

ภาคผนวกที่ 5

เอกสารการสอบเทียบเครื่องมือ

- เอกสาร 5-1 เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศในบรรยากาศ
- เอกสาร 5-2 เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศจากปล่อง
- เอกสาร 5-3 เอกสารสอบเทียบเครื่องมือการตรวจคุณภาพอากาศในสถานประกอบการ (Working Area)
- เอกสาร 5-4 เอกสารสอบเทียบเครื่องมือการตรวจระดับเสียงโดยทั่วไปและเสียงในสถานประกอบการ (Working Area)
- เอกสาร 5-5 เอกสารสอบเทียบเครื่องมือการตรวจค่าความร้อนในสถานประกอบการ (Working Area)

เอกสารที่ 5-1

เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศ
ในบรรยากาศ

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 (l/min)	R ²	
B01	B01	02/08/2022	y = 1.254x - 2.366	0.998	
B02	B02	02/08/2022	y = 0.987x + 5.729	0.999	
B03	B03	02/08/2022	y = 1.247x - 5.106	0.999	
B04	B04	01/08/2022	y = 1.242x - 4.834	0.997	
B05	B05	01/08/2022	y = 1.245x - 5.869	0.997	
B06	B06	01/08/2022	y = 1.360x - 10.516	0.999	
B07	B07	01/08/2022	y = 1.290x - 6.871	0.999	
B08	B08	01/08/2022	y = 1.353x - 8.231	0.999	
B09	B09	04/08/2022	y = 1.289x - 6.478	0.999	
B10	B10	04/08/2022	y = 1.317x - 9.553	0.998	
B11	B11	04/08/2022	y = 1.331x - 8.248	0.999	
B12	B12	04/08/2022	y = 1.317x - 9.553	0.998	
B13	B13	01/08/2022	y = 1.338x - 9.806	0.999	
B14	B14	01/08/2022	y = 1.230x - 3.685	0.998	
B15	B15	01/08/2022	y = 1.169x - 2.059	0.998	
B16	B16	01/08/2022	y = 1.240x - 1.078	0.996	
B17	B17	01/08/2022	y = 1.241x - 3.121	0.997	
B18	B18	01/08/2022	y = 1.190x - 1.997	0.998	
B19	B19	02/08/2022	y = 1.108x - 0.786	0.999	
B20	B20	02/08/2022	y = 1.251x - 6.369	0.997	
B21	B21	02/08/2022	y = 1.176x - 0.519	0.999	
B22	B22	02/08/2022	y = 1.291x - 7.071	0.999	
B23	B23	02/08/2022	y = 1.177x - 2.290	0.998	
B24	B24	03/08/2022	y = 1.367x - 11.212	0.997	
B25	B25	03/08/2022	y = 1.178x - 3.689	0.999	
B26	B26	03/08/2022	y = 1.204x - 3.765	0.999	
B27	B27	03/08/2022	y = 1.331x - 10.619	0.998	
B28	B28	03/08/2022	y = 1.139x - 1.295	0.999	
B29	B29	03/08/2022	y = 1.333x - 10.813	0.999	
B30	B30	01/08/2022	y = 1.344x - 10.463	0.997	
B31	B31	01/08/2022	y = 1.162x + 0.382	0.997	
B32	B32	01/08/2022	y = 1.304x - 2.345	0.999	
B33	B33	01/08/2022	y = 1.349x - 10.216	0.999	
B34	B34	01/08/2022	y = 1.289x - 4.593	1.000	

Calibrated by :

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 (l/min)	R ²	
B01	B01	01/08/2022	y = 1.310x - 7.517	0.998	
B02	B02	01/08/2022	y = 1.098x + 2.659	0.997	
B03	B03	01/08/2022	y = 1.089x - 0.857	0.998	
B04	B04	01/08/2022	y = 1.206x - 3.858	0.995	
B05	B05	01/08/2022	y = 1.285x - 7.595	0.997	
B06	B06	01/08/2022	y = 1.287x - 6.981	0.998	
B07	B07	01/08/2022	y = 1.197x - 4.661	0.998	
B08	B08	01/08/2022	y = 1.224x - 5.592	0.999	
B09	B09	01/08/2022	y = 1.275x - 6.394	0.997	
B10	B10	01/08/2022	y = 1.121x + 1.091	0.995	
B11	B11	04/08/2022	y = 1.165x - 2.786	0.998	
B12	B12	04/08/2022	y = 1.230x - 4.896	0.998	
B13	B13	01/08/2022	y = 1.249x - 6.430	0.998	
B14	B14	02/08/2022	y = 1.232x - 4.320	0.996	
B15	B15	02/08/2022	y = 1.154x - 0.926	0.997	
B16	B16	02/08/2022	y = 1.261x - 6.890	0.998	
B17	B17	02/08/2022	y = 1.175x - 2.039	0.997	
B18	B18	02/08/2022	y = 1.290x - 7.805	0.999	
B19	B19	02/08/2022	y = 1.375x - 11.753	0.995	
B20	B20	02/08/2022	y = 1.262x - 7.100	0.999	
B21	B21	03/08/2022	y = 1.142x - 1.809	0.999	
B22	B22	02/08/2022	y = 1.289x - 8.540	0.997	
B23	B23	02/08/2022	y = 1.216x - 4.912	0.999	
B24	B24	01/08/2022	y = 1.147x - 1.299	1.000	
B25	B25	02/08/2022	y = 1.025x - 3.341	0.997	
B26	B26	02/08/2022	y = 1.184x - 3.486	0.995	
B27	B27	03/08/2022	y = 1.237x - 6.825	0.996	
B28	B28	02/08/2022	y = 1.284x - 7.704	0.998	
B29	B29	02/08/2022	y = 1.305x - 8.854	0.996	
B30	B30	03/08/2022	y = 1.227x - 5.387	0.996	
B31	B31	03/08/2022	y = 1.215x - 4.628	0.995	
B32	B32	03/08/2022	y = 1.313x - 8.558	0.995	
B33	B33	03/08/2022	y = 1.330x - 7.545	1.000	
B34	B34	03/08/2022	y = 1.287x - 8.617	0.999	

Calibrated by :

CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE :	10 August 2022	BRAND :	API	MODEL :	200E
NO.	NOX-B11			SERIAL NO.	4467

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 04 August 2022	Serial No.	: 911

Reference Standard Gas

Standard Gas	: Nitric Oxide (NO)	Cylinder No.	: D636192
Certified Date	: 20 April 2022	Expired Date	: 20 April 2024

CALIBRATING CONDITION

Pressure	1011 mmbar	Temp.	24.5 °C	% RH	49
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CALIBRATION SETTING

Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
	Set Point	Expected Concentration	Analyzer Response	%Diff	Slope
Zero	0	0	-0.10	0	-
NO Span	400	400	400.1	0.025	1.007
NO _x Span	400	400	400.2	0.050	1.011

API Model 200E 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		505	cc/min	500 ± 50
OZONE FLOW		78	cc/min	80 ± 15
PMT		103.2	mV	-20 - 150
AZERO		93.9	mV	-20 - 150
HVPS		671	V	420 - 900 constant
RCCELL TEMP		50.5	°C	50 ± 1
BOX TEMP		29.4	°C	8 - 48
PMT TEMP		7.3	°C	7 ± 2
MOLY TEMP		314.9	°C	315 ± 5
RCCELL PRESS		8.4	IN-Hg-A	2 - 10 constant
SAMPLE PRESS		28.6	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		1.007	-	1.0 ± 0.3
NO _x Slope		1.011	-	1.0 ± 0.3
NO Offset		1.2	mV	-20 to +150
NO _x Offset		0.8	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 :

CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE :	10 August 2022	BRAND :	API	MODEL :	TML-41M
NO.	NOX-B18			SERIAL NO.	N07543

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 04 August 2022	Serial No.	: 911

Reference Standard Gas

Standard Gas	: Nitric Oxide (NO)	Cylinder No.	: D636192
Certified Date	: 20 April 2022	Expired Date	: 20 April 2024

CALIBRATING CONDITION

Pressure	1011 mmbar	Temp.	24.5 °C	% RH	49
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CALIBRATION SETTING

Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
	Set Point	Expected Concentration	Analyzer Response	%Diff	Slope
Zero	0	0	-0.10	-	0
NO Span	400	400	399.6	-0.100	1.003
NO _x Span	400	400	399.9	-0.025	1.006

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		509	cc/min	500 ± 50
OZONE FLOW		78	cc/min	80 ± 15
PMT		103.1	mV	-20 - 150
AZERO		94.0	mV	-20 - 150
HVPS		669	V	420 - 900 constant
RCCELL TEMP		50.2	°C	50 ± 1
BOX TEMP		29.5	°C	8 - 48
PMT TEMP		7.1	°C	7 ± 2
MOLY TEMP		315.3	°C	315 ± 5
RCCELL 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		1.003	-	1.0 ± 0.3
NO _x Slope		1.006	-	1.0 ± 0.3
NO Offset		1.1	mV	-20 to +150
NO _x Offset		0.6	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 :

CALIBRATION REPORT

CHEMILUMINESCENT NO_x / NO_x ANALYZER

DATE:	10 August 2022	BRAND:	API	MODEL:	TML-41M
NO.	NOX-B21	SERIAL NO.	NO2374		

Calibrator (Dilution System)

Brand	: API	Model	: 700
Last Cal. Date	: 04 August 2022	Serial No.	: 911
Standard Gas	: Nitric Oxide (NO)	Cylinder No.	: D636192
Certified Date	: 20 April 2022	Expired Date	: 20 April 2024
		Cylinder Conc.	: 49.1 ppm

CALIBRATING CONDITION

Pressure	1011 mmbar	Temp.	24.5 °C	% RH	49
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CALIBRATION SETTING

Span	Initial Reading (Before Adj.) PPB			Final Reading (After Adj.) PPB	
	Expected Concentration	Analyzer Response	%Diff	Analyzer Response	Slope
Set Point					
Zero	0	0.11	-	0	-
NO Span	400	400.1	0.025	400.0	1.009
NO _x Span	400	400.4	0.100	400.0	1.013

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	512	cc/min	500 ± 50
OZONE FLOW	79	cc/min	80 ± 15
PMT	103.3	mV	-20 - 150
AZERO	94.1	mV	-20 - 150
HVPS	675	V	420 - 900 constant
RCELL TEMP	50.3	°C	50 ± 1
BOX TEMP	29.1	°C	8 - 48
PMT TEMP	7.4	°C	7 ± 2
MOLY TEMP	314.7	°C	315 ± 5
RCELL PRESS	8.2	IN-Hg-A	2 - 10 constant
SAMPLE PRESS	28.4	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	1.009	-	1.0 ± 0.3
NO _x Slope	1.013	-	1.0 ± 0.3
NO Offset	1.6	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 :

Gas Sampler Box Calibration Report

Calibration Method : Dry Cal Primary Flowmeter	Model : Dry Cal DCL-ML	S/N : 136164
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Calibration Data							
Gas Sampler Data		Calibration Data					
No.	Rotameter	Date	Setting (Constant Flow) (ml/min)	Actual Flow Rate (ml/min)			
				Sampling Line A		Sampling Line B	
				Normal Condition	Standard Condition		
B01	2 (A&B)	01/06/2022	200	200.4	199.0	200.6	199.2
B02	2 (A&B)	01/06/2022	200	200.6	199.1	200.5	199.0
B03	2 (A&B)	03/06/2022	200	200.5	199.0	200.5	199.1
B04	2 (A&B)	02/06/2022	200	200.5	199.1	200.6	199.2
B05	2 (A&B)	01/06/2022	200	200.4	199.0	200.5	199.1
B06	2 (A&B)	01/06/2022	200	200.5	199.1	200.4	198.9
B07	2 (A&B)	03/06/2022	200	200.3	198.9	200.5	199.1
B08	2 (A&B)	01/06/2022	200	200.5	199.1	200.4	199.0
B09	2 (A&B)	01/06/2022	200	200.4	199.0	200.3	198.9
B10	2 (A&B)	02/06/2022	200	200.5	199.0	200.5	199.0
B11	2 (A&B)	01/06/2022	200	200.4	199.0	200.7	199.2
B12	2 (A&B)	01/06/2022	200	200.5	199.1	200.5	199.0
B13	2 (A&B)	02/06/2022	200	200.4	199.0	200.5	199.1
B14	2 (A&B)	02/06/2022	200	200.5	199.0	200.4	198.9
B15	2 (A&B)	03/06/2022	200	200.6	199.2	200.6	199.2
B16	2 (A&B)	01/06/2022	200	200.5	199.0	200.5	199.1
B17	2 (A&B)	01/06/2022	200	200.5	199.0	200.4	199.0

Calibrated by :



CERTIFICATE No : 22M2570
REFERENCE No : 64386-4

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : METTLER TOLEDO
MODEL : XSR 105DU
SERIAL No : B926859981
ID No : BA 10/62
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 : TETNITHI W.
CALIBRATION DATE : 11-Mar-22
APPROVED BY : 
ISSUED DATE : 17-Mar-22
RECEIVED DATE : 11-Mar-22

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



CERTIFICATE No : 22M2570

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : METTLER TOLEDO
MODEL : XSR 105DU
ID No : BA 10/62
SERIAL No : B926859981
RECEIVED DATE : 11-Mar-22
CALIBRATION DATE : 11-Mar-22
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 :-

1. STANDARD WEIGHT SET
E2
OK-1-151
C02210415
DUE DATE
09-Feb-23
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

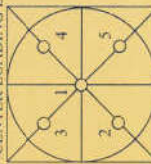
3. REPEATABILITY OF READING AT 20 g WAS 0.000014 g

4. REPEATABILITY OF READING AT 100 g WAS 0.000042 g

5. DEPARTURE FROM NOMINAL VALUE / LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.00000	0.00000	0.000051
0.02	0.01999	0.00001	0.000051
0.10	0.10000	0.00000	0.000052
0.20	0.20001	-0.00001	0.000050
0.50	0.50002	-0.00002	0.000051
1.00	1.00002	-0.00002	0.000052
2.00	2.00002	-0.00002	0.000052
5.00	5.00003	-0.00003	0.000054
10.00	10.00007	-0.00007	0.000058
20.00	20.00007	-0.00007	0.000067
50.00	50.00000	0.00000	0.00011
100.00	100.00001	-0.00001	0.00019
120.00	120.00001	-0.00001	0.00022

6. OFF-CENTER LOADING ERROR



POINT	READING (g)
1	50.0000
2	50.0000
3	50.0000
4	49.9999
5	50.0000
OFF-CENTER LOADING	0.00001

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

Lambda UV Preventive Maintenance (PM)					
Company Name:	S.P.S. CONSULTING SERVICE CO., LTD.				
Address:	7, Soi Phaholyothin24, Ladyao, Jatujak, Bangkok				
User Name:	นายจตุรพร	WO Number:	WO-01801032		
Telephone Number:	086-141-2523	PM Number:	2 of 6		
Customer Support Engineer:	Korkkiat Kerdasil	Certificate Number:	UV5078-2022		
Date PM Performed: (DD-MM-YYYY)	22-Jul-2022	Next PM Due Date: (DD-MM-YYYY)	22-Jan-2023		

Scope

The purpose of this PM is to ensure the continued functionality of the PerkinElmer Lambda UV/Vis Spectrophotometer by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer. The customer should save their method before the PM begins.

General Instructions:

The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM. Always check with the customer before making any changes that may affect the customer's analysis. Should be signed by an authorized PerkinElmer and customer representative and left with the customer. Update the PM sticker and instrument logbook as required.

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Component List

Component Specific Model	Serial #	Software Version		Configuration Notes
LAMBDA365	365K7060203	4.1.1	STD	160529
NA	NA	NA	NA	NA

Parts Lists

Part Number (If applicable)	Description	Quantity	Batch/L of/SN#	Expiration Date (MM-YY)
B250 0999	Stray Light Standard			
	NaI	1	1943	Mar/23
	NaNO2	1	2963	
	KCl	1	31030	
	NA	NA	NA	
B050-7805 RM-1N2N3N	Secondary Standard for calibration of wavelength and photometric accuracy or use NBS/NIST 930 standards			
	Gray Glass G1	1	2926	Mar/23
	Gray Glass G2	1	3501	Mar/23
	Gray Glass G3	1	2552	Mar/23
	Holmium Oxide	1	1085	Mar/23
	NA	NA	NA	
	NA	NA	NA	

Additional Parts Required for PM					
Part Number (if applicable)	Description	Quantity	Serial #	Remark	
NA	NA	NA	NA	NA	
NA	NA	NA	NA	NA	
NA	NA	NA	NA	NA	
Additional Reagents and Standards Required for PM					
Part Number (if applicable)	Description	Quantity	Batch/Lot #	Expiration Date (MM/YY)	
NA	NA	NA	NA	NA	
NA	NA	NA	NA	NA	
NA	NA	NA	NA	NA	

Procedure Checklist

Use (✓) to check off those steps in the checklist that have been completed.

1. General:

- ☒ Review the instrument performance with the customer and document any recent problems.
- ☒ Inspect the customer log book and make any appropriate PM entries.
- ☒ Perform general inspection of system for cleanliness.

2. Optical checks:

- ☒ Lamp Alignment/Energy
- ☒ Sample Compartment Windows/Monochromator
- ☒ Mirror and Grating Alignment
- ☒ Cell Holder Alignment

3. Mechanical:

- ☒ Physical inspection – Please write any comments in the additional comments section.
- ☒ Grating Drive Mechanism.
- ☒ Lamp Change Mechanism.
- ☒ Slit Drive Manual Servo.

4. Performance Test:

- ☒ D2 Wavelength accuracy

	Actual Value	Specification
Accuracy at 656.1 nm	656.15	± 0.1

☒ Holmium Oxide wavelength accuracy. (Specification ± 0.5 nm.)

Filter ID #		1085	
Test	Calibration Value	Actual Value	Deviation
279.3 nm	279.3	279.2	-0.10
360.8 nm	360.8	360.8	0.00
459.9 nm	459.9	0.0089	-459.89
536.4 nm	536.2	0.0132	-536.19

☒ Stay Light.

Test	Filter ID #	Result	Specification
NaI @ 220 nm	1943	0.0030	< 0.02 %T
NaNO ₂ @ 340 nm	2963	0.0089	< 0.02 %T
KCl @ 198 nm	31030	0.0132	< 1 %T

☒ Baseline Flatness.

Corrected Baseline	Specification
0.001400	± 0.002 A

☒ Noise Test @ 700 nm.

Actual Value	Specification
0.000000	± 0.000005 A

☒ Photometric Accuracy. (Specification ± 0.006 A.)

Filter 1 ID #		2926	
Test	Calibrated Value	Actual Value	Deviation
440 nm	0.3487	0.3473	-0.0014
546.1 nm	0.3038	0.3036	-0.0002
635 nm	0.3215	0.3216	0.0001
Filter 2 ID #		3501	
Test	Calibrated Value	Actual Value	Deviation
440 nm	1.0009	0.9965	-0.0044
546.1 nm	0.9795	0.9772	-0.0023
635 nm	1.0302	1.0261	-0.0041
Filter 3 ID #		2552	
Test	Calibrated Value	Actual Value	Deviation
440 nm	0.4940	0.4949	0.0009
546.1 nm	0.4583	0.4595	0.0012
635 nm	0.5058	0.5052	-0.0006

5. Accessory (where applicable):

- ☐ Integrating Sphere
- ☐ Reflecting Attachment
- ☐ Cell Changer
- ☐ Sipper
- ☐ Auto Sampler

6. Review:

- ☒ Review with the customer PM work performed.
- ☒ Review with the customer routine maintenance procedures.
- ☒ Discuss recommended customer-supplied materials to have on hand
- ☒ Attach PM sticker.

Additional Comments

Additional Comments Regarding the PM

Review

The preventive maintenance checks and if applicable performance tests for Lambda UV have been completed.	
This Lambda UV Passes <input checked="" type="checkbox"/> Fails <input type="checkbox"/> the preventive maintenance.	
Review of Preventive Maintenance:	
Authorized PerkinElmer Representative:	Date: 22/Jul/2022 (DD-MMM-YYYY)
Aut	Date: 22/Jul/2022 (DD-MMM-YYYY)



Calibration Certificate

Equipment : UV-VIS SPECTROPHOTOMETER
Manufacturer : PERKINELMER
Model : LAMBDA 365
Serial No.: 365K7060203
ID No.: SP04/60
Calibration Mode : WAVELENGTH ACCURACY
PHOTOMETRIC ACCURACY
Condition As Found : GOOD
Customer : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN ROAD,
CHOMPON, CHATUCHAK,
BANGKOK 10900, THAILAND.
Location : ORGANIC LABORATORY IV
Ambient Temperature : (24.5 ± 5) °C
Relative Humidity : (68.0 ± 25) %
Received Date : 30 AUGUST 2021
Calibration Date : 30 AUGUST 2021
Date of Issue : 31 AUGUST 2021

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

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

Material	Ref. type	Cell serial No.	Cert. No.	Due Date
Holmium liquid	RM-HL	29706	87569	13/10/2022
Didymium liquid	RM-DL	28912	87588	15/10/2022
Neutral density filter	RM-IN2N3N	13877	87600	15/10/2022
Potassium dichromate solutions	RM-0204060810	14204	87614	16/10/2022
Potassium Iodide solution	-	KI-0701-001	CI-0030-20	13/02/2022

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

Continuation of Calibration Certificate

Cert. No. : SP21012
Job No. : VC64SP0012
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	1.0524	1.0507	-0.0017	0.0028	2.00
		29914	0.7	0.7454	0.7441	-0.0013	0.0030	2.00
		29381	0.5	0.5426	0.5414	-0.0012	0.0028	2.00
	546.1	29360	1.0	0.9822	0.9801	-0.0021	0.0028	2.00
		29914	0.7	0.6962	0.6947	-0.0015	0.0028	2.00
		29381	0.5	0.5076	0.5064	-0.0012	0.0028	2.00
	590.0	29360	1.0	1.0221	1.0199	-0.0022	0.0028	2.00
		29914	0.7	0.7238	0.7222	-0.0016	0.0029	2.00
		29381	0.5	0.5364	0.5342	-0.0022	0.0031	2.00
	635.0	29360	1.0	0.9751	0.9737	-0.0015	0.0028	2.00
		29914	0.7	0.6912	0.6899	-0.0013	0.0028	2.00
		29381	0.5	0.5214	0.5197	-0.0017	0.0032	2.00

UUC* = Unit Under Calibration

Condition of this result of calibration : Spectrophotometer PERKINELMER Model LAMBDA 365 S/N 365K7060203

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	600 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)
0.0002	6.3546

**Specific Acceptance :

Transmission ≤ 1.0 T(%), Absorbance ≥ 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 —

**ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม**

รายการตรวจวัด	เครื่องมือเก็บตัวอย่าง	เครื่องมือตรวจวิเคราะห์
	ชื่อเครื่องมือ	ชื่อเครื่องมือ
คุณภาพอากาศในบรรยากาศ TSP	- High Volume Air Sampler No. B02, B07, B22	- Digital Balance
PM ₁₀	- High Volume PM-10 Air Sampler No. B05, B06, B24	- Digital Balance
SO ₂	- Gas Sampler Box No. B08, B10, B11	- Spectrophotometer
NO ₂	- NO ₂ Analyzer No. B11, B18, B21	- NO ₂ Analyzer No. B11, B18, B21
คุณภาพอากาศจากปล่อง TSP	- Console No. B01 - Pitot Tube No. B035	- Digital Balance
SO ₂	- Personal Pump SKC No. B31 - Rotameter No. B07	-
NO _x	- Vacuum Gauge	- Spectrophotometer
คุณภาพอากาศในสถานประกอบการ Total Dust	- Personal Pump SKC No. B01, B04, B06, B09, B43, B92	- Digital Balance
	- Rotameter No. H-B01, B10	
ระดับเสียงในบรรยากาศ L _{eq} 24 hr, L _{eq} 1 hr, L _{max} และ L ₉₀	- Acoustic Calibrator	-
	- Sound Level Meter No. B11, B16, B18, B29, B33, B41, B43	
ระดับเสียงในสถานประกอบการ L _{eq} 8 hr	- Acoustic Calibrator	-
	- Sound Level Meter No. B29, B36, B41, B43	
ระดับความร้อนในสถานประกอบการ WBGT	- Digital Thermometer with Probe No. B11, B17, B18, B26, R12	-

เอกสารที่ 5-2

เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศ
จากปล่อง

Console Calibration Report

Calibration Method			Critical Orifices		
Calibration Data					
Console Data		Calibration Data			
No.	Serial No.	Date	y	ΔH_{or} (mmH ₂ O)	
B01	1563	01/06/2022	0.999	50.02	
B02	8002514	03/06/2022	1.002	49.37	
B03	1503016	06/06/2022	1.003	50.46	
B04	00006659	02/06/2022	1.002	49.71	
B05	00007428	02/06/2022	0.997	49.55	
R01	1561	02/06/2022	0.999	49.94	
R02	8002513	03/06/2022	0.994	50.51	
R03	1570	06/06/2022	1.002	49.68	
R04	8002519	02/06/2022	1.004	49.55	
R05	1503015	01/06/2022	0.997	50.14	

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

Accept Value of ΔH_{test} is $46.7 \pm 6.4 \text{ (mmH}_2\text{O)}$

Calibrated by :

Pitot Tube Calibration Report

Calibration Method			Standard Pitot Tube		
Calibration Data					
Pitot Tube Data			Calibration Data		
No.	Type of Pitot	Coefficiency of Standard Pitot	Date	Avg. of Cp (test)	
B03	S	0.99	01/08/2022	Side A	Side B
B04	S	0.99	01/08/2022	0.84	0.83
B05	S	0.99	01/08/2022	0.85	0.84
B07	S	0.99	01/08/2022	0.84	0.84
B08	S	0.99	01/08/2022	0.83	0.84
B08	S	0.99	02/08/2022	0.85	0.84
B09	S	0.99	02/08/2022	0.84	0.84
B11	S	0.99	02/08/2022	0.84	0.83
B16	S	0.99	02/08/2022	0.85	0.84
B18	S	0.99	02/08/2022	0.84	0.83
B19	S	0.99	02/08/2022	0.84	0.84
B21	S	0.99	02/08/2022	0.84	0.85
B24	S	0.99	03/08/2022	0.84	0.84
B27	S	0.99	03/08/2022	0.84	0.85
B30	S	0.99	03/08/2022	0.84	0.84
B31	S	0.99	03/08/2022	0.84	0.83
B33	S	0.99	01/08/2022	0.83	0.84
B35	S	0.99	01/08/2022	0.85	0.84

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

Calibra

Rotameter Calibration Report (For Personal Pump High 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 (m³/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	r^2	
H-101	Dwyer	VFB-65	04/07/2022	500	1,000	2,000	505.3	985.9	1973.5	0.9906 ± 8.629	1,000
H-102	Dwyer	VFB-65	04/07/2022	500	1,000	2,000	495.3	997.8	1993.3	0.9996 ± 1.842	1,000
H-103	Dwyer	VFB-65	05/07/2022	500	1,000	2,000	497.9	987.5	2010.2	1.0065 ± 16.084	0.999
H-104	Dwyer	VFB-65	05/07/2022	500	1,000	2,000	500.4	999.5	2008.7	0.9988 ± 1.696	1,000
H-105	Dwyer	VFB-65	01/07/2022	500	1,000	2,000	496.6	997.4	1982.3	0.9888 ± 13.004	1,000
H-106	Dwyer	VFB-65	04/07/2022	500	1,000	2,000	503.9	994.2	1981.4	1.0035 ± 5.757	0.999
H-107	Dwyer	VFB-65	04/07/2022	500	1,000	2,000	504.1	993.3	2018.3	1.0028 ± 1.639	1,000
H-108	Dwyer	VFB-65	01/07/2022	500	1,000	2,000	500.2	999.2	1975.8	0.9986 ± 3.649	0.989
H-109	Dwyer	VFB-65	01/07/2022	500	1,000	2,000	503.7	1006.6	2014.3	0.9948 ± 14.326	1,000
H-110	Dwyer	VFB-65	04/07/2022	500	1,000	2,000	496.6	998.6	2012.4	0.9976 ± 3.130	1,000

Calibrated by :

Pitot Tube Calibration Report									
Calibration Method					Standard Pitot Tube				
No.	Pitot Tube Data		Coefficient of Standard	Pitot	Date	Calibration Data			
						Avg. of Cp (test)		Side A	Side B
	Type of Pitot								
B36	S		0.99		01/08/2022		0.83	0.84	0.84
B37	S		0.99		01/08/2022		0.84	0.84	0.84
B38	S		0.99		02/08/2022		0.85	0.84	0.84
B39	S		0.99		02/08/2022		0.85	0.84	0.84
B40	S		0.99		02/08/2022		0.84	0.84	0.84
B41	S		0.99		02/08/2022		0.84	0.84	0.84
B44	S		0.99		02/08/2022		0.83	0.84	0.84
B45	S		0.99		01/08/2022		0.84	0.85	0.85
B46	S		0.99		01/08/2022		0.84	0.84	0.84
B47	S		0.99		03/08/2022		0.84	0.84	0.84
B48	S		0.99		03/08/2022		0.83	0.84	0.84
B49	S		0.99		01/08/2022		0.84	0.84	0.84
B54	S		0.99		01/08/2022		0.84	0.83	0.83
B56	S		0.99		01/08/2022		0.84	0.84	0.84
B57	S		0.99		04/08/2022		0.83	0.84	0.84
B58	S		0.99		04/08/2022		0.84	0.83	0.83

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

Calibrated by :



Rotameter Calibration Report (For Personal Pump Low Flow Adjust)											
Calibration Method : Dry Cal Primary Flowmeter				Model : Defender 510-H				S/N : 130104			
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-1001	Dwyer	VFA-21	04/07/2022	50	100	200	50.7	99.1	198.9	$0.995x + 1.078$	1.000
L-1002	Dwyer	VFA-21	04/07/2022	50	100	200	50.2	99.4	198.5	$1.004x - 1.615$	0.999
L-1003	Dwyer	VFA-21	05/07/2022	50	100	200	50.8	98.6	198.3	$1.016x - 2.213$	1.000
L-1004	Dwyer	VFA-21	05/07/2022	50	100	200	49.9	102.0	201.1	$0.994x + 1.640$	1.000
L-1005	Dwyer	VFA-21	01/07/2022	50	100	200	50.5	98.1	200.8	$0.991x + 0.476$	1.000
L-1006	Dwyer	VFA-21	04/07/2022	50	100	200	50.3	100.5	203.0	$0.995x + 0.476$	0.999
L-1007	Dwyer	VFA-21	04/07/2022	50	100	200	49.4	100.8	199.7	$1.016x - 1.898$	1.000
L-1008	Dwyer	VFA-21	01/07/2022	50	100	200	49.8	101.3	198.1	$0.989x - 0.218$	1.000
L-1009	Dwyer	VFA-21	01/07/2022	50	100	200	49.6	99.6	200.7	$1.010x - 1.907$	0.999
L-1010	Dwyer	VFA-21	04/07/2022	50	100	200	51.0	100.2	202.8	$0.992x + 2.246$	1.000
Calibrated by : <div></div>											

DATE OF RECEIVED : 20 July 2022

DATE OF ISSUED : 22 July 2022

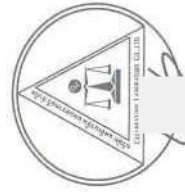
Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

Calibrated By :

Sitipong Pimdee
Calibration Engineer

Approved By :

Authorized Signatory
22 July 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. Q22073204

F3-011-04/01-12

page 1 of 3



@clcalibration



REPORT OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : HI-LIGHT
MODEL / TYPE : N/A
SERIAL NO. : N/A[64-220066-4]
DATE OF CALIBRATION : 21 July 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. **CLC-CPPP-05** according to **DKD-R 6-1** as calibration guidelines.

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

REFERENCE STANDARD USED :

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

TRACEABILITY :

The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand).
Certificate No. MP-0196-21, Due Date 17 November 2022.

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. Q22073204

F3-011-04/01-12

page 2 of 3



@calibration

Certificate No. Q22073204

F3-011-04/01-12

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@calibration

CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

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

CALIBRATION DATA

CORRECTION OF PRESSURE

DUC Test point (inHg)	STD Reading (inHg)		Correction (inHg)	
	Up	Down	Up	Down
0	0.0	0.0	0.0	0.0
-5	-5.1	-5.1	-0.1	-0.1
-10	-10.0	-10.1	0.0	-0.1
-15	-15.0	-15.0	0.0	0.0
-20	-19.9	-20.0	+0.1	0.0
-25	-24.9	-24.9	+0.1	+0.1
-30	-29.9	-29.9	+0.1	+0.1

Uncertainty of measurement ± 0.2 inHg

Transmitting fluid : Air.

Technical Note: k factor 1 kPa = 0.2952998 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.



CERTIFICATE No : 22M2570
REFERENCE No : 64386-4

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : METTLER TOLEDO
MODEL : XSR 105DU
SERIAL No : B926859981
ID No : BA 10/62
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 : TETNITHI W.
CALIBRATION DATE : 11-Mar-22
APPROVED BY : 
ISSUED DATE : 17-Mar-22
RECEIVED DATE : 11-Mar-22



CERTIFICATE No : 22M2570

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : METTLER TOLEDO
MODEL : XSR 105DU
ID No : BA 10/62
S/N : B926859981
AIR PRESSURE : 1008mbar \pm 1mbar
RECEIVED DATE : 11-Mar-22
AMBIENT TEMPERATURE : 22 $^{\circ}$ C \pm 1 $^{\circ}$ C
CALIBRATION DATE : 11-Mar-22
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 :-

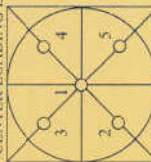
- INSTRUMENT : E2
SERIAL No : OK-1-151
CERTIFICATE No : C02210415
DUE DATE : 09-Feb-23
1. STANDARD WEIGHT SET
2. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.
3. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
4. THIS CERTIFICATE IS TRACEABLE TO 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 20 g WAS 0.000014 g
4. REPEATABILITY OF READING AT 100 g WAS 0.000042 g
5. DEPARTURE FROM NOMINAL VALUE / LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.00000	0.00000	0.000051
0.02	0.01999	0.00001	0.000051
0.10	0.10000	0.00000	0.000052
0.20	0.20001	-0.00001	0.000050
0.50	0.50002	-0.00002	0.000051
1.00	1.00002	-0.00002	0.000052
2.00	2.00002	-0.00002	0.000052
5.00	5.00003	-0.00003	0.000054
10.00	10.00007	-0.00007	0.000058
20.00	20.00007	-0.00007	0.000067
50.00	50.00000	0.00000	0.00011
100.00	100.00001	-0.00001	0.00019
120.00	120.00001	-0.00001	0.00022

6. OFF-CENTER LOADING ERROR



POINT	READING (g)
1	10.00003
2	10.00003
3	10.00004
4	10.00003
5	10.00003
OFF-CENTER LOADING	0.00001

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

Lambda UV Preventive Maintenance (PM)					
Company Name:	S.P.S. CONSULTING SERVICE CO., LTD.				
Address:	7, Soi Phaholyothin24, Ladyao, Jatujak, Bangkok				
User Name:	นายจตุรพร	WO Number:	WO-01801032		
Telephone Number:	086-141-2523	PM Number:	2 of 6		
Customer Support Engineer:	Korkkiat Kerdasil	Certificate Number:	UV5078-2022		
Date PM Performed: (DD-MM-YYYY)	22-Jul-2022	Next PM Due Date: (DD-MM-YYYY)	22-Jan-2023		

Scope

The purpose of this PM is to ensure the continued functionality of the PerkinElmer Lambda UV/Vis Spectrophotometer by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer. The customer should save their method before the PM begins.

General Instructions:

The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM. Always check with the customer before making any changes that may affect the customer's analysis. Should be signed by an authorized PerkinElmer and customer representative and left with the customer. Update the PM sticker and instrument logbook as required.

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Component List

Component Specific Model	Serial #	Software Version		Configuration Notes
LAMBDA365	365K7060203	4.1.1	STD	160529
NA	NA	NA	NA	NA

Parts Lists

Part Number (if applicable)	Description	Quantity	Batch/L or/SN#	Expiration Date (MM-YY)
B250 0999	Stray Light Standard			
	NaI	1	1943	Mar/23
	NaNO2	1	2963	
	KCl	1	31030	
	NA	NA	NA	
B050-7805 RM-1N2N3N	Secondary Standard for calibration of wavelength and photometric accuracy or use NBS/NIST 930 standards			
	Gray Glass G1	1	2926	Mar/23
	Gray Glass G2	1	3501	Mar/23
	Gray Glass G3	1	2552	Mar/23
	Holmium Oxide	1	1085	Mar/23
	NA	NA	NA	
	NA	NA	NA	

Additional Parts Required for PM					
Part Number (if applicable)	Description	Quantity	Serial #	Remark	
NA	NA	NA	NA	NA	
NA	NA	NA	NA	NA	
NA	NA	NA	NA	NA	
Additional Reagents and Standards Required for PM					
Part Number (if applicable)	Description	Quantity	Batch/Lot #	Expiration Date (MM/YY)	
NA	NA	NA	NA	NA	
NA	NA	NA	NA	NA	
NA	NA	NA	NA	NA	

Procedure Checklist

Use (✓) to check off those steps in the checklist that have been completed.

1. General:

- ☒ Review the instrument performance with the customer and document any recent problems.
- ☒ Inspect the customer log book and make any appropriate PM entries.
- ☒ Perform general inspection of system for cleanliness.

2. Optical checks:

- ☒ Lamp Alignment/Energy
- ☒ Sample Compartment Windows/Monochromator
- ☒ Mirror and Grating Alignment
- ☒ Cell Holder Alignment

3. Mechanical:

- ☒ Physical inspection – Please write any comments in the additional comments section.
- ☒ Grating Drive Mechanism.
- ☒ Lamp Change Mechanism.
- ☒ Slit Drive Manual Servo.

4. Performance Test:

- ☒ D2 Wavelength accuracy

	Actual Value	Specification
Accuracy at 656.1 nm	656.15	± 0.1

☒ Holmium Oxide wavelength accuracy. (Specification ± 0.5 nm.)

Filter ID #		1085	
Test	Calibration Value	Actual Value	Deviation
279.3 nm	279.3	279.2	-0.10
360.8 nm	360.8	360.8	0.00
459.9 nm	459.9	0.0089	-459.89
536.4 nm	536.2	0.0132	-536.19

☒ Stay Light.

Test	Filter ID #	Result	Specification
NaI @ 220 nm	1943	0.0030	< 0.02 %T
NaNO ₂ @ 340 nm	2963	0.0089	< 0.02 %T
KCl @ 198 nm	31030	0.0132	< 1 %T

☒ Baseline Flatness.

Corrected Baseline	Specification
0.001400	± 0.002 A

☒ Noise Test @ 700 nm.

Actual Value	Specification
0.000000	± 0.000005 A

☒ Photometric Accuracy. (Specification ± 0.006 A.)

Filter 1 ID #		2926	
Test	Calibrated Value	Actual Value	Deviation
440 nm	0.3487	0.3473	-0.0014
546.1 nm	0.3038	0.3036	-0.0002
635 nm	0.3215	0.3216	0.0001
Filter 2 ID #		3501	
Test	Calibrated Value	Actual Value	Deviation
440 nm	1.0009	0.9965	-0.0044
546.1 nm	0.9795	0.9772	-0.0023
635 nm	1.0302	1.0261	-0.0041
Filter 3 ID #		2552	
Test	Calibrated Value	Actual Value	Deviation
440 nm	0.4940	0.4949	0.0009
546.1 nm	0.4583	0.4595	0.0012
635 nm	0.5058	0.5052	-0.0006

5. Accessory (where applicable):

- ☐ Integrating Sphere
- ☐ Reflecting Attachment
- ☐ Cell Changer
- ☐ Sipper
- ☐ Auto Sampler

6. Review:

- ☒ Review with the customer PM work performed.
- ☒ Review with the customer routine maintenance procedures.
- ☒ Discuss recommended customer-supplied materials to have on hand
- ☒ Attach PM sticker.

Additional Comments

Additional Comments Regarding the PM

Review

The preventive maintenance checks and if applicable performance tests for Lambda UV have been completed.	
This Lambda UV Passes <input checked="" type="checkbox"/> Fails <input type="checkbox"/> the preventive maintenance.	
Review of Preventive Maintenance:	
	Date: 22/Jul/2022 (DD-MMM-YYYY)
	Date: 22/Jul/2022 (DD-MMM-YYYY)



Calibration Certificate

Equipment : UV-VIS SPECTROPHOTOMETER
Manufacturer : PERKINELMER
Model : LAMBDA 365
Serial No.: 365K7060203
ID No.: SP04/60
Calibration Mode : WAVELENGTH ACCURACY
PHOTOMETRIC ACCURACY
Condition As Found : GOOD
Customer : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN ROAD,
CHOMPON, CHATUCHAK,
BANGKOK 10900, THAILAND.
Location : ORGANIC LABORATORY IV
Ambient Temperature : (24.5 ± 5) °C
Relative Humidity : (68.0 ± 25) %
Received Date : 30 AUGUST 2021
Calibration Date : 30 AUGUST 2021
Date of Issue : 31 AUGUST 2021

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.

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

Material	Ref. type	Cell serial No.	Cert. No.	Due Date
Holmium liquid	RM-HL	29706	87569	13/10/2022
Didymium liquid	RM-DL	28912	87588	15/10/2022
Neutral density filter	RM-IN2N3N	13877	87600	15/10/2022
Potassium dichromate solutions	RM-0204060810	14204	87614	16/10/2022
Potassium Iodide solution	-	KI-0701-001	CI-0030-20	13/02/2022
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)

Material	Certified Values of Reference Material (nm)	UUC* Reading (nm)	Error (nm)	Uncertainty ± (nm)	k Factor
RM-HL	278.13	278.2	0.07	0.16	2.00
	361.25	361.4	0.15	0.16	2.00
	467.82	468.1	0.28	0.16	2.00
	536.56	536.7	0.14	0.16	2.00
RM-DL	640.50	640.7	0.20	0.16	2.00
	740.09	739.2	-0.89	0.16	2.00
	864.94	863.8	-1.14	0.16	2.00

UUC* = Unit Under Calibration

Continuation of Calibration Certificate

Cert. No. : SP21012
Job No. : VC64SP0012
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	1.0524	1.0507	-0.0017	0.0028	2.00
		29914	0.7	0.7454	0.7441	-0.0013	0.0030	2.00
		29381	0.5	0.5426	0.5414	-0.0012	0.0028	2.00
	546.1	29360	1.0	0.9822	0.9801	-0.0021	0.0028	2.00
		29914	0.7	0.6962	0.6947	-0.0015	0.0028	2.00
		29381	0.5	0.5076	0.5064	-0.0012	0.0028	2.00
	590.0	29360	1.0	1.0221	1.0199	-0.0022	0.0028	2.00
		29914	0.7	0.7238	0.7222	-0.0016	0.0029	2.00
		29381	0.5	0.5364	0.5342	-0.0022	0.0031	2.00
	635.0	29360	1.0	0.9751	0.9737	-0.0015	0.0028	2.00
		29914	0.7	0.6912	0.6899	-0.0013	0.0028	2.00
		29381	0.5	0.5214	0.5197	-0.0017	0.0032	2.00

UUC* = Unit Under Calibration

Condition of this result of calibration : Spectrophotometer PERKINELMER Model LAMBDA 365 S/N 365K7060203

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	600 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)
0.0002	6.3546

**Specific Acceptance :

Transmission ≤ 1.0 T(%), Absorbance ≥ 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

เอกสารที่ 5-3

เอกสารสอบเทียบเครื่องมือการตรวจคุณภาพอากาศ
ในสถานประกอบการ (Working Area)

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter	Model : Defender 510-II	S/N : 136164
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Calibration Method : Dry Cal Primary Flowmeter	Model : Defender 510-II	S/N : 136164
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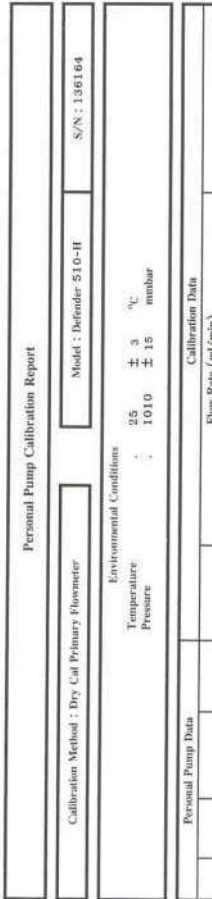
Environmental Conditions	
Temperature	25 ± 3 °C
Pressure	1010 ± 15 mmbar

Environmental Conditions	
Temperature	25 ± 3 °C
Pressure	1010 ± 15 mmbar

Personal Pump Data				Calibration Data												
No.	Brand	Model	Serial No.	Date	Setting			Flow Rate (Gal/min)			Actual (Q act.)			Value From Calibration Curve		
					1	2	3	1	2	3	1	2	3	y	R ²	
B01	SKC	224-PCXR4	202101	04/07/2022	1,000	1,500	2,000	994	1,497	1,998	1,002x - 4.028	1,000			1,000	
B02	SKC	224-PCXR4	626166	01/07/2022	1,000	1,500	2,000	1,002	1,505	2,001	1,009x - 30.106	0,999			0,999	
B03	SKC	224-PCXR4	613968	04/07/2022	1,000	1,500	2,000	996	1,494	2,001	1,006x - 12.997	1,000			1,000	
B04	SKC	224-PCXR4	602604	04/07/2022	1,000	1,500	2,000	1,000	1,502	1,996	1,001x - 2.688	1,000			1,000	
B05	SKC	224-PCXR4	612693	06/07/2022	1,000	1,500	2,000	1,003	1,499	2,005	1,012x - 22.383	0,999			0,999	
B06	SKC	224-PCXR4	602188	04/07/2022	1,000	1,500	2,000	996	1,506	2,009	1,020x - 35.110	0,999			0,999	
B07	SKC	224-PCXR4	626162	01/07/2022	1,000	1,500	2,000	998	1,492	1,995	0,992x + 6.884	1,000			1,000	
B08	SKC	224-PCXR4	626160	01/07/2022	1,000	1,500	2,000	1,003	1,499	2,003	1,012x - 22.669	0,999			0,999	
B09	SKC	224-PCXR4	626179	01/07/2022	1,000	1,500	2,000	997	1,490	1,984	0,983x + 3.909	1,000			1,000	
B10	SKC	224-PCXR4	001910	01/07/2022	1,000	1,500	2,000	993	1,493	2,001	1,017x - 33.950	0,999			0,999	
B11	SKC	224-PCXR4	504313	04/07/2022	1,000	1,500	2,000	995	1,490	1,999	1,004x - 10.290	1,000			1,000	
B12	SKC	224-PCXR4	094656	04/07/2022	1,000	1,500	2,000	1,003	1,503	2,003	1,010x - 19.404	0,999			0,999	
B13	SKC	224-PCXR4	400273	04/07/2022	1,000	1,500	2,000	995	1,490	1,992	1,001x - 3.354	1,000			1,000	
B14	SKC	224-PCXR4	626313	04/07/2022	1,000	1,500	2,000	999	1,491	1,988	0,992x + 7.243	1,000			1,000	
B15	SKC	224-PCXR4	626474	04/07/2022	1,000	1,500	2,000	1,002	1,498	2,005	1,010x - 35.723	0,999			0,999	
B16	SKC	224-PCXR4	626477	01/07/2022	1,000	1,500	2,000	994	1,494	2,001	1,015x - 31.425	0,999			0,999	
B17	SKC	224-PCXR4	626860	04/07/2022	1,000	1,500	2,000	997	1,485	1,991	0,997x - 0.558	1,000			1,000	
B18	SKC	224-PCXR4	691484	01/07/2022	1,000	1,500	2,000	1,003	1,500	2,001	1,006x - 18.825	0,999			0,999	
B19	SKC	224-PCXR4	691509	01/07/2022	1,000	1,500	2,000	995	1,503	1,999	1,005x - 7.885	1,000			1,000	
B20	SKC	224-PCXR4	691507	01/07/2022	1,000	1,500	2,000	993	1,504	1,999	1,014x - 30.719	0,999			0,999	
B21	SKC	224-PCXR4	691531	04/07/2022	1,000	1,500	2,000	993	1,499	1,994	1,001x - 7.187	1,000			1,000	
B22	SKC	224-PCXR4	691654	01/07/2022	1,000	1,500	2,000	1,004	1,501	2,003	1,011x - 19.990	0,999			0,999	
B23	SKC	224-PCXR4	798383	04/07/2022	1,000	1,500	2,000	993	1,505	2,002	1,017x - 34.763	0,999			0,999	
B24	SKC	224-PCXR4	626383	01/07/2022	1,000	1,500	2,000	1,000	1,502	2,000	1,011x - 22.558	0,999			0,999	
B25	SKC	224-PCXR4	798449	04/07/2022	1,000	1,500	2,000	1,001	1,512	2,001	0,998x + 4.850	1,000			1,000	
B26	SKC	224-PCXR4	798479	05/07/2022	1,000	1,500	2,000	999	1,499	1,993	0,996x - 2.892	1,000			1,000	
B27	SKC	224-PCXR4	691673	05/07/2022	1,000	1,500	2,000	993	1,503	2,002	1,017x - 32.888	0,999			0,999	
B28	SKC	224-PCXR4	691570	05/07/2022	1,000	1,500	2,000	1,001	1,500	2,002	1,012x - 33.632	0,999			0,999	
B29	SKC	224-PCXR4	626472	05/07/2022	1,000	1,500	2,000	996	1,494	1,998	1,005x - 6.866	1,000			1,000	
B30	SKC	224-PCXR4	691489	05/07/2022	1,000	1,500	2,000	1,004	1,504	2,004	1,013x - 32.910	0,999			0,999	
B31	SKC	224-PCXR4	691509	04/07/2022	1,000	1,500	2,000	993	1,485	1,998	1,009x - 8.879	1,000			1,000	
B32	SKC	224-PCXR4	691507	05/07/2022	1,000	1,500	2,000	992	1,504	2,001	1,016x - 32.843	0,999			0,999	
B33	SKC	224-PCXR4	691576	05/07/2022	1,000	1,500	2,000	984	1,496	1,991	0,996x + 6.634	1,000			1,000	
B34	SKC	224-PCXR4	612962	05/07/2022	1,000	1,500	2,000	1,002	1,501	2,002	1,011x - 31.693	0,999			0,999	
B35	SKC	224-PCXR4	602682	04/07/2022	1,000	1,500	2,000	993	1,498	1,996	1,001x - 7.411	1,000			1,000	
B36	SKC	224-PCXR4	626164	04/07/2022	1,000	1,500	2,000	999	1,495	1,999	1,000x - 4.946	1,000			1,000	
B37	SKC	224-PCXR4	626256	01/07/2022	1,000	1,500	2,000	994	1,506	2,000	1,014x - 36.892	0,999			0,999	
B38	SKC	224-PCXR4	626167	04/07/2022	1,000	1,500	2,000	997	1,497	1,996	1,002x - 5.594	1,000			1,000	
B39	SKC	224-PCXR4	034637	04/07/2022	1,000	1,500	2,000	1,003	1,500	2,002	1,011x - 22.548	0,999			0,999	
B40	SKC	224-PCXR4	798349	05/07/2022	1,000	1,500	2,000	992	1,505	1,998	1,015x - 32.314	0,999			0,999	

Calibrated by :	
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Personal Pump Data				Calibration Data										Value From Calibration Curve		
No.	Brand	Model	Serial No.	Date	Flow Rate (Q cal/m³/s)									y	R²	
					Setting			Actual (Q std.)			1	2	3			
					1	2	3	1	2	3						
B41	SKC	224-PCXR4	612609	06/07/2022	1,000	1,500	2,000	998	1,496	1,990	0.984x + 3.749	1,000				
B42	SKC	224-PCXR4	626041	06/07/2022	1,000	1,500	2,000	1,003	1,498	1,995	0.986x + 12.346	1,000				
B43	SKC	224-PCXR4	024636	06/07/2022	1,000	1,500	2,000	999	1,501	1,992	0.991x + 10.805	1,000				
B44	SKC	224-PCXR4	629344	06/07/2022	1,000	1,500	2,000	1,002	1,501	1,993	1.012x - 21.817	0,999				
B45	SKC	224-PCXR4	629344	01/07/2022	1,000	1,500	2,000	997	1,498	1,989	0.984x + 4.663	1,000				
B47	SKC	224-PCXR4	606747	04/07/2022	1,000	1,500	2,000	1,002	1,500	1,994	1.016x - 33.363	0,999				
B48	SKC	224-PCXR4	606753	04/07/2022	1,000	1,500	2,000	999	1,494	1,994	0.992x + 2.194	1,000				
B49	SKC	224-PCXR4	606780	04/07/2022	1,000	1,500	2,000	1,002	1,495	1,992	1.012x - 25.626	0,999				
B50	SKC	224-PCXR4	600400	04/07/2022	1,000	1,500	2,000	995	1,497	1,994	1.012x - 28.388	0,999				
B51	SKC	224-PCXR4	600403	04/07/2022	1,000	1,500	2,000	995	1,497	1,994	0.997x + 1.360	1,000				
B52	SKC	224-PCXR4	093166	04/07/2022	1,000	1,500	2,000	995	1,497	1,994	1.012x - 28.388	0,999				
B53	SKC	224-PCXR4	707070	04/07/2022	1,000	1,500	2,000	1,002	1,499	1,992	1.010x - 20.847	0,999				
B54	SKC	224-PCXR4	609821	01/07/2022	1,000	1,500	2,000	993	1,501	1,991	1.016x - 33.878	0,999				
B55	SKC	224-PCXR4	610710	01/07/2022	1,000	1,500	2,000	1,002	1,494	1,995	0.984x + 4.432	1,000				
B56	SKC	224-PCXR4	611450	01/07/2022	1,000	1,500	2,000	1,002	1,500	1,994	1.011x - 20.804	0,999				
B57	SKC	224-PCXR4	610798	01/07/2022	1,000	1,500	2,000	997	1,493	1,998	1.001x - 3.199	1,000				
B58	SKC	224-PCXR4	609852	06/07/2022	1,000	1,500	2,000	1,001	1,498	1,999	1.007x - 19.033	0,999				
B59	SKC	224-PCXR4	609863	05/07/2022	1,000	1,500	2,000	996	1,503	1,994	0.997x + 3.115	1,000				
B60	SKC	224-PCXR4	612656	04/07/2022	1,000	1,500	2,000	1,002	1,500	1,993	1.012x - 23.691	0,999				
B61	SKC	224-PCXR4	603916	04/07/2022	1,000	1,500	2,000	994	1,489	1,996	1.004x - 11.866	1,000				
B62	SKC	224-PCXR4	605975	04/07/2022	1,000	1,500	2,000	999	1,494	1,996	0.997x - 0.104	1,000				
B63	SKC	224-PCXR4	611432	01/07/2022	1,000	1,500	2,000	991	1,501	1,989	1.017x - 36.541	0,989				
B64	SKC	224-PCXR4	608302	01/07/2022	1,000	1,500	2,000	997	1,493	1,989	0.992x + 5.947	1,000				
B65	SKC	224-PCXR4	606310	04/07/2022	1,000	1,500	2,000	1,002	1,500	1,993	1.013x - 23.949	0,999				
B66	SKC	224-PCXR4	609861	05/07/2022	1,000	1,500	2,000	993	1,507	1,997	0.988x + 13.423	1,000				
B67	SKC	224-PCXR4	606795	01/07/2022	1,000	1,500	2,000	993	1,507	1,997	1.017x - 32.943	0,999				
B68	SKC	224-PCXR4	605872	01/07/2022	1,000	1,500	2,000	1,002	1,491	1,991	0.984x + 6.755	1,000				
B69	SKC	224-PCXR4	608375	01/07/2022	1,000	1,500	2,000	1,001	1,503	1,997	1.002x - 6.532	1,000				
B70	SKC	224-PCXR4	610822	04/07/2022	1,000	1,500	2,000	992	1,503	1,997	1.002x - 6.532	1,000				
B71	SKC	224-PCXR4	608367	06/07/2022	1,000	1,500	2,000	990	1,505	1,992	0.992x + 5.952	1,000				
B72	SKC	224-PCXR4	605977	05/07/2022	1,000	1,500	2,000	1,001	1,498	1,993	0.992x + 5.952	1,000				
B73	SKC	224-PCXR4	612606	04/07/2022	1,000	1,500	2,000	1,001	1,498	1,993	1.013x - 24.278	0,999				
B74	SKC	224-PCXR4	604982	01/07/2022	1,000	1,500	2,000	1,001	1,501	1,993	1.013x - 24.278	0,999				
B75	SKC	224-PCXR4	608820	01/07/2022	1,000	1,500	2,000	996	1,495	1,994	1.006x - 4.683	1,000				
B76	SKC	224-PCXR4	609811	04/07/2022	1,000	1,500	2,000	993	1,498	1,998	0.994x + 3.025	1,000				
B77	SKC	224-PCXR4	608301	04/07/2022	1,000	1,500	2,000	1,000	1,501	1,994	1.007x - 14.602	1,000				
B78	SKC	224-PCXR4	610677	04/07/2022	1,000	1,500	2,000	996	1,498	1,998	1.014x - 26.842	0,999				
B79	SKC	224-PCXR4	610920	04/07/2022	1,000	1,500	2,000	994	1,493	1,994	1.012x - 37.121	0,999				
B79	SKC	224-PCXR4	610920	04/07/2022	1,000	1,500	2,000	994	1,493	1,994	0.999x - 3.506	1,000				



			TEB	%TEB	99%	99.9%	99.99%	99.999%	99.9999%	99.99999%
B195	SKC	324-PCX195	12/27/2021	05/07/2022	1,000	1,500	2,000	992	1,502	2,002
B196	SKC	324-PCX196	12/27/2021	05/07/2022	1,000	1,500	2,000	998	1,498	1,998
B197	SKC	324-PCX197	12/27/2021	05/07/2022	1,000	1,500	2,000	1,002	1,502	2,003
B198	SKC	324-PCX198	12/27/2021	05/07/2022	1,000	1,500	2,000	1,000	1,498	1,998

Calibrated by:

Rotameter Calibration Report (For Personal Pump High 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		R ²	
				Flow Rate (Reading)			Actual (Q act.)						
				1	2	3	1	2	3	1	2	3	y
H-101	Dwyer	VFB-65	04/07/2022	500	1,000	2,000	505.3	959.5	1973.3	0.980x + 8.629	1,000		
H-102	Dwyer	VFB-65	04/07/2022	500	1,000	2,000	495.3	997.8	1995.3	0.999x - 1.842	1,000		
H-103	Dwyer	VFB-65	05/07/2022	500	1,000	2,000	497.9	987.5	2010.2	1.006x - 16.084	0.999		
H-104	Dwyer	VFB-65	05/07/2022	500	1,000	2,000	500.4	989.5	2006.7	0.998x - 1.698	1,000		
H-105	Dwyer	VFB-65	01/07/2022	500	1,000	2,000	496.6	997.4	1982.3	0.988x + 13.004	1,000		
H-106	Dwyer	VFB-65	04/07/2022	500	1,000	2,000	503.9	994.2	1981.4	1.005x - 8.737	0.999		
H-107	Dwyer	VFB-65	04/07/2022	500	1,000	2,000	504.1	993.3	2016.3	1.002x - 1.639	1,000		
H-108	Dwyer	VFB-65	01/07/2022	500	1,000	2,000	500.2	999.2	1975.8	0.986x + 3.649	0.999		
H-109	Dwyer	VFB-65	01/07/2022	500	1,000	2,000	503.7	1006.6	2014.3	0.984x + 14.328	1,000		
H-110	Dwyer	VFB-65	04/07/2022	500	1,000	2,000	496.9	998.6	2012.4	0.997x + 3.130	1,000		

Calibrated by :

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 act.)				
				1	2	3	1	2	3	y	R ²
L-1001	Dwyer	VFA-21	04/07/2022	50	100	200	50.7	99.1	198.9	0.986x + 1.078	1.000
L-1002	Dwyer	VFA-21	04/07/2022	50	100	200	50.2	96.4	198.3	1.004x - 1.615	0.999
L-1003	Dwyer	VFA-21	05/07/2022	50	100	200	50.8	98.6	198.3	1.016x - 2.213	1.000
L-1004	Dwyer	VFA-21	05/07/2022	50	100	200	49.9	102.0	201.1	0.994x + 1.640	1.000
L-1005	Dwyer	VFA-21	01/07/2022	50	100	200	50.3	98.1	200.8	0.991x + 0.476	1.000
L-1006	Dwyer	VFA-21	04/07/2022	50	100	200	50.3	100.5	203.0	0.999x + 0.476	0.999
L-1007	Dwyer	VFA-21	04/07/2022	50	100	200	49.4	100.8	199.7	1.016x - 1.898	1.000
L-1008	Dwyer	VFA-21	01/07/2022	50	100	200	49.8	101.3	198.1	0.999x - 0.218	1.000
L-1009	Dwyer	VFA-21	01/07/2022	50	100	200	49.6	99.6	200.7	1.010x - 1.907	0.999
L-1010	Dwyer	VFA-21	04/07/2022	50	100	200	51.0	100.2	202.8	0.992x + 2.266	1.000

Calibrated by :

CERTIFICATE No : 22M2570
REFERENCE No : 64386-4

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : METTLER TOLEDO
MODEL : XSR 105DU
SERIAL No : B926859981
ID No : BA 10/62
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 : TETNITHI W.
CALIBRATION DATE : 11-Mar-22
APPROVED BY : 
ISSUED DATE : 17-Mar-22
RECEIVED DATE : 11-Mar-22

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

CERTIFICATE No : 22M2570

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : METTLER TOLEDO
ID No : BA 10/62
AIR PRESSURE : 1008mbar \pm 1mbar
AMBIENT TEMPERATURE : 22 $^{\circ}$ C \pm 1 $^{\circ}$ C
MODEL : XSR 105DU
S/N : B926859981
RECEIVED DATE : 11-Mar-22
CALIBRATION DATE : 11-Mar-22
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 : STANDARD WEIGHT SET
MODEL : E2
SERIAL No : OK-1-151
CERTIFICATE No : C02210415
DUE DATE : 09-Feb-23

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

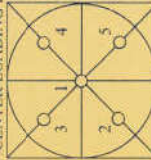
3. REPEATABILITY OF READING AT 20 g WAS 0.000014 g

4. REPEATABILITY OF READING AT 100 g WAS 0.000042 g

5. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.00000	0.00000	0.000051
0.02	0.01999	0.00001	0.000051
0.10	0.10000	0.00000	0.000052
0.20	0.20001	-0.00001	0.000050
0.50	0.50002	-0.00002	0.000051
1.00	1.00002	-0.00002	0.000052
2.00	2.00002	-0.00002	0.000052
5.00	5.00003	-0.00003	0.000054
10.00	10.00007	-0.00007	0.000058
20.00	20.00007	-0.00007	0.000067
50.00	50.00000	0.00000	0.00011
100.00	100.00001	-0.00001	0.00019
120.00	120.00001	-0.00001	0.00022

6. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.0000
2	50.0000
3	50.0000
4	49.9999
5	50.0000
OFF-CENTER LOADING	0.00001

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

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions
Temperature : 25 ± 0.5 °C
Pressure : 1.010 ± 0.15 mmHg

Personal Pump Data				Flow Rate (ml/min)				Value From Calibration Curve			
No.	Brand	Model	Serial No.	Date	Setting	1	2	3	1	2	3
B01	SKC	224-PCXB4	503101	06/10/2022	1,000	1,500	2,000	994	1,497	1,998	1,000
B02	SKC	224-PCXB4	626166	03/10/2022	1,000	1,500	2,000	1,002	1,005	2,001	0.999
B03	SKC	224-PCXB4	612065	03/10/2022	1,000	1,500	2,000	996	1,494	2,001	1,000
B04	SKC	224-PCXB4	602850	03/10/2022	1,000	1,500	2,000	1,000	1,002	2,000	1,000
B05	SKC	224-PCXB4	612693	06/10/2022	1,000	1,500	2,000	1,003	1,499	2,003	0.999
B06	SKC	224-PCXB4	503168	06/10/2022	1,000	1,500	2,000	995	1,497	1,999	1,000
B07	SKC	224-PCXB4	626262	04/10/2022	1,000	1,500	2,000	998	1,492	1,995	1,000
B08	SKC	224-PCXB4	626160	04/10/2022	1,000	1,500	2,000	1,002	1,499	2,003	1,000
B09	SKC	224-PCXB4	603479	06/10/2022	1,000	1,500	2,000	996	1,490	1,994	1,000
B10	SKC	224-PCXB4	601950	03/10/2022	1,000	1,500	2,000	993	1,503	2,001	1,000
B11	SKC	224-PCXB4	564315	06/10/2022	1,000	1,500	2,000	994	1,490	2,003	1,000
B12	SKC	224-PCXB4	604656	03/10/2022	1,000	1,500	2,000	1,003	1,503	2,003	0.999
B13	SKC	224-PCXB4	602073	03/10/2022	1,000	1,500	2,000	998	1,491	1,986	1,000
B14	SKC	224-PCXB4	626033	03/10/2022	1,000	1,500	2,000	1,003	1,502	2,005	1,000
B15	SKC	224-PCXB4	604477	03/10/2022	1,000	1,500	2,000	993	1,504	2,001	1,000
B16	SKC	224-PCXB4	626460	03/10/2022	1,000	1,500	2,000	997	1,494	1,991	1,000
B17	SKC	224-PCXB4	626460	03/10/2022	1,000	1,500	2,000	999	1,502	2,001	1,000
B18	SKC	224-PCXB4	601484	03/10/2022	1,000	1,500	2,000	993	1,503	2,000	1,000
B19	SKC	224-PCXB4	601589	03/10/2022	1,000	1,500	2,000	993	1,503	2,000	1,000
B20	SKC	224-PCXB4	601387	03/10/2022	1,000	1,500	2,000	993	1,504	1,994	1,000
B21	SKC	224-PCXB4	601531	06/10/2022	1,000	1,500	2,000	993	1,503	2,000	1,000
B22	SKC	224-PCXB4	601654	04/10/2022	1,000	1,500	2,000	991	1,504	1,999	1,000
B23	SKC	224-PCXB4	626365	06/10/2022	1,000	1,500	2,000	999	1,502	2,000	1,000
B24	SKC	224-PCXB4	796449	06/10/2022	1,000	1,500	2,000	994	1,503	1,995	1,000
B25	SKC	224-PCXB4	626460	06/10/2022	1,000	1,500	2,000	994	1,503	1,999	1,000
B26	SKC	224-PCXB4	626460	06/10/2022	1,000	1,500	2,000	994	1,503	1,999	1,000
B27	SKC	224-PCXB4	626460	06/10/2022	1,000	1,500	2,000	994	1,503	1,999	1,000
B28	SKC	224-PCXB4	626460	06/10/2022	1,000	1,500	2,000	994	1,503	1,999	1,000
B29	SKC	224-PCXB4	626460	06/10/2022	1,000	1,500	2,000	994	1,503	1,999	1,000
B30	SKC	224-PCXB4	626460	06/10/2022	1,000	1,500	2,000	994	1,503	1,999	1,000
B31	SKC	224-PCXB4	626460	06/10/2022	1,000	1,500	2,000	994	1,503	1,999	1,000
B32	SKC	224-PCXB4	626460	06/10/2022	1,000	1,500	2,000	994	1,503	1,999	1,000
B33	SKC	224-PCXB4	626460	06/10/2022	1,000	1,500	2,000	994	1,503	1,999	1,000
B34	SKC	224-PCXB4	626460	06/10/2022	1,000	1,500	2,000	994	1,503	1,999	1,000
B35	SKC	224-PCXB4	626460	06/10/2022	1,000	1,500	2,000	994	1,503	1,999	1,000
B36	SKC	224-PCXB4	626460	06/10/2022	1,000	1,500	2,000	994	1,503	1,999	1,000
B37	SKC	224-PCXB4	626460	06/10/2022	1,000	1,500	2,000	994	1,503	1,999	1,000
B38	SKC	224-PCXB4	626460	06/10/2022	1,000	1,500	2,000	994	1,503	1,999	1,000
B39	SKC	224-PCXB4	626460	06/10/2022	1,000	1,500	2,000	994	1,503	1,999	1,000
B40	SKC	224-PCXB4	626460	06/10/2022	1,000	1,500	2,000	994	1,503	1,999	1,000

Calibrated by :

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions
Temperature : 25 ± 0.5 °C
Pressure : 1.010 ± 0.15 mmHg

Personal Pump Data				Flow Rate (ml/min)				Value From Calibration Curve			
No.	Brand	Model	Serial No.	Date	Setting	1	2	3	1	2	3
B41	SKC	224-PCXB4	612669	06/10/2022	1,000	1,500	2,000	998	1,496	1,990	1,000
B42	SKC	224-PCXB4	626041	06/10/2022	1,000	1,500	2,000	1,005	1,488	1,994	1,000
B43	SKC	224-PCXB4	626436	06/10/2022	1,000	1,500	2,000	999	1,501	1,992	1,000
B44	SKC	224-PCXB4	526341	06/10/2022	1,000	1,500	2,000	1,002	1,502	2,002	1,000
B45	SKC	224-PCXB4	526341	06/10/2022	1,000	1,500	2,000	998	1,498	1,989	1,000
B46	SKC	224-PCXB4	526343	06/10/2022	1,000	1,500	2,000	994	1,504	2,002	1,000
B47	SKC	224-PCXB4	526347	06/10/2022	1,000	1,500	2,000	1,002	1,500	2,004	1,000
B48	SKC	224-PCXB4	526353	03/10/2022	1,000	1,500	2,000	999	1,494	1,998	1,000
B49	SKC	224-PCXB4	526350	05/10/2022	1,000	1,500	2,000	1,003	1,502	2,003	1,000
B50	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	1,001	1,495	2,002	1,000
B51	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	998	1,504	1,999	1,000
B52	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	995	1,496	1,994	1,000
B53	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	1,002	1,500	2,002	1,000
B54	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	993	1,500	2,001	1,000
B55	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	999	1,494	1,994	1,000
B56	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	1,002	1,500	2,003	1,000
B57	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	997	1,492	1,998	1,000
B58	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	1,000	1,496	1,999	1,000
B59	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	996	1,503	1,994	1,000
B60	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	1,003	1,500	2,003	1,000
B61	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	999	1,494	1,998	1,000
B62	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	991	1,501	1,999	1,000
B63	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	997	1,492	1,989	1,000
B64	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	1,002	1,500	2,003	1,000
B65	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	998	1,503	1,994	1,000
B66	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	993	1,500	2,004	1,000
B67	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	992	1,491	1,997	1,000
B68	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	1,002	1,491	1,997	1,000
B69	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	999	1,494	1,996	1,000
B70	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	992	1,503	1,997	1,000
B71	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	990	1,506	2,002	1,000
B72	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	1,001	1,498	1,993	1,000
B73	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	1,001	1,501	2,005	1,000
B74	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	998	1,495	1,994	1,000
B75	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	996	1,498	1,990	1,000
B76	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	999	1,498	1,996	1,000
B77	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	1,000	1,501	2,003	1,000
B78	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	996	1,503	1,999	1,000
B79	SKC	224-PCXB4	526350	06/10/2022	1,000	1,500	2,000	984	1,493	1,994	1,000

Calibrated by :

Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter				Model : Defender 510-H				S/N : 1361164							
Rotameter Data				Calibration Data											
No.	Brand	Model	Date	Flow Rate (Reading)			Flow Rate (ml/min)			Actual (Q std.)			Value From Calibration Curve		
				1	2	3	1	2	3	1	2	3	y	R ²	
H-801	Dwyer	VFB-65	06/10/2022	500	1,000	2,000	503.3	990.7	1975.7	0.990%	8.856	1.000			
H-802	Dwyer	VFB-65	04/10/2022	500	1,000	2,000	495.7	997.6	1995.3	0.994%	4.605	1.000			
H-803	Dwyer	VFB-65	04/10/2022	500	1,000	2,000	498.3	997.5	2010.2	1.004%	-14.483	0.999			
H-804	Dwyer	VFB-65	06/10/2022	500	1,000	2,000	501.2	999.9	2008.7	0.998%	-0.511	1.000			
H-805	Dwyer	VFB-65	05/10/2022	500	1,000	2,000	499.0	997.4	1972.3	0.987%	14.507	1.000			
H-806	Dwyer	VFB-65	05/10/2022	500	1,000	2,000	503.9	993.4	1981.4	1.006%	-9.415	0.999			
H-807	Dwyer	VFB-65	05/10/2022	500	1,000	2,000	504.1	993.0	2018.3	1.002%	-2.355	1.000			
H-808	Dwyer	VFB-65	04/10/2022	500	1,000	2,000	499.8	999.2	1975.5	0.997%	2.922	0.999			
H-809	Dwyer	VFB-65	06/10/2022	500	1,000	2,000	503.7	1006.6	2014.3	0.993%	14.424	1.000			
H-810	Dwyer	VFB-65	06/10/2022	500	1,000	2,000	496.9	998.6	2012.4	0.998%	1.450	1.000			

Calibrated by :

Rotameter Calibration Report (For Personal Pump Low Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter			Model : Defender 510-H			S/N : 1361164						
Rotameter Data			Calibration Data									
No.	Brand	Model	Date	Flow Rate (Reading)			Flow Rate (ml/min)			Value From Calibration Curve		
				1	2	3	1	2	3	1	2	3
L-801	Dwyer	VFA-21	05/10/2022	50	100	200	50.7	99.1	198.9	0.985%	1.192	1.000
L-802	Dwyer	VFA-21	04/10/2022	50	100	200	49.8	99.4	198.3	1.012%	-2.104	1.000
L-803	Dwyer	VFA-21	04/10/2022	50	100	200	50.6	99.2	198.3	1.009%	-1.844	0.999
L-804	Dwyer	VFA-21	04/10/2022	50	100	200	49.9	101.6	201.1	0.986%	1.334	1.009
L-805	Dwyer	VFA-21	04/10/2022	50	100	200	50.1	98.5	200.8	0.985%	0.311	1.000
L-806	Dwyer	VFA-21	04/10/2022	50	100	200	50.3	100.3	203.4	1.009%	0.376	1.000
L-807	Dwyer	VFA-21	04/10/2022	50	100	200	49.4	100.8	199.7	1.005%	-1.24	0.999
L-808	Dwyer	VFA-21	04/10/2022	50	100	200	49.8	101.3	198.1	0.988%	0.116	1.000
L-809	Dwyer	VFA-21	06/10/2022	50	100	200	49.6	99.2	200.7	1.013%	-1.491	1.000
L-810	Dwyer	VFA-21	06/10/2022	50	100	200	50.6	100.2	202.8	0.993%	0.011	1.000

Calibrated by :

CERTIFICATE No : 22M2570
REFERENCE No : 64386-4

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : METTLER TOLEDO
MODEL : XSR 105DU
SERIAL No : B926859981
ID No : BA 10/62
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 : TETNITHI W.
CALIBRATION DATE : 11-Mar-22
APPROVED BY : 
ISSUED DATE : 17-Mar-22
RECEIVED DATE : 11-Mar-22

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

CERTIFICATE No : 22M2570

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : METTLER TOLEDO
ID No : BA 10/62
AIR PRESSURE : 1008mbar \pm 1mbar
AMBIENT TEMPERATURE : 22 $^{\circ}$ C \pm 1 $^{\circ}$ C
MODEL : XSR 105DU
S/N : B926859981
RECEIVED DATE : 11-Mar-22
CALIBRATION DATE : 11-Mar-22
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 :-

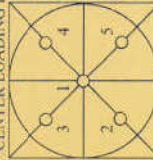
- INSTRUMENT : E2
SERIAL No : OK-1-151
CERTIFICATE No : C02210415
DUE DATE : 09-Feb-23
1. STANDARD WEIGHT SET
2. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.
3. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
4. THIS CERTIFICATE IS TRACEABLE TO 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 20 g WAS 0.000014 g
4. REPEATABILITY OF READING AT 100 g WAS 0.000042 g
5. DEPARTURE FROM NOMINAL VALUE / LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.00000	0.00000	0.000051
0.02	0.01999	0.00001	0.000051
0.10	0.10000	0.00000	0.000052
0.20	0.20001	-0.00001	0.000050
0.50	0.50002	-0.00002	0.000051
1.00	1.00002	-0.00002	0.000052
2.00	2.00002	-0.00002	0.000052
5.00	5.00003	-0.00003	0.000054
10.00	10.00007	-0.00007	0.000058
20.00	20.00007	-0.00007	0.000067
50.00	50.00000	0.00000	0.00011
100.00	100.00001	-0.00001	0.00019
120.00	120.00001	-0.00001	0.00022

6. OFF-CENTER LOADING ERROR



POINT	READING (g)
1	50.0000
2	50.0000
3	50.0000
4	49.9999
5	50.0000
OFF-CENTER LOADING	0.00001

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

เอกสารที่ 5-4

เอกสารสอบเทียบเครื่องมือการตรวจระดับเสียง
โดยทั่วไปและเสียงในสถานประกอบการ
(Working Area)



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0455

MTC No. EEL. BP. 41/0465

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 ± 3) °C
Relative Humidity : (50 ± 15) %
Ambient Pressure : (101.325 ± 1.500) 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-303A S/N OF 2214.

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

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

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

7. Condenser Microphone Brüel&Kjær 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 : 22 Apr. 2022

Date of Calibration : 28 Apr. 2022

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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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0455

MTC No. EEL. BP. 41/0465

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

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

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942-2003 Class I
1/2 inch Brüel&Kjær 4180	93.93	-0.07	± 0.10	± 0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942-2003 Class I
1/2 inch Brüel&Kjær 4180	999.9	-0.1	± 1.5	± 1.0%

3. Total Distortion

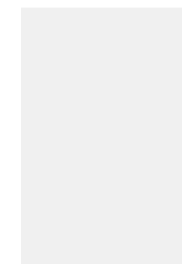
Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942-2003 Class I
1/2 inch Brüel&Kjær 4180	1.44	± 0.50	± 3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :



Approved by :



Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 28 Apr. 2022

Date of Issue : 28 Apr. 2022

Ref : 2011265042601787001

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End of Certificate

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

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FM.BL.MTC.002 Rev.4

Noise B 457/22

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	28 April 2022		
		Due Date	28 April 2023		
Calibration Data					
Sound Level Meter Data				Calibration Data	
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]
ACO-B11	ACO	6236	00152079	10 August 2022	Before Adjustment After Adjustment
ACO-B16	ACO	6236	00172039	10 August 2022	94.0 94.0
ACO-B18	ACO	6236	00172048	10 August 2022	94.1 94.0
ACO-B29	ACO	6236	00182011	10 August 2022	93.9 94.0
ACO-B33	ACO	6236	00182015	10 August 2022	94.0 94.0
ACO-B41	ACO	6236	00192032	10 August 2022	94.0 94.0
ACO-B43	ACO	6236	00192034	10 August 2022	94.0 94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.93 ±0.10 dB

Calibrated by :

Request No. 21-65/0378

MTC No. EEL. BP. 53/0365

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., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial No. : 192032

Microphone : Type 7052NR No.73330

Preamplifier : -

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AI-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-103A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistophone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 14 Mar. 2022

Date of Calibration : 30 Mar. 2022

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Request No. 21-65/0378

MTC No. EEL. BP. 53/0365

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

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

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

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

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (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 Calibration : 30 Mar. 2022

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test			Tolerance Limit Class 2 (±dB)	
	Measured Value (dB)		Deviation (dB)		
	Uncertainty (±dB)				
	Before adjust	After adjust			
113.92	114.4	113.9	0.0	0.30	1.4

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 114.9 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
20.1	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	14.9	0.10
C-Weighting	20.6	0.10
Flat	25.2	0.10

Date of Calibration : 30 Mar. 2022

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	0.1	0.1	0.0	0.40	2.0
1 000	-0.4	-0.4	-0.3	0.40	1.4
4 000	0.8	0.8	1.2	0.40	3.6

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	0.2	0.0	-0.1	0.20	2.5
125	0.0	0.0	-0.1	0.20	2.0
250	0.1	0.0	0.0	0.20	1.9
500	0.1	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	-0.1	-0.1	-0.1	0.20	2.6
4 000	-0.4	-0.4	-0.2	0.20	3.6
8 000	-0.6	-0.7	-0.3	0.20	5.6

Date of Calibration : 30 Mar. 2022

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5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.1	0.1	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
122	122.1	0.1	0.30	1.4
121	121.1	0.1	0.30	1.4
120	120.1	0.1	0.30	1.4
119	119.1	0.1	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4

Date of Calibration : 30 Mar. 2022

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

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	84.2	0.2	0.30	1.4
79	79.1	0.1	0.30	1.4
74	74.1	0.1	0.30	1.4
69	69.1	0.1	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.0	0.0	0.30	1.4
54	54.0	0.0	0.30	1.4
49	49.0	0.0	0.30	1.4
44	44.1	0.1	0.30	1.4
39	39.1	0.1	0.30	1.4
34	34.1	0.1	0.30	1.4
33	33.2	0.2	0.30	1.4
32	32.2	0.2	0.30	1.4
31	31.3	0.3	0.30	1.4
30	30.4	0.4	0.30	1.4

Date of Calibration : 30 Mar. 2022

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7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
40-130	125	125.1	0.1	0.30	1.4
30-120	115	115.0	0.0	0.30	1.4
20-110	105	105.0	0.0	0.30	1.4
20-100	95	95.0	0.0	0.30	1.4
20-90	85	85.0	0.0	0.30	1.4
20-80	75	75.0	0.0	0.30	1.4

8. Tone burst response

Time Weighing	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (dB)
Fast	200	115.8	-0.2	0.20	+1.3
	2	98.6	-0.4	0.20	+1.3; -2.8
	0.25	89.5	-0.5	0.20	+1.8; -5.3
Slow	200	109.5	-0.1	0.20	+1.3
	2	89.8	-0.2	0.20	+1.3; -5.3
	0.25	109.9	-0.1	0.20	+1.3
SEL	200	89.9	-0.1	0.20	+1.3; -2.8
	2	89.9	-0.1	0.20	+1.3; -2.8
	0.25	80.9	-0.1	0.20	+1.8; -5.3

Date of Calibration : 30 Mar. 2022

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9. Peak C sound level

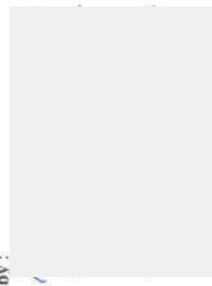
Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (+dB)	Tolerance limits Class 2 (+dB)
Complete cycle	125.4	125.7	0.3	0.20	2.4
Positive half cycle	124.4	124.2	-0.2	0.20	1.4
Negative half cycle	124.4	124.2	-0.2	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
Positive one-half cycle	Negative one-half cycle	0.0	0.30	1.8
133.0	133.0			

Calibrated by :

Approved by :



Director
Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 30 Mar. 2022

Date of Issue : 31 Mar. 2022

Ref : 2011265031401123003

End of Certificate

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0378

MTC No. EEL. BP. 52/0365

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., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Integrating Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial No. : 182011

Microphone : Type 7052NR No.69840

Preamplifier : -

Ambient Environment

Temperature : $(23 \pm 3) ^\circ\text{C}$

Relative Humidity : $(50 \pm 15) \%$

Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Briel&Kjaer 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Briel&Kjaer 2636 S/N 1537484.

Date of Receipt : 14 Mar. 2022

Date of Calibration : 4-5 Apr. 2022

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Request No. 21-65/0378

MTC No. EEL. BP. 52/0365

9. Power Amplifier Briel&Kjaer 2706 S/N 1517650.

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

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

12. Programmable Attenuator Tamagawa 1PA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (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 Calibration : 4-5 Apr. 2022

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FM.BLMTC.002 Rev.4

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test				Tolerance Limit Class 2 (±dB)
	Measured Value (dB)		Deviation (dB)	Uncertainty (±dB)	
	Before adjust	After adjust			
	116.1	113.9			
113.93			0.0	0.30	1.4

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 113.9 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
22.4	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	18.7	0.10
C-Weighting	32.1	0.10
Flat	38.9	0.10

Date of Calibration : 4-5 Apr. 2022

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	-0.1	-0.1	-0.1	0.40	2.0
1 000	-1.0	-1.0	-1.0	0.40	1.4
4 000	-0.2	0.0	-0.2	0.40	3.6

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	0.1	0.0	0.0	0.20	2.5
125	0.0	0.0	0.0	0.20	2.0
250	0.0	0.0	0.0	0.20	1.9
500	0.0	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	-0.2	0.0	0.0	0.20	2.6
4 000	-0.3	-0.3	0.0	0.20	3.6
8 000	-0.5	-0.4	-0.2	0.20	5.6

Date of Calibration : 4-5 Apr. 2022

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0378

MTC No. EEL. BP. 52/0365

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.1	0.1	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
122	122.0	0.0	0.30	1.4
121	120.9	-0.1	0.32	1.4
120	119.9	-0.1	0.30	1.4
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4

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

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.1	0.1	0.30	1.4
89	88.9	-0.1	0.30	1.4
84	84.1	0.1	0.30	1.4
79	79.2	0.2	0.30	1.4
74	74.0	0.0	0.30	1.4
69	68.9	-0.1	0.30	1.4
64	63.9	-0.1	0.30	1.4
59	58.9	-0.1	0.30	1.4
54	53.9	-0.1	0.30	1.4
49	48.9	-0.1	0.30	1.4
44	44.0	0.0	0.30	1.4
39	38.9	-0.1	0.30	1.4
34	34.0	0.0	0.30	1.4
33	33.2	0.2	0.30	1.4
32	32.2	0.2	0.30	1.4
31	31.3	0.3	0.30	1.4
30	30.3	0.3	0.30	1.4

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7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
40-130	125	125.0	0.0	0.30	1.4
30-120	115	115.0	0.0	0.30	1.4
20-110	105	105.0	0.0	0.30	1.4
20-100	95	95.0	0.0	0.30	1.4
20-90	85	84.9	-0.1	0.30	1.4
20-80	75	74.9	-0.1	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, T _b (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	115.9	-0.1	0.20	±1.3
	2	97.8	-1.2	0.20	+1.3; -2.8
	0.25	89.5	-0.5	0.20	+1.8; -5.3
Slow	200	109.5	-0.1	0.20	±1.3
	2	89.9	-0.1	0.20	+1.3; -5.3
	200	109.9	-0.1	0.20	±1.3
SEL	2	90.0	0.0	0.20	+1.3; -2.8
	0.25	80.9	-0.1	0.20	+1.8; -5.3

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MTC No. EEL. BP. 52/0365

9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	125.4	125.7	0.3	0.20	2.4
Positive half cycle	124.4	124.3	-0.1	0.20	1.4
Negative half cycle	124.4	124.3	-0.1	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	Negative one-half cycle	0.0	0.30	1.8
131.1	131.1			

Calibration

Approved by :

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre
Ref : 2011265031401123002

End of Certificate

8 / 8

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FM.BLMTC.002 Rev.4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0378

MTC No. EEL, BP. 55/0365

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., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description	: Sound Level Meter	Ambient Environment
Manufacturer	: ACO	Temperature : $(23 \pm 3) ^\circ\text{C}$
Model	: 6236	Relative Humidity : $(50 \pm 15) \%$
Serial No.	: 192027	Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$
Microphone	: Type 7052NR No.61756	
Preamplifier	: -	

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AI-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 14 Mar. 2022

Date of Calibration : 30 Mar. 2022

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4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0378

MTC No. EEL, BP. 55/0365

9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (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%.

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test			Tolerance Limit Class 2 (±dB)
	Measured Value (dB)		Deviation (dB)	
	Before adjust	After adjust		
113.92	115.1	113.9	0.0	0.30
				1.4

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 116.8 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
21.4	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	15.4	0.10
C-Weighting	20.9	0.10
Flat	24.8	0.10

Date of Calibration : 30 Mar. 2022

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FMBLMTC.002 Rev.4

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	0.3	0.3	0.2	0.40	2.0
1 000	-0.3	-0.3	-0.2	0.40	1.4
4 000	1.1	1.1	1.5	0.40	3.6

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	0.2	0.0	-0.1	0.20	2.5
125	0.1	0.1	0.0	0.20	2.0
250	0.1	0.0	0.0	0.20	1.9
500	0.1	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	-0.1	-0.1	0.0	0.20	2.6
4 000	-0.5	-0.4	-0.1	0.20	3.6
8 000	-0.6	-0.6	-0.3	0.20	5.6

Date of Calibration : 30 Mar. 2022

4 / 8

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FMBLMTC.002 Rev.4

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Fax. (66) 0 2579 8592
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5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	93.9	-0.1	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
122	122.1	0.1	0.30	1.4
121	121.1	0.1	0.30	1.4
120	120.1	0.1	0.30	1.4
119	119.1	0.1	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4

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

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	84.2	0.2	0.30	1.4
79	79.2	0.2	0.30	1.4
74	74.2	0.2	0.30	1.4
69	69.2	0.2	0.30	1.4
64	64.1	0.1	0.30	1.4
59	59.1	0.1	0.30	1.4
54	54.1	0.1	0.30	1.4
49	49.1	0.1	0.30	1.4
44	44.2	0.2	0.30	1.4
39	39.2	0.2	0.30	1.4
34	34.2	0.2	0.30	1.4
33	33.3	0.3	0.30	1.4
32	32.4	0.4	0.30	1.4
31	31.4	0.4	0.30	1.4
30	30.5	0.5	0.30	1.4

7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
40-130	125	125.0	0.0	0.30	1.4
30-120	115	115.0	0.0	0.30	1.4
20-110	105	105.0	0.0	0.30	1.4
20-100	95	95.0	0.0	0.30	1.4
20-90	85	84.9	-0.1	0.30	1.4
20-80	75	74.9	-0.1	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	115.9	-0.1	0.20	+1.3
	2	98.9	-0.1	0.20	+1.3; -2.8
	0.25	89.8	-0.2	0.20	+1.8; -5.3
Slow	200	109.4	-0.2	0.20	+1.3
	2	89.8	-0.2	0.20	+1.3; -5.3
	200	109.9	-0.1	0.20	+1.3
SEL	2	89.9	-0.1	0.20	+1.3; -2.8
	0.25	80.9	-0.1	0.20	+1.8; -5.3

Date of Calibration : 30 Mar. 2022

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9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	125.4	125.7	0.3	0.20	2.4
Positive half cycle	124.4	124.2	-0.2	0.20	1.4
Negative half cycle	124.4	124.2	-0.2	0.20	1.4

10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	Negative one-half cycle	0.0	0.30	1.8
133.0	133.0			

Calibrated

Approved by :

Director
Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 30 Mar. 2022

Date of Issue : 31 Mar. 2022

Ref : 201126503140123005

End of Certificate

8 / 8

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FM.BLMTC.002 Rev.4

Noise B_630_1/22

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	28 April 2022		
		Due Date	28 April 2023		
Calibration Data					
Sound Level Meter Data			Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]
ACO-B29	ACO	6236	00182011	25 November 2022	Before Adjustment 93.9 After Adjustment 94.0
ACO-B36	ACO	6236	00192027	25 November 2022	94.1 94.0
ACO-B43	ACO	6236	00192034	25 November 2022	94.0 94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.93 ± 0.10 dB

Calibrated by :

Signature of Calibrator

Signature of Client

Noise B_459_1/22

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	28 April 2022		
		Due Date	28 April 2023		
Calibration Data					
Sound Level Meter Data			Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]
ACO-B29	ACO	6236	00182011	12 August 2022	Before Adjustment 94.0 After Adjustment 94.0
ACO-B36	ACO	6236	00192027	12 August 2022	94.0 94.0
ACO-B41	ACO	6236	00192032	12 August 2022	94.0 94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.93 ± 0.10 dB

Calibrated by :

Signature of Calibrator

Signature of Client

เอกสารที่ 5-5

เอกสารสอบเทียบเครื่องมือการตรวจค่าความร้อน
ในสถานประกอบการ (Working Area)



CALIBRATION LABORATORY Co., LTD.

2/10-11, 14, 55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail: sale@cal-laboratory.com



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp[®]34

SERIAL NO. : TEL080034

CLID. NO. : 231801937

JOB CONTROL NO. : 211026102931

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

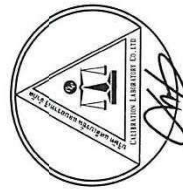
DATE OF RECEIVED : 26 October 2021

DATE OF ISSUED : 29 October 2021

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 :

Mongkol Yotsoontorn
Authorized Signatory
29 October 2021



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. Q21102931

F3-011-04/01-12

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@clcalibration



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REPORT OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp[®]34

SERIAL NO. : TEL080034

DATE OF CALIBRATION : 27 October 2021

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, PGC Model 9141-5116 S/N. 1304261.

TRACEABILITY :

The measurements are traceable to International System of Units (SI), through Thunder Scientific Corporation. Certificate No.18815, Due Date 11 November 2021.

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:2013)"

Certificate No. Q21102931

F3-011-04/01-12

page 2 of 3



@clcalibration



CALIBRATION LABORATORY CO., LTD.

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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	30.07	30.1	-0.03	0.40
35.0	34.92	34.8	+0.12	
40.0	40.09	39.9	+0.19	

2. CORRECTION OF TEMPERATURE : DRY

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	30.07	30.2	-0.13	0.40
35.0	34.92	35.0	-0.08	
40.0	40.09	40.2	-0.11	

3. CORRECTION OF TEMPERATURE : GLOBE

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	30.07	30.1	-0.03	0.40
35.0	34.92	34.8	+0.12	
40.0	40.09	39.9	+0.19	

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

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

End of Certificate

Certificate No. Q21102931

F3-011-04/01-12

page 3 of 3



@calibration



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CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M
MODEL / TYPE : QUESTemp° 34
SERIAL NO. : TEF050029
CLID. NO. : 231802269
JOB CONTROL NO. : 211026102932

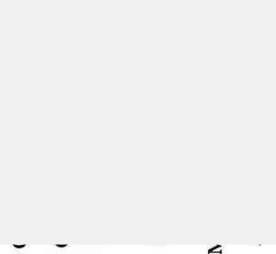
CUSTOMER : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24 ROAD., JOMPOL,
CHATUCHAK, BANGKOK 10900

DATE OF RECEIVED : 26 October 2021

DATE OF ISSUED : 29 October 2021

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Calibrated By :



Approved By :

29 October 2021

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. Q21102932

F3-011-04/01-12

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REPORT OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp^o 34

SERIAL NO. : TEF050029

DATE OF CALIBRATION : 27 October 2021

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. 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, 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 Thunder Scientific Corporation.
Certificate No. 18815, Due Date 11 November 2021.

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:2013)"

Certificate No. Q21102932
F3-011-04/01-12

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@calibration



CALIBRATION LABORATORY Co., LTD.

2710-11, 14, 55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com Email: sale@cal-laboratory.com



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	30.07	29.8	+0.27	0.40
35.0	34.92	34.6	+0.32	
40.0	40.09	39.7	+0.39	

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	30.07	30.0	+0.07	0.40
35.0	34.92	34.8	+0.12	
40.0	40.09	39.9	+0.19	

3. CORRECTION OF TEMPERATURE : GLOBE

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	30.07	29.8	+0.27	0.40
35.0	34.92	34.6	+0.32	
40.0	40.09	39.7	+0.39	

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

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

End of Certificate

Certificate No. Q21102932
F3-011-04/01-12

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@calibration



CALIBRATION LABORATORY CO., LTD.
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Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com Email: sale@cal-laboratory.com



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
[THERMAL ENVIRONMENT MONITOR]
MANUFACTURER : 3M
MODEL / TYPE : QUESTemp^o 30
SERIAL NO. : TGA090009
CLID. NO. : 231802281
JOB CONTROL NO. : 220423041340

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

DATE OF RECEIVED : 23 April 2022

DATE OF ISSUED : 27 April 2022

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

Calibrated By :



Approved By :

27 April 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. Q22041340

F3-011-04/01-12

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REPORT OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
[THERMAL ENVIRONMENT MONITOR]
MANUFACTURER : 3M
MODEL / TYPE : QUESTemp^o 30
SERIAL NO. : TGA090009
DATE OF CALIBRATION : 26 April 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. 36151.

Temperature & Humidity Chamber, PGC Model 9141-5114 S/N.0802282.

TRACEABILITY :

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

Certificate No. 19317, Due Date 09 July 2022.

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:2011)"

Certificate No. Q22041340

F3-011-04/01-12

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CALIBRATION LABORATORY Co., LTD.

2710-11, 14, 35 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail: sale@cal-laboratory.com



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	30.00	29.7	+0.30	0.40
35.0	34.99	34.7	+0.29	
40.0	39.97	39.6	+0.37	

2. CORRECTION OF TEMPERATURE : DRY

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	30.00	29.7	+0.30	0.40
35.0	34.99	34.6	+0.39	
40.0	39.97	39.6	+0.37	

3. CORRECTION OF TEMPERATURE : GLOBE BULB

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	30.00	29.6	+0.40	0.40
35.0	34.99	34.7	+0.29	
40.0	39.97	39.7	+0.27	

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

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

End of Certificate

Certificate No. Q22041340

F3-011-04/01-12





CALIBRATION LABORATORY CO., LTD.
2/10-11, 14, 55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
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Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail: sale@cal-laboratory.com

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp[®]32

SERIAL NO. : TPH050041

CLID. NO. : 231801942

JOB CONTROL NO. : 220815082002

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

DATE OF RECEIVED : 15 August 2022

DATE OF ISSUED : 20 August 2022

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

Calibrated By :



Approved By :

Authorized Signatory

20 August 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. Q22082002
F3-011-04/01-12

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@calibration

REPORT OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp[®]32

SERIAL NO. : TPH050041

DATE OF CALIBRATION : 18 August 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, PGC Model 9141-5116 S/N. 1304261.

TRACEABILITY :

The measurements are traceable to International System of Units (SI), through Thunder 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 $k = 2,00$ 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. Q22082002
F3-011-04/01-12

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@calibration



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	29.98	30.0	-0.02	0.40
35.0	34.98	34.7	+0.28	
40.0	40.00	39.7	+0.30	

Note. * means Calibrations marked " Not TISI Accredited " in this Certificate have been included for completeness.

2. CORRECTION OF TEMPERATURE [DRY]

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.98	30.2	-0.22	0.40
35.0	34.98	34.9	+0.08	
40.0	40.00	39.7	+0.30	

3. CORRECTION OF TEMPERATURE [GLOBE BULB]

Test point (° C)	Actual Temperature (° C)	DUC Reading (° C)	Correction (° C)	Uncertainty ± (° C)
30.0	29.98	30.2	-0.22	0.40
35.0	34.98	34.9	+0.08	
40.0	40.00	39.8	+0.20	

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 OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M
MODEL / TYPE : QUESTemp[®]32
SERIAL NO. : TPE070001
CLID. NO. : 231801941
JOB CONTROL NO. : 211125114743

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

DATE OF RECEIVED : 25 November 2021

DATE OF ISSUED : 29 November 2021

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

Calibrated By :

7



Approved By :

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



REPORT OF CALIBRATION

FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp³²

SERIAL NO. : TPE070001

DATE OF CALIBRATION : 26 November 2021

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. 36151.
Temperature & Humidity Chamber, PGC Model 9141-5114 S/N.0802282.

TRACEABILITY :

The measurements are traceable to International System of Units (SI), through Thunder Scientific Corporation, Certificate No. 19317, Due Date 09 July 2022.

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:2013)"

Certificate No. Q21114743

F3-011-04/01-12

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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	29.97	29.9	+0.07	0.40
35.0	34.95	34.9	+0.05	
40.0	39.93	39.9	+0.03	

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	29.97	30.0	-0.03	0.42
35.0	34.95	34.9	+0.05	
40.0	39.93	39.9	+0.03	

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	29.97	29.9	+0.07	0.40
35.0	34.95	34.9	+0.05	
40.0	39.93	40.1	-0.17	

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

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

End of Certificate

Certificate No. Q21114743

F3-011-04/01-12

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Heat Stress WBGT Meter Verification Report					
Verification Data					
Heat Stress WBGT Meter No.	: B11	Verification Date	: 12 August 2022		
Brand	: 3M	Ambient Temp.	: 24.5 °C		
Model	: QUESTemp 34	Barometric Pressure	: 1011 mmbar		
Serial No.	: TEL080034	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	47.0	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					

Verified by : -

Heat Stress WBGT Meter Verification Report					
Verification Data					
Heat Stress WBGT Meter No.	: B17	Verification Date	: 12 August 2022		
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	12.6	-0.1		± 0.5	
Dry Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)		Tolerance Limit (°C)	
47.1	47.0	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					

Yes

Heat B169_1/22

Heat Stress WBGT Meter Verification Report					
Verification Data					
Heat Stress WBGT Meter No.	: B11	Verification Date	: 25 November 2022		
Brand	: 3M	Ambient Temp.	: 24.5 °C		
Model	: QUESTemp [®] 34	Barometric Pressure	: 1011 mmbar		
Serial No.	: TEL080034	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	12.4	0.1	± 0.5		
Dry Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
47.1	47.0	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					

Verified by :

Heat B116_3/22

Heat Stress WBGT Meter Verification Report					
Verification Data					
Heat Stress WBGT Meter No.	: B18	Verification Date	: 12 August 2022		
Brand	: 3M	Ambient Temp.	: 24.5 °C		
Model	: QUESTemp [®] 32	Barometric Pressure	: 1011 mmbar		
Serial No.	: TGA090009	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	47.0		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					

Verified by :

Heat B169_3/22

Heat Stress WBGT Meter Verification Report						
Verification Data						
Heat Stress WBGT Meter No.	: B26	Verification Date	: 25 November 2022			
Brand	: 3M	Ambient Temp.	: 24.5 °C			
Model	: QUESTemp [®] 32	Barometric Pressure	: 1011 mmbar			
Serial No.	: TP1050041	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	12.4	0.1	± 0.5			
Dry Probe Temperature Measurement						
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)			
47.1	47.0	0.1	± 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						

Verified by : _____

Heat B169_2/22

Heat Stress WBGT Meter Verification Report						
Verification Data						
Heat Stress WBGT Meter No.	: R12	Verification Date	: 25 November 2022			
Brand	: 3M	Ambient Temp.	: 24.5 °C			
Model	: QUESTemp 32	Barometric Pressure	: 1011 mmhgr			
Serial No.	: TPE070001	Relative Humidity	: 49 %			
Verification Module (Electronic Sensor Check) :						
Verification Module No. :	21	WB = <u>12.5</u> °C , DB = <u>47.1</u> °C , G = <u>69.3</u> °C				
Result of Verification : Without Adjustment						
Wet Probe Temperature Measurement						
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)			
12.5	12.4	0.1	± 0.5			
Dry Probe Temperature Measurement						
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)			
47.1	47.0	0.1	± 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						

Verified by : _____