Uncertainty \pm ($^{\circ}\text{C}$)
30.0	30.01	30.0	-0.01	
35.0	35.00	35.0	0.00	0.40
40.0	40.01	39.8	+0.21	

2. CORRECTION OF TEMPERATURE : DRY

Test point ($^{\circ}\text{C}$)	Actual Temperature ($^{\circ}\text{C}$)	DUC Reading ($^{\circ}\text{C}$)	Correction ($^{\circ}\text{C}$)	Uncertainty \pm ($^{\circ}\text{C}$)
30.0	30.01	30.1	-0.05	
35.0	35.00	35.1	-0.10	0.40
40.0	40.01	40.0	+0.01	

3. CORRECTION OF TEMPERATURE : GLOBE BULB

Test point ($^{\circ}\text{C}$)	Actual Temperature ($^{\circ}\text{C}$)	DUC Reading ($^{\circ}\text{C}$)	Correction ($^{\circ}\text{C}$)	Uncertainty \pm ($^{\circ}\text{C}$)
30.0	30.01	30.0	0.01	
35.0	35.00	35.0	0.00	0.40
40.0	40.01	39.8	+0.21	

Note: The Scope of Accredited TISI Certificate No. 19C0870655 Issue 1 Page 36 of 111

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

End of Certificate

Certificate No. Q22109979

F3-011-04/01-12

page 3 of 3



Heat Stress WBGT Meter Verification Report					
Verification Data					
Heat Stress WBGT Meter No. :	B30	Verification Date :	1 October 2023		
Brand :	3M	Ambient Temp. :	24.5	°C	
Model :	QUESTemp ³²	Barometric Pressure :	1011	mmbar	
Serial No. :	TPH050057	Relative Humidity :	49	%	
Verification Module (Electronic Sensor Check) :					
Verification Module No. :	21	WB = 12.5 °C, DB = 17.1 °C, G = 69.3 °C			
Result of Verification : Without Adjustment					
Wet Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
12.5	12.6	-0.1	± 0.5		
Dry Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
47.1	47.1	0.0	± 0.5		
Globe Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
69.3	69.4	-0.1	± 0.5		
UUC* = UNIT UNDER CALIBRATION					

(Mr. Adut Banglorn)

(Mr. Peera Detudom)



CALIBRATION LABORATORY CO., LTD.
279-11, 14 501 501 ถนนพหลโยธิน 24 แขวงจตุจักร กรุงเทพฯ 10900
Tel : 08-671-0353-4 Fax : 02-578-3572 www.spl-lab.com E-mail : sales@spl-lab.com



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGROMETER
(THERMAL ENVIRONMENT MONITOR)
MANUFACTURER : 3M
MODEL / TYPE : QUESTemp³²
SERIAL NO. : TPH050057
CLID. NO. : 231801945
JOB CONTROL NO. : 231028109977

CUSTOMER : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24 ROAD, JONGPOT,
CHATUCHAK, BANGKOK 10900

DATE OF RECEIVED : 28 October 2022

DATE OF ISSUED : 31 October 2022

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

Calibrated By :

Oranut Kamchatphai
Calibration Engineer

Approved By :

Authorized Signatory
31 October 2022

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

Certificate No. Q22109977

F3-011-04/01-12

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ack calibration

กลิ่นในสถานประกอบการ



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

S.P.S. CONSULTING SERVICE CO., LTD.

7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900

7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900

Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature : 25 \pm 3 $^{\circ}$ C
Pressure : 1010 \pm 15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)			y	R ²
					1	2	3	1	2	3		
B80	SKC	224-PCXR3	504569	07/10/2023	1,000	1,500	2,000	1,001	1,497	2,000	1.007x - 19.202	0.999
B81	SKC	224-PCXR3	503480	07/10/2023	1,000	1,500	2,000	994	1,496	1,996	1.006x - 17.526	1.000
B82	SKC	224-PCXR3	505673	05/10/2023	1,000	1,500	2,000	992	1,495	1,992	1.002x - 11.742	1.000
B83	SKC	224-PCXR3	510785	05/10/2023	1,000	1,500	2,000	994	1,497	1,998	1.005x - 15.177	1.000
B84	SKC	224-PCXR3	508333	04/10/2023	1,000	1,500	2,000	1,000	1,498	1,999	1.003x - 16.041	0.999
B85	SKC	224-PCXR3	505757	04/10/2023	1,000	1,500	2,000	999	1,498	1,999	1.010x - 23.715	0.999
B86	SKC	224-PCXR3	512625	02/10/2023	1,000	1,500	2,000	1,000	1,493	1,989	0.994x + 1.568	1.000
B87	SKC	224-PCXR3	504324	09/10/2023	1,000	1,500	2,000	1,001	1,500	1,996	1.006x - 16.049	0.999
B88	SKC	224-PCXR3	508307	09/10/2023	1,000	1,500	2,000	1,000	1,496	1,990	0.990x + 9.617	1.000
B89	SKC	224-PCXR3	509860	05/10/2023	1,000	1,500	2,000	999	1,496	1,998	0.997x - 5.214	0.999
B90	SKC	224-PCXR3	508366	03/10/2023	1,000	1,500	2,000	992	1,495	1,992	0.999x - 5.095	1.000
B91	SKC	224-PCXR3	510919	10/10/2023	1,000	1,500	2,000	998	1,496	1,993	0.995x - 1.847	1.000
B92	SKC	224-PCXR3	510987	04/10/2023	1,000	1,500	2,000	1,001	1,496	1,997	1.009x - 22.028	0.999
B93	SKC	224-PCXR3	509845	04/10/2023	1,000	1,500	2,000	997	1,491	1,990	0.993x + 2.516	1.000
B94	SKC	224-PCXR8	A127871	04/10/2023	1,000	1,500	2,000	998	1,495	1,995	1.005x - 19.074	0.999
B95	SKC	224-PCXR8	A127921	09/10/2023	1,000	1,500	2,000	998	1,498	1,999	1.012x - 25.793	0.999
B96	SKC	224-PCXR8	A127942	09/10/2023	1,000	1,500	2,000	999	1,495	1,989	0.991x + 5.720	1.000
B97	SKC	224-PCXR8	A127955	09/10/2023	1,000	1,500	2,000	994	1,496	1,996	1.011x - 28.512	0.999
B98	SKC	224-PCXR8	A127956	10/10/2023	1,000	1,500	2,000	995	1,489	1,987	0.994x + 1.218	1.000



Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Rotameter Data

Calibration Data

No.	Brand	Model	Date	Flow Rate (mL/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	y	R ²
H-B01	Dwyer	VFB-65	02/10/2023	500	1,000	2,000	500.1	992.7	1979.6	0.993x + 4.560	1.000
H-B02	Dwyer	VFB-65	03/10/2023	500	1,000	2,000	503.6	989.1	1983.1	0.991x + 6.131	1.000
H-B03	Dwyer	VFB-65	02/10/2023	500	1,000	2,000	498.7	991.6	2006.8	0.999x - 9.214	0.999
H-B04	Dwyer	VFB-65	04/10/2023	500	1,000	2,000	502.3	988.1	2003.7	1.000x - 2.013	1.000
H-B05	Dwyer	VFB-65	03/10/2023	500	1,000	2,000	497.8	989.1	1971.6	0.981x + 16.401	0.999
H-B06	Dwyer	VFB-65	05/10/2023	500	1,000	2,000	499.3	995.9	1979.0	0.988x + 11.304	1.000
H-B07	Dwyer	VFB-65	04/10/2023	500	1,000	2,000	495.1	995.8	1991.3	0.997x - 1.222	1.000
H-B08	Dwyer	VFB-65	05/10/2023	500	1,000	2,000	500.7	998.7	1975.8	0.990x + 5.555	0.999
H-B09	Dwyer	VFB-65	03/10/2023	500	1,000	2,000	496.9	998.5	1979.0	0.989x + 10.735	1.000
H-B10	Dwyer	VFB-65	07/10/2023	500	1,000	2,000	499.4	997.5	2004.6	0.998x - 1.062	1.000



SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



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

NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : SP23016

Pages : 1 of 3

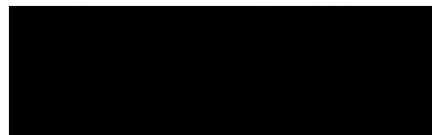
Calibration Certificate

Equipment : UV-VIS SPECTROPHOTOMETER
Manufacturer : PERKINELMER
Model : LAMBDA 25
Serial No.: 501S14123010
ID No.: SP03/58
Calibration Mode : WAVELENGTH ACCURACY
PHOTOMETRIC ACCURACY
Condition As Found : GOOD
Customer : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN ROAD,
CHOMPHON, CHATUCHAK,
BANGKOK 10900, THAILAND.
Location : ORGANIC LABORATORY IV
Ambient Temperature : (25.0 ± 5) °C
Relative Humidity : (48.4 ± 25) %
Received Date : 30 AUGUST 2023
Calibration Date : 30 AUGUST 2023
Date of Issue : 31 AUGUST 2023

Calibrated by :

Nathakorn Pisutpaisan

Approved by :



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

Continuation of Calibration Certificate

Cert. No. : SP23016

Job No. : VC66SP0014

Pages : 2 of 3

Calibration Method :

This instrument was calibrated by using on-site calibration procedure In-house method : CP-SP-01

The calibration procedure to direct measurement wavelength accuracy by using wavelength standard solution, Photometric accuracy by using absorbance standard filter and absorbance standard solution

The calibration procedure used was based on ASTM E275-01,ASTM E925-02

Condition of this result of calibration :

1. Certified reference materials

<u>Material</u>	<u>Ref. type</u>	<u>Cell serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Holmium liquid	RM-HL	29706	106864	01/11/2024
Didymium liquid	RM-DL	28912	106905	02/11/2024
Neutral density filter	RM-1N2N3N	13877	106918	03/11/2024
Potassium dichromate solutions	RM-0204060810	14204	106902	02/11/2024
Potassium Iodide solution	-	KI-0701-001	CI-0090-22	08/04/2024

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

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

3.1 The UK National Physical Laboratory (NPL)

3.2 The National Institute of Standards and Technology, NIST.

Result of calibration : Wavelength Accuracy

(Without adjustment)

<u>Material</u>	<u>Certified Values of Reference Material (nm)</u>	<u>UUC* Reading (nm)</u>	<u>Error (nm)</u>	<u>Uncertainty ± (nm)</u>	<u>k Factor</u>
RM-HL	278.13	278.3	0.17	0.16	2.00
	361.25	361.3	0.05	0.16	2.00
	467.82	468.0	0.18	0.16	2.00
	536.56	536.6	0.04	0.16	2.00
	640.50	640.4	-0.10	0.16	2.00
RM-DL	740.09	740.0	-0.09	0.16	2.00
	864.94	865.0	0.06	0.16	2.00

UUC* = Unit Under Calibration

Continuation of Calibration Certificate

Cert. No. : SP23016
Job No. : VC66SP0014
Pages : 3 of 3

Result of calibration : Photometric Accuracy

(Without adjustment)

Material	Wavelength (nm)	Filter S/N	Nominal Absorbance (A)	Certified Absorbance (A)	UUC* Reading Absorbance (A)	Error (A)	Uncertainty ± (A)	k Factor
Neutral Density glass filter	440.0	29360	1.0	1.0517	1.0564	0.0047	0.0031	2.00
		29914	0.7	0.7445	0.7460	0.0015	0.0032	2.00
		29381	0.5	0.5416	0.5429	0.0013	0.0032	2.00
	546.1	29360	1.0	0.9821	0.9849	0.0028	0.0030	2.00
		29914	0.7	0.6961	0.6961	0.0000	0.0030	2.00
		29381	0.5	0.5073	0.5073	0.0000	0.0030	2.00
	590.0	29360	1.0	1.0222	1.0244	0.0022	0.0030	2.00
		29914	0.7	0.7237	0.7234	-0.0003	0.0030	2.00
		29381	0.5	0.5361	0.5360	-0.0001	0.0031	2.00
	635.0	29360	1.0	0.9753	0.9775	0.0022	0.0030	2.00
		29914	0.7	0.6910	0.6910	0.0000	0.0030	2.00
		29381	0.5	0.5211	0.5210	-0.0001	0.0032	2.00
Material	Wavelength (nm)	Solution (mg/l)	Certified Absorbance (A)	UUC* Reading Absorbance (A)	Error (A)	Uncertainty ± (A)	k Factor	
RM-0204060810	235.0	20	0.2422	0.2462	0.0040	0.0101	2.00	
		40	0.4866	0.4900	0.0034	0.0115	2.00	
		60	0.7414	0.7390	-0.0024	0.0068	2.00	
		80	0.9858	0.9871	0.0013	0.0093	2.00	
		100	1.2442	1.2480	0.0038	0.0087	2.00	

UUC* = Unit Under Calibration

Condition of this result of calibration : Spectrophotometer PERKINELMER Model Lambda 25 S/N 501S141230

Resolution of Wavelength Mode 0.1 nm
Resolution of Photometric Mode 0.0001 A
Parameter Setting
Measurement Mode Wavelength, Absorbance
Wavelength Scan 1100 nm-190 nm
Scanning Speed 7.5 nm/min
Data Pitch 0.1 nm
Band width(Wavelength) 1.0 nm
Band width(Vis) 1.0 nm
Band width(Uv) 1.0 nm

Stray Light** UUC* Reading at 220 nm	
Transmission T(%)	Absorbance(A)
0.0111	3.9564

**Specific Acceptance :

Transmission \leq 1.0 T(%), Absorbance \geq 2.0 A

**Stray light not TISI Accredited

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

End of Calibration Certificate