

# ภาคผนวกที่ 5

## เอกสารการสอบเทียบเครื่องมือ

- |            |  |
|------------|--|
| เอกสาร 5-1 | เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศในบรรยากาศ                                      |
| เอกสาร 5-2 | เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศจากปล่อง  |
| เอกสาร 5-3 | เอกสารสอบเทียบเครื่องมือการตรวจคุณภาพอากาศในสถานประกอบการ<br>(Working Area)                  |
| เอกสาร 5-4 | เอกสารสอบเทียบเครื่องมือการตรวจระดับเสียงโดยทั่วไปและเสียงในสถาน<br>ประกอบการ (Working Area) |
| เอกสาร 5-5 | เอกสารสอบเทียบเครื่องมือการตรวจค่าความร้อนในสถานประกอบการ<br>(Working Area)                  |

ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง  
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม

รายการตรวจวัด	เครื่องมือเก็บตัวอย่าง	เครื่องมือตรวจวิเคราะห์
	ชื่อเครื่องมือ	ชื่อเครื่องมือ
คุณภาพอากาศในบรรยากาศ		
TSP	- High Volume Air Sampler No. B02, B18, B36	- Digital Balance
PM <sub>10</sub>	- High Volume PM-10 Air Sampler No. B03, B24, B34	- Digital Balance
SO <sub>2</sub>	- Gas Sampler Box No. B01, B08, B17	- Spectrophotometer
NO <sub>2</sub>	- NO <sub>2</sub> Analyzer No. B10, B18, B20	- NO <sub>2</sub> Analyzer No.B10, B18, B20
คุณภาพอากาศจากปล่อง		
TSP	- Console No. B01 - Pitot Tube No. B035	- Digital Balance
SO <sub>2</sub>	- Personal Pump SKC No. B10 - Rotameter No.B07	-
NO <sub>x</sub>	- Vacuum Gauge	- Spectrophotometer
คุณภาพอากาศในสถานประกอบการ		
Total Dust	- Personal Pump SKC No. B04, B23, B29, B46, B53, B56, - Rotameter No. H-B01, B03	- Digital Balance
ระดับเสียงในบรรยากาศ		
L <sub>eq</sub> 24 hr, L <sub>eq</sub> 1 hr, L <sub>max</sub> และ L <sub>90</sub>	- Acoustic Calibrator - Sound Level Meter No. B01, B07, B08, B09, B11, B19, B23	-
ระดับเสียงในสถานประกอบการ		
L <sub>eq</sub> 8 hr	- Acoustic Calibrator - Sound Level Meter No. B18, B29, B33 , R40	-
ระดับความร้อนในสถานประกอบการ		
WBGT	- Digital Thermometer with Probe No. B05, B07, B11, B21, B28	-

**เอกสารที่ 5-1**

เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศ  
ในบรรยากาศ

High Volume Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard				S/N : 3611
Calibration Data				
High Volume Air Sampler Data		Calibration Data		
Recorder No.	Blower No.	Date	Actual Flowrate (l/min)	R <sup>2</sup>
B01	B01	01/02/2023	y = 1.278x-5.652	0.997
B02	B02	02/02/2023	y = 1.147x+0.663	0.999
B03	B03	01/02/2023	y = 1.133x-0.622	0.995
B04	B04	01/02/2023	y = 1.229x-4.835	0.996
B05	B05	02/02/2023	y = 1.280x-6.358	0.997
B06	B06	01/02/2023	y = 1.251x-5.438	0.999
B07	B07	03/02/2023	y = 1.165x-3.515	0.996
B08	B08	03/02/2023	y = 1.289x-7.559	0.997
B09	B09	01/02/2023	y = 1.198x-2.843	0.998
B10	B10	01/02/2023	y = 1.128x+0.785	0.999
B11	B11	02/02/2023	y = 1.138x-1.752	0.999
B12	B12	01/02/2023	y = 1.195x-4.080	0.998
B13	B13	01/02/2023	y = 1.254x-5.913	0.999
B14	B14	03/02/2023	y = 1.291x-7.822	0.999
B15	B15	01/02/2023	y = 1.149x-1.829	0.997
B16	B16	01/02/2023	y = 1.287x-7.502	0.997
B17	B17	02/02/2023	y = 1.207x-4.147	1.000
B18	B18	01/02/2023	y = 1.277x-7.238	0.999
B19	B19	03/02/2023	y = 1.243x-6.520	0.995
B20	B20	01/02/2023	y = 1.287x-7.056	1.000
B21	B21	03/02/2023	y = 1.141x-1.101	0.999
B22	B22	03/02/2023	y = 1.221x-5.534	0.996
B23	B23	02/02/2023	y = 1.197x-4.328	0.995
B24	B24	01/02/2023	y = 1.159x-2.269	0.999
B25	B25	01/02/2023	y = 1.050x+2.684	0.998
B26	B26	03/02/2023	y = 1.253x-6.203	0.997
B27	B27	03/02/2023	y = 1.220x-5.822	0.997
B28	B28	01/02/2023	y = 1.251x-6.762	0.999
B29	B29	01/02/2023	y = 1.201x-3.793	0.998
B30	B30	03/02/2023	y = 1.242x-6.540	0.995
B31	B31	03/02/2023	y = 1.255x-6.508	0.999
B32	B32	02/02/2023	y = 1.249x-6.292	0.997
B33	B33	02/02/2023	y = 1.260x-5.168	0.997
B34	B34	01/02/2023	y = 1.272x-7.454	1.000

Calibrated by :

Approved 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 <sup>2</sup>	
B35	B35	01/02/2023	y = 1.194x-4.992	0.995	
B36	B36	02/02/2023	y = 1.201x-3.946	0.997	
B37	B37	02/02/2023	y = 1.284x-6.745	0.997	
B38	B38	02/02/2023	y = 1.250x-6.733	0.998	
B39	B39	01/02/2023	y = 1.268x-7.186	0.998	
B40	B40	03/02/2023	y = 1.214x-4.324	0.998	
B41	B41	03/02/2023	y = 1.176x-2.734	0.999	
B42	B42	02/02/2023	y = 1.283x-8.167	0.997	
B43	B43	02/02/2023	y = 1.197x-3.772	0.996	
B44	B44	02/02/2023	y = 1.249x-7.038	0.995	
R01	R01	01/02/2023	y = 1.287x-8.462	0.998	
R02	R02	01/02/2023	y = 1.239x-6.678	0.998	
R03	R03	03/02/2023	y = 1.254x-7.928	0.999	
R04	R04	02/02/2023	y = 1.206x-3.694	0.999	
R05	R05	02/02/2023	y = 1.237x-6.503	0.997	
R06	R06	02/02/2023	y = 1.239x-4.541	0.995	
R07	R07	03/02/2023	y = 1.060x+1.983	0.999	
R08	R08	03/02/2023	y = 1.274x-8.050	0.998	
R09	R09	02/02/2023	y = 1.280x-7.005	0.998	
R10	R10	03/02/2023	y = 1.244x-5.980	1.000	
R11	R11	03/02/2023	y = 1.097x-0.462	0.998	
R12	R12	02/02/2023	y = 1.151x-2.727	0.995	
R13	R13	02/02/2023	y = 1.134x-1.526	1.000	
R14	R14	02/02/2023	y = 1.173x-2.510	0.999	
R15	R15	01/02/2023	y = 1.131x-2.129	0.998	
R16	R16	01/02/2023	y = 1.202x-5.830	0.998	
R17	R17	01/02/2023	y = 1.182x-3.281	0.998	
R18	R18	03/02/2023	y = 1.217x-5.060	0.999	
R19	R19	03/02/2023	y = 1.228x-6.084	0.996	
R20	R20	03/02/2023	y = 1.277x-9.434	0.997	

Calibrated by :

Approved by :

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 <sup>2</sup>
B01	B01	02/02/2023	y = 1.210x - 0.261	0.997
B02	B02	02/02/2023	y = 1.046x - 2.414	0.998
B03	B03	02/02/2023	y = 1.199x - 4.047	0.996
B04	B04	02/02/2023	y = 1.288x - 7.602	0.997
B05	B05	01/02/2023	y = 1.222x - 4.886	1.000
B06	B06	01/02/2023	y = 1.210x - 3.612	0.996
B07	B07	03/02/2023	y = 1.270x - 6.088	0.999
B08	B08	01/02/2023	y = 1.277x - 5.288	0.998
B09	B09	03/02/2023	y = 1.289x - 6.478	0.999
B10	B10	03/02/2023	y = 1.266x - 6.106	0.997
B11	B11	01/02/2023	y = 1.258x - 6.917	0.995
B12	B12	02/02/2023	y = 1.192x - 3.640	0.998
B13	B13	02/02/2023	y = 1.289x - 7.913	0.998
B14	B14	02/02/2023	y = 1.250x - 4.233	0.999
B15	B15	01/02/2023	y = 1.118x - 0.802	0.999
B16	B16	03/02/2023	y = 1.297x - 3.106	0.998
B17	B17	01/02/2023	y = 1.204x - 4.477	0.996
B18	B18	02/02/2023	y = 1.176x - 1.624	0.998
B19	B19	02/02/2023	y = 1.097x + 1.230	0.999
B20	B20	03/02/2023	y = 1.188x - 4.372	0.999
B21	B21	03/02/2023	y = 1.156x - 0.146	0.996
B22	B22	03/02/2023	y = 1.269x - 6.647	0.998
B23	B23	02/02/2023	y = 1.197x - 2.685	1.000
B24	B24	02/02/2023	y = 1.251x - 6.437	0.995
B25	B25	01/02/2023	y = 1.144x - 2.851	0.997
B26	B26	01/02/2023	y = 1.249x - 5.704	0.996
B27	B27	01/02/2023	y = 1.241x - 5.428	0.997
B28	B28	01/02/2023	y = 1.198x - 4.626	0.998
B29	B29	02/02/2023	y = 1.244x - 7.658	0.997
B30	B30	02/02/2023	y = 1.246x - 7.229	0.997
B31	B31	02/02/2023	y = 1.178x - 0.243	0.995
B32	B32	03/02/2023	y = 1.201x - 2.954	0.998
B33	B33	03/02/2023	y = 1.168x - 1.341	0.997
B34	B34	01/02/2023	y = 1.237x - 2.684	0.995

Calibrated by :

Approved by :

(Mr. Adul Dangdom)

Gas Sampler Box Calibration Report

Calibration Method : Dry Cal Primary Flowmeter			Model : Dry Cal DCL-ML		S/N : 136164		
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	Standard Condition	
B01	2 (A&B)	01/03/2023	200	200.4	199.0	200.6	199.1
B02	2 (A&B)	01/03/2023	200	200.5	199.1	200.7	199.2
B03	2 (A&B)	01/03/2023	200	200.4	199.0	200.8	199.3
B04	2 (A&B)	02/03/2023	200	200.5	199.1	200.4	199.0
B05	2 (A&B)	01/03/2023	200	200.7	199.2	200.9	199.4
B06	2 (A&B)	03/03/2023	200	200.8	199.4	200.5	199.1
B07	2 (A&B)	03/03/2023	200	200.7	199.2	200.4	199.0
B08	2 (A&B)	03/03/2023	200	200.5	199.1	200.5	199.1
B09	2 (A&B)	03/03/2023	200	200.7	199.2	200.7	199.3
B10	2 (A&B)	01/03/2023	200	200.4	199.0	200.5	199.1
B11	2 (A&B)	02/03/2023	200	200.6	199.1	200.7	199.2
B12	2 (A&B)	02/03/2023	200	200.5	199.0	200.5	199.1
B13	2 (A&B)	01/03/2023	200	200.6	199.1	200.4	199.0
B14	2 (A&B)	03/03/2023	200	200.7	199.3	200.5	199.1
B15	2 (A&B)	03/03/2023	200	200.4	199.0	200.4	199.0
B16	2 (A&B)	03/03/2023	200	200.6	199.1	200.5	199.1
B17	2 (A&B)	01/03/2023	200	200.5	199.0	200.7	199.3

Calibrated by :

Approved by :



CALIBRATION REPORT

CHEMILUMINESCENT NO / NO<sub>2</sub> / NO<sub>x</sub> ANALYZER

DATE :	20 March 2023	BRAND :	API	MODEL :	200E
NO.	NOX-B10	SERIAL NO.	4465		
Calibrator (Dilution System)					
Brand	: API				
Last Cal. Date	: 04 August 2022				
Model	: 700				
Serial No.	: 911				
Reference Standard Gas					
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				

CALIBRATION SETTING

Span	Initial Reading (Before Adj.) PPB	Final Reading (After Adj.) PPB
Set Point	Expected Concentration	Analyzer Response
Zero	0	-0.10
NO Span	400	398.7
NO <sub>x</sub> Span	400	400.1
%Df	-0.075	1.005
Slope	0	1.009

API Model 200E NO<sub>x</sub> 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	79	cc/min	80 ± 15
PMT	103.2	mV	-20 - 150
AZERO	93.9	mV	-20 - 150
HVPS	674	V	420 - 900 constant
RCCELL TEMP	50.1	°C	50 ± 1
BOX TEMP	29.3	°C	8 - 48
PMT TEMP	7.5	°C	7 ± 2
MOLY TEMP	314.9	°C	315 ± 5
RCCELL PRESS	8.3	IN-Hg-A	2 - 10 constant
SAMPLE PRESS	28.5	IN-Hg-A	25 - 30 constant
NO Span Conc	400	PPB	20 - 20,000
NO <sub>x</sub> Span Conc	400	PPB	20 - 20,000
NO Slope	1.005	-	1.0 ± 0.3
NO <sub>x</sub> Slope	1.009	-	1.0 ± 0.3
NO Offset	1.1	mV	-20 to +150
NO <sub>x</sub> Offset	0.7	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 : A Approved by :

CALIBRATION REPORT

CHEMILUMINESCENT NO / NO<sub>2</sub> / NO<sub>x</sub> ANALYZER

DATE :	26 March 2023	BRAND :	API	MODEL :	TML-41M
NO.	NOX-B18	SERIAL NO.	NO7543		
Calibrator (Dilution System)					
Brand	: API				
Last Cal. Date	: 04 August 2022				
Model	: 700				
Serial No.	: 911				
Reference Standard Gas					
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				

CALIBRATION SETTING

Span	Initial Reading (Before Adj.) PPB	Final Reading (After Adj.) PPB
Set Point	Expected Concentration	Analyzer Response
Zero	0	-0.10
NO Span	400	400.1
NO <sub>x</sub> Span	400	400.3
%Df	0.025	1.008
Slope	0	1.011

API Model TML-41M NO<sub>x</sub> 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	513	cc/min	500 ± 50
OZONE FLOW	79	cc/min	80 ± 15
PMT	103.3	mV	-20 - 150
AZERO	94.1	mV	-20 - 150
HVPS	670	V	420 - 900 constant
RCCELL TEMP	50.2	°C	50 ± 1
BOX TEMP	29.4	°C	8 - 48
PMT TEMP	7.0	°C	7 ± 2
MOLY TEMP	315.1	°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 <sub>x</sub> Span Conc	400	PPB	20 - 20,000
NO Slope	1.008	-	1.0 ± 0.3
NO <sub>x</sub> Slope	1.011	-	1.0 ± 0.3
NO Offset	1.6	mV	-20 to +150
NO <sub>x</sub> Offset	1.0	mV	-20 to 150
Stability at Zero	0.1	PPB	< 0.2
Stability at Span	0.2	PPB	< 2 ppb @ 400 ppb span gas

Calibrated by : Approved by :

CALIBRATION REPORT

CHEMILUMINESCENT NO / NO<sub>2</sub> / NO<sub>x</sub> ANALYZER

DATE :	26 March 2023	BRAND :	API	MODEL :	TML-41M
NO.	NOX-B20			SERIAL NO.	N02782

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 2023	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
Set Point		
Zero	Expected Concentration	Analyzer Response
	0	-0.11
NO Span	400	400.2
NO <sub>x</sub> Span	400	400.4
		% Dif
		0.050
		Slope
		0
		400.0
		1.010
		400.0
		1.014

API Model TML-41M NO<sub>x</sub> 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	103.1	mV	-20 - 150
AZERO	93.7	mV	-20 - 150
HVPS	671	V	420 - 900 constant
RCCELL TEMP	50.4	°C	50 ± 1
BOX TEMP	29.2	°C	8 - 48
PMT TEMP	7.3	°C	7 ± 2
MOLY TEMP	315.4	°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 <sub>x</sub> Span Conc	400	PPB	20 - 20,000
NO Slope	1.010	-	1.0 ± 0.3
NO <sub>x</sub> Slope	1.014	-	1.0 ± 0.3
NO Offset	1.7	mV	-20 to +150
NO <sub>x</sub> 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





CERTIFICATE No : 23M2445  
REFERENCE No : 68471-5

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE  
MANUFACTURER : METTLER TOLEDO  
MODEL : XSR105DU  
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 : [REDACTED]  
CALIBRATION DATE : 10-Mar-23  
APPROVED BY : [REDACTED]  
ISSUED DATE : 16-Mar-23  
RECEIVED DATE : 10-Mar-23

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



CERTIFICATE No : 23M2445

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL BALANCE  
MANUFACTURER : METTLER TOLEDO  
ID No : BA 10/62  
AIR PRESSURE : 1010mbar  $\pm$  1mbar  
AMBIENT TEMPERATURE : 23°C  $\pm$  1°C  
RELATIVE HUMIDITY : 49%RH  $\pm$  10% RH  
CONDITION OF THIS RESULTS OF CALIBRATION  
1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT  
STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO  
TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS  
MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE  
PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED  
ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.  
2. REFERENCE STANDARD INSTRUMENTS :-  
1) STANDARD WEIGHT SET : E2  
2) STANDARD WEIGHT : E2  
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

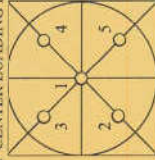
SERIAL No : QK-1-151  
15843  
CERTIFICATE No : M2302013S  
M2302014S  
DUE DATE : 02-Feb-25  
02-Feb-25

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL
2. TARE FUNCTION : NORMAL
3. REPEATABILITY OF READING AT 100 g WAS 0 g
4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (±g)
0.00	0.00000	0.00000	0.000039
0.02	0.02000	0.00000	0.000039
0.10	0.10000	0.00000	0.000039
0.20	0.20000	0.00000	0.000040
0.50	0.50000	0.00000	0.000040
1.00	1.00001	-0.00001	0.000041
2.00	2.00000	0.00000	0.000042
5.00	5.00000	0.00000	0.000046
10.00	10.00004	-0.00004	0.000053
20.00	20.00005	-0.00005	0.000067
50.00	50.00005	-0.00005	0.00011
100.00	100.00009	-0.00009	0.00019
120.00	120.00015	-0.00015	0.00019

### 5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.00000
2	50.00003
3	50.00000
4	49.99997
5	50.00003
OFF-CENTER LOADING	0.00003

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

END OF CALIBRATION REPORT





## Calibration Certificate

**Equipment :** UV-VIS SPECTROPHOTOMETER  
**Manufacturer :** PERKINELMER  
**Model :** LAMBDA 25  
**Serial No.:** 501S14123010  
**ID No.:** SP03/58  
**Calibration Mode :** WAVELENGTH ACCURACY  
PHOTOMETRIC ACCURACY  
**Condition As Found :** GOOD  
**Customer :** S.P.S. CONSULTING SERVICE CO., LTD.  
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN ROAD,  
CHOMPON, CHATUCHAK,  
BANGKOK 10900, THAILAND.  
**Location :** ORGANIC LABORATORY IV  
**Ambient Temperature :** ( 24.4 ± 5 ) °C  
**Relative Humidity :** ( 60.1 ± 25 ) %  
**Received Date :** 30 AUGUST 2022  
**Calibration Date :** 30 AUGUST 2022  
**Date of Issue :** 31 AUGUST 2022

**Calibrated by :**

**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 :

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-1N2N3N	13877	87600	15/10/2022
Potassium dichromate solutions	RM-0204060810	14204	87614	16/10/2022
Potassium Iodide solution	-	KI-0701-001	CI-0090-22	08/04/2024

1. Certified reference materials

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	278.3	0.17	0.16	2.00
	361.25	361.4	0.15	0.16	2.00
	467.82	467.8	-0.02	0.16	2.00
RM-DL	536.56	536.5	-0.06	0.16	2.00
	640.50	640.5	0.00	0.16	2.00
	740.09	740.0	-0.09	0.16	2.00
	864.94	865.2	0.26	0.16	2.00

UUC\* = Unit Under Calibration

Continuation of Calibration Certificate

Cert. No. : SP22018  
Job No. : VC6SP0008  
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	1.0539	0.0015	0.0028	2.00
		29914	0.7	0.7454	0.7459	0.0005	0.0029	2.00
		29381	0.5	0.5426	0.5426	0.0000	0.0028	2.00
	546.1	29360	1.0	0.9822	0.9810	-0.0012	0.0028	2.00
		29914	0.7	0.6962	0.6960	-0.0002	0.0028	2.00
		29381	0.5	0.5076	0.5070	-0.0006	0.0029	2.00
	590.0	29360	1.0	1.0221	1.0202	-0.0019	0.0028	2.00
		29914	0.7	0.7238	0.7230	-0.0008	0.0029	2.00
		29381	0.5	0.5364	0.5360	-0.0004	0.0031	2.00
	635.0	29360	1.0	0.9751	0.9732	-0.0019	0.0028	2.00
		29914	0.7	0.6912	0.6902	-0.0010	0.0029	2.00
		29381	0.5	0.5214	0.5210	-0.0004	0.0032	2.00
Material	Wavelength (nm)	Solution (mg/l)	Certified Absorbance (A)	UUC* Reading Absorbance (A)	Error (A)	Uncertainty ± (A)	k Factor	
RM-0204060810	235.0	20	0.2436	0.2419	-0.0017	0.0101	2.00	
		40	0.4905	0.4855	-0.0050	0.0115	2.00	
		60	0.7453	0.7388	-0.0065	0.0067	2.00	
	80	0.9920	0.9839	-0.0081	0.0071	2.00		
		100	1.2487	1.2414	-0.0073	0.0073	2.00	

UUC\* = Unit Under Calibration

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

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

Stray Light** UUC* Reading at 220 nm	
Transmission T(%)	Absorbance(A)
0.0107	3.9886

\*\*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 5-2

เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศ  
จากปล่อง

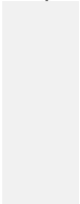



Pitot Tube Calibration Report

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

Remark : Accept value of Cp (test) is  $0.84 \pm 0.01$

Calibrated by : 	Approved by : 
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Console Calibration Report

Calibration Method	Critical Orifices
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Calibration Data				
Console Data		Calibration Data		
No.	Serial No.	Date	y	DH <sub>0</sub> (mmH <sub>2</sub> O)
B01	1563	02/03/2023	0.998	50.11
B02	8002514	03/03/2023	1.004	49.25
B03	1503016	03/03/2023	1.002	50.62
B04	00006659	02/03/2023	1.004	50.14
B05	00007428	03/03/2023	1.001	49.76
R01	1561	01/03/2023	0.997	49.86
R02	8002513	03/03/2023	0.996	49.93
R03	1570	02/03/2023	1.003	49.57
R04	8002519	01/03/2023	1.002	48.90
R05	1503015	01/03/2023	0.998	50.20

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

Accept Value of  $\Delta H_0$  (test) is  $46.7 \pm 6.4$  (mmH<sub>2</sub>O)

Calibrated by : 	Approved by : 
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Personal Pump Calibration Report											
Calibration Method : Dry Cal Primary Flowmeter					Model : Defender 510-H						
Environmental Conditions					S/N : 136164						
Temperature					± 3 °C						
Pressure					± 15 mmbar						
Personal Pump Data					Calibration Data						
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)				Value From Calibration Curve		
					Setting				Actual (Q std.)		
					1	2	3	1	2	3	R <sup>2</sup>
B01	SKC	224-PCXR4	262101	03/01/2023	1,000	1,500	2,000	993	1,497	1,998	1,000
B02	SKC	224-PCXR4	826166	03/01/2023	1,000	1,500	2,000	1,003	1,505	2,001	0.999
B03	SKC	224-PCXR4	612968	03/01/2023	1,000	1,500	2,000	996	1,494	2,000	0.999
B04	SKC	224-PCXR4	802804	04/01/2023	1,000	1,500	2,000	1,000	1,502	1,995	1,000
B05	SKC	224-PCXR4	612603	04/01/2023	1,000	1,500	2,000	1,003	1,500	2,003	0.999
B06	SKC	224-PCXR4	262188	03/01/2023	1,000	1,500	2,000	985	1,508	2,005	1,000
B07	SKC	224-PCXR4	634262	03/01/2023	1,000	1,500	2,000	998	1,492	1,995	1,000
B08	SKC	224-PCXR4	626100	03/01/2023	1,000	1,500	2,000	1,003	1,500	2,003	0.999
B09	SKC	224-PCXR4	626479	03/01/2023	1,000	1,500	2,000	996	1,490	1,994	0.999
B10	SKC	224-PCXR4	081950	03/01/2023	1,000	1,500	2,000	992	1,503	2,001	1,000
B11	SKC	224-PCXR4	564315	05/01/2023	1,000	1,500	2,000	996	1,490	1,999	1,000
B12	SKC	224-PCXR4	034666	05/01/2023	1,000	1,500	2,000	1,003	1,503	2,003	0.999
B13	SKC	224-PCXR4	402073	05/01/2023	1,000	1,500	2,000	995	1,500	1,998	1,000
B14	SKC	224-PCXR4	626313	04/01/2023	1,000	1,500	2,000	999	1,491	1,988	1,000
B15	SKC	224-PCXR4	626474	04/01/2023	1,000	1,500	2,000	1,001	1,502	2,005	1,000
B16	SKC	224-PCXR4	626477	04/01/2023	1,000	1,500	2,000	994	1,504	2,001	0.999
B17	SKC	224-PCXR4	626860	04/01/2023	1,000	1,500	2,000	997	1,494	1,991	1,000
B18	SKC	224-PCXR4	691484	04/01/2023	1,000	1,500	2,000	1,003	1,500	2,001	0.999
B19	SKC	224-PCXR4	691699	03/01/2023	1,000	1,500	2,000	993	1,503	1,998	1,000
B20	SKC	224-PCXR4	691887	03/01/2023	1,000	1,500	2,000	992	1,504	1,999	0.999
B21	SKC	224-PCXR4	691531	03/01/2023	1,000	1,500	2,000	993	1,499	1,994	1,000
B22	SKC	224-PCXR4	691654	03/01/2023	1,000	1,500	2,000	1,003	1,501	2,003	0.999
B23	SKC	224-PCXR4	796393	03/01/2023	1,000	1,500	2,000	992	1,507	2,002	0.999
B24	SKC	224-PCXR4	826363	03/01/2023	1,000	1,500	2,000	1,000	1,502	2,000	1,000
B25	SKC	224-PCXR4	796489	03/01/2023	1,000	1,500	2,000	999	1,496	1,995	0.999
B26	SKC	224-PCXR4	796479	03/01/2023	1,000	1,500	2,000	1,001	1,503	2,001	1,000
B27	SKC	224-PCXR4	691673	04/01/2023	1,000	1,500	2,000	994	1,503	2,002	0.999
B28	SKC	224-PCXR4	691670	04/01/2023	1,000	1,500	2,000	1,002	1,500	2,002	0.999
B29	SKC	224-PCXR4	626472	04/01/2023	1,000	1,500	2,000	1,000	1,498	1,998	1,000
B30	SKC	224-PCXR4	691489	03/01/2023	1,000	1,500	2,000	1,004	1,510	2,004	0.999
B31	SKC	224-PCXR4	691509	03/01/2023	1,000	1,500	2,000	992	1,497	1,996	1,000
B32	SKC	224-PCXR4	691687	03/01/2023	1,000	1,500	2,000	991	1,504	2,001	0.999
B33	SKC	224-PCXR4	091766	05/01/2023	1,000	1,500	2,000	993	1,498	1,995	1,000
B34	SKC	224-PCXR4	612662	05/01/2023	1,000	1,500	2,000	993	1,498	1,995	1,000
B35	SKC	224-PCXR4	602682	05/01/2023	1,000	1,500	2,000	999	1,496	1,999	1,000
B36	SKC	224-PCXR4	626164	03/01/2023	1,000	1,500	2,000	994	1,506	1,999	0.999
B37	SKC	224-PCXR4	626256	03/01/2023	1,000	1,500	2,000	997	1,496	1,996	1,000
B38	SKC	224-PCXR4	626167	03/01/2023	1,000	1,500	2,000	1,003	1,501	2,001	0.999
B39	SKC	224-PCXR4	034637	03/01/2023	1,000	1,500	2,000	1,000	1,500	2,000	0.999
B40	SKC	224-PCXR4	796349	05/01/2023	1,000	1,500	2,000	984	1,506	1,999	0.999
Calibrated by :					Approved by :						

Rotameter Calibration Report (For Personal Pump High Flow Adjust)											
Calibration Method : Dry Cal Primary Flowmeter					Model : Defender 510-H						
					S/N : 136164						
Calibration Data											
Rotameter Data			Calibration Data								
No.	Brand	Model	Date	Flow Rate (Reading)			Flow Rate (ml/min)			Value From Calibration Curve	
				1			Actual (Q std.)				
				1	2	3	1	2	3	y	R <sup>2</sup>
H-B01	Dwyer	VRB-65	05/01/2023	500	1,000	2,000	506.1	999.5	1973.5	0.9981x + 8.311	1.000
H-B02	Dwyer	VRB-65	05/01/2023	500	1,000	2,000	494.9	998.2	1995.3	0.9983x + 4.772	1.000
H-B03	Dwyer	VRB-65	05/01/2023	500	1,000	2,000	498.3	987.3	2010.6	1.0058x - 15.990	0.999
H-B04	Dwyer	VRB-65	03/01/2023	500	1,000	2,000	500.4	999.5	2068.7	0.9981x - 2.369	1.000
H-B05	Dwyer	VRB-65	03/01/2023	500	1,000	2,000	499.0	997.8	1972.3	0.9811x + 20.957	0.999
H-B06	Dwyer	VRB-65	03/01/2023	500	1,000	2,000	503.6	995.0	1981.4	1.0035x - 8.768	0.999
H-B07	Dwyer	VRB-65	04/01/2023	500	1,000	2,000	504.1	989.0	2018.7	1.0022x - 2.144	1.000
H-B08	Dwyer	VRB-65	06/01/2023	500	1,000	2,000	499.8	999.2	1972.8	0.9986x + 3.270	0.999
H-B09	Dwyer	VRB-65	06/01/2023	500	1,000	2,000	503.7	1006.6	2014.9	0.9944x + 14.202	1.000
H-B10	Dwyer	VRB-65	06/01/2023	500	1,000	2,000	496.1	996.6	2012.4	0.9975x + 2.443	1.000
Calibrated by :				Approved by :							



CALIBRATION LABORATORY CO., LTD.

210-11, 14, 55 Soi Prasert Manukit 25 Yaek 4, Prasert Manukit Rd., Ladprao, Bangkok 10230  
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com Email: sale@cal-laboratory.com



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CALIBRATION AND  
MEASUREMENT  
MUSCULATORY  
KIDNEY 2014



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Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com Email: sale@cal-laboratory.com



ANAB  
Accredited  
ISO/IEC 17025  
CALIBRATION AND  
MEASUREMENT  
MUSCULATORY  
KIDNEY 2014

## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : VACUUM GAUGE  
MANUFACTURER : HI-LIGHT  
MODEL / TYPE : N/A  
SERIAL NO. : N/A[64-220066-4]  
CLID. NO. : 212201115  
JOB CONTROL NO. : 220720073204

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

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 :

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)

Certificate No. Q22073204

F3-011-04/01-12

page 1 of 3



@calibration

## 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





# 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



## 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  $\pm 0.2$  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.

### End of Certificate ###

Certificate No. Q22073204

F3-011-04/01-12

page 3 of 3



#cccalibration



CERTIFICATE No : 23M2445  
REFERENCE No : 68471-5

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE  
MANUFACTURER : METTLER TOLEDO  
MODEL : XSR105DU  
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 :   
CALIBRATION DATE : 10-Mar-23  
APPROVED BY :   
ISSUED DATE : 16-Mar-23  
RECEIVED DATE : 10-Mar-23

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



CERTIFICATE No : 23M2445

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL BALANCE  
MANUFACTURER : METTLER TOLEDO  
ID No : BA 10/62  
AIR PRESSURE : 1010mbar  $\pm$  1mbar  
AMBIENT TEMPERATURE : 23°C  $\pm$  1°C  
RELATIVE HUMIDITY : 49%RH  $\pm$  10% RH  
RECEIVED DATE : 10-Mar-23  
CALIBRATION DATE : 10-Mar-23  
MODEL : XSR105DU  
S/N : B926859981  
INSTRUMENT : E2  
SERIAL No : QK-1-151  
15843  
CERTIFICATE No : M2302013S  
02-Feb-25  
M2302014S  
02-Feb-25  
DUE DATE : 02-Feb-25

CERTIFICATE No

DUE DATE

SERIAL No

DUE DATE

1) STANDARD WEIGHT SET

02-Feb-25

2) STANDARD WEIGHT

02-Feb-25

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

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

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

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

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

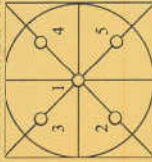
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 100 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (±g)
0.00	0.00000	0.00000	0.000039
0.02	0.02000	0.00000	0.000039
0.10	0.10000	0.00000	0.000039
0.20	0.20000	0.00000	0.000040
0.50	0.50000	0.00000	0.000040
1.00	1.00001	-0.00001	0.000041
2.00	2.00000	0.00000	0.000042
5.00	5.00000	0.00000	0.000046
10.00	10.00004	-0.00004	0.000053
20.00	20.00005	-0.00005	0.000067
50.00	50.00005	-0.00005	0.00011
100.00	100.00009	-0.00009	0.00019
120.00	120.00015	-0.00015	0.00019

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.00000
2	50.00003
3	50.00000
4	49.99997
5	50.00003
OFF-CENTER LOADING	0.00003

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

END OF CALIBRATION REPORT



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-1N2N3N	13877	87600	15/10/2022
Potassium dichromate solutions	RM-0204060810	14204	87614	16/10/2022
Potassium Iodide solution	-	KI-0701-001	CI-0090-22	08/04/2024

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

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

3.1 The UK National Physical Laboratory (NPL)

3.2 The National Institute of Standards and Technology,NIST.

Result of calibration : Wavelength Accuracy

(Without adjustment)

Material	Certified Values of Reference Material (nm)	UUC* Reading (nm)	Error (nm)	Uncertainty ± (nm)	k Factor
RM-HL	278.13	278.3	0.17	0.16	2.00
	361.25	361.4	0.15	0.16	2.00
	467.82	467.8	-0.02	0.16	2.00
	536.56	536.5	-0.06	0.16	2.00
RM-DL	640.50	640.5	0.00	0.16	2.00
	740.09	740.0	-0.09	0.16	2.00
	864.94	865.2	0.26	0.16	2.00

UUC\* = Unit Under Calibration

## Calibration Certificate

Equipment :	UV-VIS SPECTROPHOTOMETER
Manufacturer :	PERKINELMER
Model :	LAMBDA 25
Serial No.:	501S14123010
ID No.:	SP03/58
Calibration Mode :	WAVELENGTH ACCURACY PHOTOMETRIC ACCURACY
Condition As Found :	GOOD
Customer :	S.P.S. CONSULTING SERVICE CO., LTD. 7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN ROAD, CHOMPON, CHATUCHAK, BANGKOK 10900, THAILAND.
Location :	ORGANIC LABORATORY IV
Ambient Temperature :	( 24.4 ± 5 ) °C
Relative Humidity :	( 60.1 ± 25 ) %
Received Date :	30 AUGUST 2022
Calibration Date :	30 AUGUST 2022
Date of Issue :	31 AUGUST 2022

Calibrated by :

Approved by :

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



Continuation of Calibration Certificate

Cert. No. : SP22018  
Job No. : VC65SP0008  
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	1.0539	0.0015	0.0028	2.00
		29914	0.7	0.7454	0.7459	0.0005	0.0029	2.00
		29381	0.5	0.5426	0.5426	0.0000	0.0028	2.00
	546.1	29360	1.0	0.9822	0.9810	-0.0012	0.0028	2.00
		29914	0.7	0.6962	0.6960	-0.0002	0.0028	2.00
		29381	0.5	0.5076	0.5070	-0.0006	0.0029	2.00
	590.0	29360	1.0	1.0221	1.0202	-0.0019	0.0028	2.00
		29914	0.7	0.7238	0.7230	-0.0008	0.0029	2.00
		29381	0.5	0.5364	0.5360	-0.0004	0.0031	2.00
	635.0	29360	1.0	0.9751	0.9732	-0.0019	0.0028	2.00
		29914	0.7	0.6912	0.6902	-0.0010	0.0029	2.00
		29381	0.5	0.5214	0.5210	-0.0004	0.0032	2.00
Material	Wavelength (nm)	Solution (mg/l)	Certified Absorbance (A)	UUC* Reading Absorbance (A)	Error (A)	Uncertainty ± (A)	k Factor	
RM-0204060810	235.0	20	0.2436	0.2419	-0.0017	0.0101	2.00	
		40	0.4905	0.4855	-0.0050	0.0115	2.00	
		60	0.7453	0.7388	-0.0065	0.0067	2.00	
RM-0204060810	235.0	80	0.9920	0.9839	-0.0081	0.0071	2.00	
		100	1.2487	1.2414	-0.0073	0.0073	2.00	

UUC\* = Unit Under Calibration

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

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

Stray Light** UUC* Reading at 220 nm
Transmission T(%)
Absorbance(A)
0.0107
3.9886

\*\*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-H

S/N : 1361164

Environmental Conditions  
Temperature : 25 ± 3 °C  
Pressure : 1010 ± 15 mmHr

Personal Pump Data				Calibration Data										Value From Calibration Curve			
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)				Actual (Q std.)				R <sup>2</sup>	Value From Calibration Curve			
					1	2	3	4	1	2	3	4		1	2	3	4
B01	SKC	224-PCXR4	626101	03/01/2023	1,009	1,500	2,000	993	1,497	1,998			1.003x - 5.584	1,000			
B02	SKC	224-PCXR4	626166	03/01/2023	1,000	1,500	2,000	1,003	1,505	2,001			1.009x - 19.667	0.999			
B03	SKC	224-PCXR4	612968	03/01/2023	1,000	1,500	2,000	996	1,494	2,000			1.008x - 12.109	1,000			
B04	SKC	224-PCXR4	602804	04/01/2023	1,000	1,500	2,000	1,000	1,502	1,995			1.005x - 0.893	1,000			
B05	SKC	224-PCXR4	612603	04/01/2023	1,000	1,500	2,000	1,003	1,500	2,003			1.012x - 22.224	0.999			
B06	SKC	224-PCXR4	620188	03/01/2023	1,000	1,500	2,000	985	1,508	2,005			1.011x - 30.373	1,000			
B07	SKC	224-PCXR4	634262	03/01/2023	1,000	1,500	2,000	998	1,492	1,995			0.992x - 6.046	1,000			
B08	SKC	224-PCXR4	626100	03/01/2023	1,000	1,500	2,000	1,003	1,500	2,003			1.012x - 33.308	0.999			
B09	SKC	224-PCXR4	626479	03/01/2023	1,000	1,500	2,000	996	1,490	1,994			0.995x - 11.117	1,000			
B10	SKC	224-PCXR4	081950	03/01/2023	1,000	1,500	2,000	992	1,493	2,001			1.018x - 38.882	0.999			
B11	SKC	224-PCXR4	644313	06/01/2023	1,000	1,500	2,000	996	1,490	1,999			1.003x - 8.256	1,000			
B12	SKC	224-PCXR4	034666	05/01/2023	1,000	1,500	2,000	1,003	1,503	2,003			1.010x - 19.324	0.999			
B13	SKC	224-PCXR4	602073	05/01/2023	1,000	1,500	2,000	995	1,500	1,998			1.001x - 3.474	1,000			
B14	SKC	224-PCXR4	626313	04/01/2023	1,000	1,500	2,000	999	1,491	1,998			0.992x - 6.444	1,000			
B15	SKC	224-PCXR4	626474	04/01/2023	1,000	1,500	2,000	994	1,491	1,998			1.014x - 35.538	0.999			
B16	SKC	224-PCXR4	626477	04/01/2023	1,000	1,500	2,000	994	1,494	1,991			1.015x - 31.345	0.999			
B17	SKC	224-PCXR4	691484	04/01/2023	1,000	1,500	2,000	997	1,494	1,991			0.997x - 0.339	1,000			
B18	SKC	224-PCXR4	691484	04/01/2023	1,000	1,500	2,000	1,003	1,500	2,001			1.008x - 17.589	0.999			
B19	SKC	224-PCXR4	691699	03/01/2023	1,000	1,500	2,000	993	1,503	1,999			1.007x - 11.374	1,000			
B20	SKC	224-PCXR4	691887	03/01/2023	1,000	1,500	2,000	992	1,504	1,999			1.018x - 32.235	0.999			
B21	SKC	224-PCXR4	691531	03/01/2023	1,000	1,500	2,000	982	1,504	1,999			1.011x - 21.107	0.999			
B22	SKC	224-PCXR4	691654	03/01/2023	1,000	1,500	2,000	1,003	1,501	2,003			1.011x - 7.107	1,000			
B23	SKC	224-PCXR4	798393	03/01/2023	1,000	1,500	2,000	992	1,507	2,002			1.018x - 34.883	0.999			
B24	SKC	224-PCXR4	626363	03/01/2023	1,000	1,500	2,000	993	1,503	1,999			1.011x - 23.387	0.999			
B25	SKC	224-PCXR4	798489	03/01/2023	1,000	1,500	2,000	994	1,503	1,998			0.996x - 1.098	1,000			
B26	SKC	224-PCXR4	691749	03/01/2023	1,000	1,500	2,000	999	1,503	1,999			1.018x - 32.071	0.999			
B27	SKC	224-PCXR4	691673	04/01/2023	1,000	1,500	2,000	994	1,503	1,999			1.015x - 23.515	0.999			
B28	SKC	224-PCXR4	691670	04/01/2023	1,000	1,500	2,000	1,002	1,500	2,002			1.015x - 1.942	1,000			
B29	SKC	224-PCXR4	626472	04/01/2023	1,000	1,500	2,000	1,004	1,510	2,004			1.008x - 12.460	0.999			
B30	SKC	224-PCXR4	691489	03/01/2023	1,000	1,500	2,000	992	1,497	1,998			1.008x - 12.711	1,000			
B31	SKC	224-PCXR4	691509	03/01/2023	1,000	1,500	2,000	992	1,497	1,998			1.008x - 12.711	1,000			
B32	SKC	224-PCXR4	691687	03/01/2023	1,000	1,500	2,000	991	1,504	2,001			1.016x - 32.322	0.999			
B33	SKC	224-PCXR4	691736	03/01/2023	1,000	1,500	2,000	993	1,497	1,991			0.997x - 0.004	1,000			
B34	SKC	224-PCXR4	612662	03/01/2023	1,000	1,500	2,000	993	1,498	1,995			1.007x - 14.195	1,000			
B35	SKC	224-PCXR4	626164	03/01/2023	1,000	1,500	2,000	993	1,498	1,995			1.007x - 5.448	1,000			
B36	SKC	224-PCXR4	626164	03/01/2023	1,000	1,500	2,000	999	1,496	1,999			1.001x - 5.424	1,000			
B37	SKC	224-PCXR4	626256	03/01/2023	1,000	1,500	2,000	997	1,496	1,996			1.013x - 27.815	0.999			
B38	SKC	224-PCXR4	626167	03/01/2023	1,000	1,500	2,000	997	1,496	1,996			0.999x - 0.997	1,000			
B39	SKC	224-PCXR4	034637	03/01/2023	1,000	1,500	2,000	1,003	1,501	2,001			1.010x - 18.618	0.999			
B40	SKC	224-PCXR4	798349	05/01/2023	1,000	1,500	2,000	894	1,506	1,999			1.014x - 29.602	0.999			

Calibrated by :

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 1361164

Environmental Conditions  
Temperature : 25 ± 3 °C  
Pressure : 1010 ± 15 mmHr

Personal Pump Data				Calibration Data										Value From Calibration Curve			
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)				Actual (Q std.)				R <sup>2</sup>	Value From Calibration Curve			
					Setting		1		2		3			4		5	
B41	SKC	224-PCXR4	612660	05/01/2023	1,000	1,500	2,000	998	1,497	1,990							
B42	SKC	224-PCXR4	626041	05/01/2023	1,000	1,500	2,000	1,004	1,498	1,991							
B43	SKC	224-PCXR4	034636	06/01/2023	1,000	1,500	2,000	1,000	1,501	1,992							
B44	SKC	224-PCXR4	626341	06/01/2023	1,000	1,500	2,000	1,002	1,502	2,002							
B45	SKC	224-PCXR4	626594	06/01/2023	1,000	1,500	2,000	999	1,501	1,989							
B46	SKC	224-PCXR4	666743	06/01/2023	1,000	1,500	2,000	995	1,504	2,002							
B47	SKC	224-PCXR4	666747	06/01/2023	1,000	1,500	2,000	1,003	1,502	2,004							
B48	SKC	224-PCXR4	666753	04/01/2023	1,000	1,500	2,000	1,000	1,494	1,996							
B49	SKC	224-PCXR4	666760	04/01/2023	1,000	1,500	2,000	1,003	1,502	2,006							
B50	SKC	224-PCXR4	600400	04/01/2023	1,000	1,500	2,000	1,001	1,496	2,002							
B51	SKC	224-PCXR4	600363	04/01/2023	1,000	1,500	2,000	996	1,504	1,999							
B52	SKC	224-PCXR4	693186	04/01/2023	1,000	1,500	2,000	995	1,496	1,994							
B53	SKC	224-PCXR4	707470	03/01/2023	1,000	1,500	2,000	1,002	1,500	2,002							
B54	SKC	224-PCXR4	609821	03/01/2023	1,000	1,500	2,000	993	1,502	2,001							
B55	SKC	224-PCXR4	519710	03/01/2023	1,000	1,500	2,000	999	1,494	1,994							
B56	SKC	224-PCXR4	611450	03/01/2023	1,000	1,500	2,000	1,002	1,500	2,001							
B57	SKC	224-PCXR4	519798	06/01/2023	1,000	1,500	2,000	997	1,492	1,998							
B58	SKC	224-PCXR4	609852	06/01/2023	1,000	1,500	2,000	1,000	1,498	1,999							
B59	SKC	224-PCXR4	609862	06/01/2023	1,000	1,500	2,000	996	1,503	1,994							
B60	SKC	224-PCXR4	612655	06/01/2023	1,000	1,500	2,000	1,002	1,500	2,003							
B61	SKC	224-PCXR4	603915	06/01/2023	1,000	1,500	2,000	994	1,489	1,986							
B62	SKC	224-PCXR4	605975	06/01/2023	1,000	1,500	2,000	999	1,494	1,986							
B63	SKC	224-PCXR4	611432	03/01/2023	1,000	1,500	2,000	991	1,501	1,999							
B64	SKC	224-PCXR4	608302	03/01/2023	1,000	1,500	2,000	997	1,492	1,998							
B65	SKC	224-PCXR4	608310	03/01/2023	1,000	1,500	2,000	1,002	1,490	1,993							
B66	SKC	224-PCXR4	609841	03/01/2023	1,000	1,500	2,000	1,002	1,491	1,991							
B67	SKC	224-PCXR4	609856	03/01/2023	1,000	1,500	2,000	1,002	1,491	1,991							
B68	SKC	224-PCXR4	609868	04/01/2023	1,000	1,500	2,000	993	1,506	2,004							
B69	SKC	224-PCXR4	608672	04/01/2023	1,000	1,500	2,000	1,002	1,490	1,987							
B70	SKC	224-PCXR4	608376	04/01/2023	1,000	1,500	2,000	1,002	1,489	2,000							
B71	SKC	224-PCXR4	610623	06/01/2023	1,000	1,500	2,000	992	1,493	1,997							
B72	SKC	224-PCXR4	608367	05/01/2023	1,000	1,500	2,000	992	1,506	2,002							
B73	SKC	224-PCXR4	605977	05/01/2023	1,000	1,500	2,000	1,001	1,498	1,993							
B74	SKC	224-PCXR4	612606	05/01/2023	1,000	1,500	2,000	1,002	1,501	2,003							
B75	SKC	224-PCXR4	605983	05/01/2023	1,000	1,500	2,000	996	1,495	1,994							
B76	SKC	224-PCXR4	609811	04/01/2023	1,000	1,500	2,000	995	1,486	1,990							
B77	SKC	224-PCXR4	608301	04/01/2023	1,000	1,500	2,000	993	1,498	1,998							
B78	SKC	224-PCXR4	610677	04/01/2023	1,000	1,500	2,000	1,000	1,501	2,003							
B79	SKC	224-PCXR4	610677	04/01/2023	1,000	1,500	2,000	995	1,503	1,999							
B79	SKC	224-PCXR4	610920	03/01/2023	1,000	1,500	2,000	994	1,493	1,994							



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 <sup>2</sup>
				Flow Rate (Reading)			Actual (Q act.)				
				1	2	3	1	2	3		
H-801	Dwyer	VFB-65	05/01/2023	500	1,000	2,000	506.1	989.5	1973.5	0.9991 ± 8.311	1.000
H-802	Dwyer	VFB-65	05/01/2023	500	1,000	2,000	484.9	988.2	1985.3	0.9934 ± 4.772	1.000
H-803	Dwyer	VFB-65	06/01/2023	500	1,000	2,000	485.3	987.3	2010.6	1.0005 ± 15.480	0.999
H-804	Dwyer	VFB-65	03/01/2023	500	1,000	2,000	505.4	999.5	2008.7	0.9984 ± 2.369	1.000
H-805	Dwyer	VFB-65	03/01/2023	500	1,000	2,000	495.0	997.8	1972.3	0.9811 ± 30.957	0.999
H-806	Dwyer	VFB-65	03/01/2023	500	1,000	2,000	503.5	985.0	1981.4	1.0055 ± 8.788	0.999
H-807	Dwyer	VFB-65	04/01/2023	500	1,000	2,000	504.1	989.0	2018.7	1.0024 ± 2.144	1.000
H-808	Dwyer	VFB-65	06/01/2023	500	1,000	2,000	495.8	999.2	1975.8	0.9961 ± 3.270	0.999
H-809	Dwyer	VFB-65	06/01/2023	500	1,000	2,000	503.7	1006.6	2014.3	0.9944 ± 14.202	1.000
H-810	Dwyer	VFB-65	06/01/2023	500	1,000	2,000	496.1	986.6	2012.4	0.9974 ± 2.413	1.000
Calibrated by :											



CERTIFICATE No : 23M2445  
REFERENCE No : 68471-5

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE  
MANUFACTURER : METTLER TOLEDO  
MODEL : XSR105DU  
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 :   
CALIBRATION DATE : 10-Mar-23  
APPROVED BY :   
ISSUED DATE : 16-Mar-23  
RECEIVED DATE : 10-Mar-23

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



CERTIFICATE No : 23M2445

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL BALANCE  
MANUFACTURER : METTLER TOLEDO  
ID No : BA 10/62  
AIR PRESSURE : 1010mbar  $\pm$  1mbar  
AMBIENT TEMPERATURE : 23°C  $\pm$  1°C  
RELATIVE HUMIDITY : 49%RH  $\pm$  10% RH  
RECEIVED DATE : 10-Mar-23  
CALIBRATION DATE : 10-Mar-23  
MODEL : XSR105DU  
S/N : B926859981  
RELATIVE HUMIDITY : 49%RH  $\pm$  10% RH

### CONDITION OF THIS RESULTS OF CALIBRATION

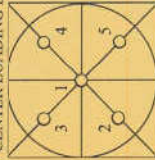
1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 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
  - 2) STANDARD WEIGHT E2
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 100 g WAS 0 g
4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (±g)
0.00	0.00000	0.00000	0.000039
0.02	0.02000	0.00000	0.000039
0.10	0.10000	0.00000	0.000039
0.20	0.20000	0.00000	0.000040
0.50	0.50000	0.00000	0.000040
1.00	1.00001	-0.00001	0.000041
2.00	2.00000	0.00000	0.000042
5.00	5.00000	0.00000	0.000046
10.00	10.00004	-0.00004	0.000053
20.00	20.00005	-0.00005	0.000067
50.00	50.00005	-0.00005	0.00011
100.00	100.00009	-0.00009	0.00019
120.00	120.00015	-0.00015	0.00019

### 5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.00000
2	50.00003
3	50.00000
4	49.99997
5	50.00003
OFF-CENTER LOADING	0.00003

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

END OF CALIBRATION REPORT

**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.

**Head Office**

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

**Office/Laboratory**

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

**Office**

196 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th

FM.BL.MTC.002 Rev.4



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 :**

(Mr. Ni)

(Mr. Ta)

**Approved by :**

Director

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

End of Certificate

2 / 2

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

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

**Head Office**

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

**Office/Laboratory**

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

**Office**

196 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th

FM.BL.MTC.002 Rev.4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

## CALIBRATION CERTIFICATE

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

Address : 7 Soi Phaholyothin 24, Phaholyothin Road, Jompol, Chatuchak, Bangkok 10900.

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

: Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, 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&Kjaer 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&Kjaer 4180 S/N 2889871.

**Calibration Procedure:** CP-102-04 based on IEC 60942-2003. The sound pressure level of instrument was measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 27 Mar. 2023

Date of Calibration : 29 Mar. 2023

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.

Head Office

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

Office/Laboratory

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

FAJBLMTC-002 Rev.4

Head Office

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

Office/Laboratory

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

FAJBLMTC-002 Rev.4

Office  
196 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

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

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

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

### 1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	93.94	-0.06	± 0.10	±0.40 dB

### 2. Frequency

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

### 3. Total distortion

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

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

.....  
(M

Approved by :



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

Date of Calibration : 29 Mar. 2023

Date of Issue : 30 Mar. 2023

Ref : 2011266032701228001

End of Certificate

2 / 2

The results relate only to the items tested/calibrated 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.

Noise B\_110/23

## Sound Level Meter Calibration Report

Acoustic Calibrator Data			
Brand	ACO	Number	AC 03/56
Model	2127	Serial No.	130006
Calibration Range	94 dB, 1000 Hz	Last Calibration	28 April 2022
		Due Date	28 April 2023

Sound Level Meter Data			
SLM No.	Brand	Model	Serial No.
ACO-B18	ACO	6236	00172048
ACO-B33	ACO	6236	00182015
ACO-R40	ACO	6236	00192052
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)			

Calibration Data			
Date	Before Adjustment	After Adjustment	Actual Reading [dB]
29 March 2023	94.0	94.0	94.0
29 March 2023	94.0	94.0	94.0
29 March 2023	94.0	94.0	94.0
93.93 ± 0.10 dB			

Calibrated by :

Noise B\_109/23

## Sound Level Meter Calibration Report

Acoustic Calibrator Data			
Brand	ACO	Number	AC 03/56
Model	2127	Serial No.	130006
Calibration Range	94 dB, 1000 Hz	Last Calibration	28 April 2022
		Due Date	28 April 2023

Sound Level Meter Data			
SLM No.	Brand	Model	Serial No.
ACO-B01	ACO	6236	00132025
ACO-B07	ACO	6236	00142004
ACO-B08	ACO	6236	00142008
ACO-B09	ACO	6236	00152004
ACO-B11	ACO	6236	00152079
ACO-B19	ACO	6236	00172057
ACO-B23	ACO	6236	00182002
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)			

Calibration Data			
Date	Before Adjustment	After Adjustment	Actual Reading [dB]
26 March 2023	93.9	94.0	94.0
26 March 2023	94.1	94.0	94.0
26 March 2023	93.9	94.0	94.0
26 March 2023	94.0	94.0	94.0
26 March 2023	94.0	94.0	94.0
26 March 2023	94.0	94.0	94.0
26 March 2023	94.0	94.0	94.0
93.93 ± 0.10 dB			

Calibrated by :



Sound Level Meter Calibration Report									
Acoustic Calibrator Data									
Brand		ACO		Number		AC 03/56			
Model		2127		Serial No.		130006			
Calibration Range		94 dB, 1000 Hz		Last Calibration		29 March 2023			
				Due Date		29 March 2024			
Calibration Data									
Sound Level Meter Data									
SLM No.		Brand		Model		Serial No.		Date	
ACO-B18		ACO		6236		00172048		02 June 2023	
ACO-B29		ACO		6236		00182011		02 June 2023	
ACO-B33		ACO		6236		00182015		02 June 2023	
Acoustic Certified Value		Thailand Institute of Scientific and Technological Research (TISTR)							
								93.94 ± 0.10 dB	

Calibrated by :

## เอกสารที่ 5-5

เอกสารสอบเทียบเครื่องมือการตรวจค่าความร้อน  
ในสถานประกอบการ (Working Area)



CLC  
Accredited  
ISO/IEC 17025

## 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



NSO-TS 17025  
CALIBRATION 0659  
CLC



NSO-TS 17025  
CALIBRATION 0659  
CLC

## CERTIFICATE OF CALIBRATION

### FOR

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

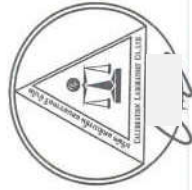
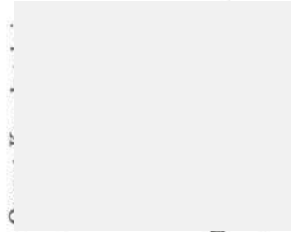
CUSTOMER : S.P.S. CONSULTING SERVICE CO., LTD.  
7 SOI PHAHOLYOTHIN 24 ROAD,, JOMPOI,  
CHATUCHAK, BANGKOK 10900

DATE OF RECEIVED : 28 October 2022

DATE OF ISSUED : 31 October 2022

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

Calibrated By :



Approved By :

31 OCTOBER 2022

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

Certificate No. Q22109978

F3-011-04/01-12

page 1 of 3



@calibration



CLC  
Accredited  
ISO/IEC 17025

## 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



NSO-TS 17025  
CALIBRATION 0659  
CLC



NSO-TS 17025  
CALIBRATION 0659  
CLC

## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
[THERMAL ENVIRONMENT MONITOR]  
MANUFACTURER : 3M  
MODEL / TYPE : QUESTemp<sup>®</sup>34  
SERIAL NO. : TEH060047  
DATE OF CALIBRATION : 29 October 2022

#### ENVIRONMENT CONDITIONS :

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

#### PROCEDURE USED :

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

#### REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, EdgeTech Model Dew Master S/N. 44602.  
Temperature & Humidity Chamber, 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-402: M:2011)"

Certificate No. Q22109978

F3-011-04/01-12

page 2 of 3



@calibration





# CALIBRATION LABORATORY CO., LTD.

210-11, 14, 35 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Latphrao, Bangkok 10230  
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-lab.co.th E-mail: sales@cal-lab.co.th



NSC-TISI-TIS 19025  
CALIBRATION 0059  
CLC

## CONDITION OF CALIBRATION ITEM : GOOD

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

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

#### CALIBRATION DATA

##### 1. CORRECTION OF TEMPERATURE : WET

Test point ( ° C )	Actual Temperature ( ° C )	DUC Reading ( ° C )	Correction ( ° C )	Uncertainty ± ( ° C )
30.0	30.01	29.8	+0.21	0.40
35.0	35.00	34.9	+0.10	
40.0	40.01	39.8	+0.21	

##### 2. CORRECTION OF TEMPERATURE : DRY

Test point ( ° C )	Actual Temperature ( ° C )	DUC Reading ( ° C )	Correction ( ° C )	Uncertainty ± ( ° C )
30.0	30.01	29.8	+0.21	0.40
35.0	35.00	35.0	0.00	
40.0	40.01	39.8	+0.21	

##### 3. CORRECTION OF TEMPERATURE : GLOBE BULB

Test point ( ° C )	Actual Temperature ( ° C )	DUC Reading ( ° C )	Correction ( ° C )	Uncertainty ± ( ° C )
30.0	30.01	29.7	+0.31	0.40
35.0	35.00	34.8	+0.20	
40.0	40.01	39.7	+0.31	

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. Q22109978

F3-011-04/01-12

page 3 of 3



@calibration



## Certificate of Calibration

Certificate Number : SPR23030505-1 Page : 1 of 3

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

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

Equipment Name : Area Heat Stress Monitor

Manufacturer : Quest Technologies

Model : QUESTemp 34

Serial Number : TEG040059

ID. Number : B07

### Environmental Conditions

Ambient Temperature :  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$  Received Date : 30 Mar 2023

Relative Humidity :  $50\% \pm 15\%$  Calibration Date : 31 Mar 2023

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

Calibration Procedure : SP-CPT-04-13 Date of Issue : 01 Apr 2023

### Method of Calibration

This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure, Standards used to perform this calibration are certified by to NIST or equivalent, National metrology institute, Natural physical constants, consensus standards. The result reported herein apply only to the calibration of the item described above as received. Our decision rule is to contact the customer if the item pass and fail calibration when the results include the uncertainties and the customer must determine if the results meets their needs.

All calibrations are performed within manufacture's specifications. The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by : N C

Approved by

Authorized Signatory



## Calibration Report

Certificate Number : SPR23030505-1 Page : 2 of 3

### Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due Date
Humidity Chamber	TH-80S	N/A	SPR23010480-5	22 Feb 2024
THERMO-HYGROMETER	5020A	A47046	QR23-0176	26 Jan 2024

### Traceability

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



## Result of Calibration

Certificate No. : SPR23030505-1

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)				
Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty ( ± )
30.0	30.013	30.0	-0.013	0.50
35.0	35.010	35.0	-0.010	0.50
40.0	40.015	40.0	-0.015	0.50

Temperature Accuracy in the Measurement. (DRY)				
Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty ( ± )
30.0	30.013	30.0	-0.013	0.50
35.0	35.010	35.0	-0.010	0.50
40.0	40.015	40.0	-0.015	0.50

Temperature Accuracy in the Measurement. (GLOBE)				
Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty ( ± )
30.0	30.013	30.0	-0.013	0.50
35.0	35.010	35.0	-0.010	0.50
40.0	40.015	40.0	-0.015	0.50

### Note:

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

### Measurement Uncertainty

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





# CALIBRATION LABORATORY CO., LTD.

2110-11, 14, 55 Soi Prasert Manukit 28 Yaek 4, Prasert Manukit Rd., Ladprao, Bangkok 10230  
Tel. 02-578-0353-4 Fax: 02-578-2672 www.ccl-lab.com E-mail: sale@ccl-lab.com



## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)  
MANUFACTURER : 3M  
MODEL / TYPE : QUESTemp<sup>o</sup>34  
SERIAL NO. : TEL080034  
CLID. NO. : 231801937  
JOB CONTROL NO. : 221028109974

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

DATE OF RECEIVED : 28 October 2022

DATE OF ISSUED : 31 October 2022

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

Calibrated By :

Approved By :

Certificate No. Q22109974

F3-011-04/01-12

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

page 1 of 3



#cclcalibration



# CALIBRATION LABORATORY CO., LTD.

2110-11, 14, 55 Soi Prasert Manukit 28 Yaek 4, Prasert Manukit Rd., Ladprao, Bangkok 10230  
Tel. 02-578-0353-4 Fax: 02-578-2672 www.ccl-lab.com E-mail: sale@ccl-lab.com



## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)  
MANUFACTURER : 3M  
MODEL / TYPE : QUESTemp<sup>o</sup>34  
SERIAL NO. : TEL080034  
DATE OF CALIBRATION : 29 October 2022

### ENVIRONMENT CONDITIONS :

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

### PROCEDURE USED :

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

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

### REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, Edgetech Model Dew Master S/N. 44602.  
Temperature & Humidity Chamber, 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. Q22109974

F3-011-04/01-12

page 2 of 3



#cclcalibration



# CALIBRATION LABORATORY Co., LTD.

2110-11, 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: sales@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	30.01	30.0	+0.01	0.40
35.0	35.00	35.0	0.00	
40.0	40.01	39.9	+0.11	

##### 2. CORRECTION OF TEMPERATURE : DRY

Test point ( ° C )	Actual Temperature ( ° C )	DUC Reading ( ° C )	Correction ( ° C )	Uncertainty ± ( ° C )
30.0	30.01	30.2	-0.19	0.40
35.0	35.00	35.1	-0.10	
40.0	40.01	40.1	-0.09	

##### 3. CORRECTION OF TEMPERATURE : GLOBE BULB

Test point ( ° C )	Actual Temperature ( ° C )	DUC Reading ( ° C )	Correction ( ° C )	Uncertainty ± ( ° C )
30.0	30.01	30.0	+0.01	0.40
35.0	35.00	34.9	+0.10	
40.0	40.01	39.9	+0.11	

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. Q22109974

F3-011-04/01-12



@calibration



## Certificate of Calibration

Certificate Number : SPR23030505-2 Page : 1 of 3

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

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

Equipment Name : Area Heat Stress Monitor  
Manufacturer : Metrosonics  
Model : hs-32  
Serial Number : MCE030011  
ID. Number : B21

Environmental Conditions  
Ambient Temperature :  $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$  Received Date : 30 Mar 2023  
Relative Humidity :  $50\% \pm 15\%$  Calibration Date : 31 Mar 2023  
Location of Calibration : In-Lab Recommend Due Date : 31 Mar 2024  
Calibration Procedure : SP-CPT-04-13 Date of Issue : 01 Apr 2023

### Method of Calibration

This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure. Standards used to perform this calibration are certified by NIST or equivalent, National metrology institute, Natural physical constants, consensus standards. The result reported herein apply only to the calibration of the item described above as received. Our decision rule is to contact the customer if the item pass and fail calibration when the results include the uncertainties and the customer must determine if the results meets their needs.

All calibrations are performed within manufacture's specifications. The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by :

Calibration Officer

Approved by

Authorized Signatory



## Calibration Report

Certificate Number : SPR23030505-2 Page : 2 of 3

### Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Humidity Chamber	TH-80S	N/A	SPR23010480-5	22 Feb 2024
THERMO-HYGROMETER	5020A	A47046	QR23-0176	26 Jan 2024

### Traceability

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





## Result of Calibration

Certificate No. : SPR23030505-2

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)					Unit : °C
Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty ( ± )	
30.0	30.013	30.4	0.387	0.50	
35.0	35.010	35.4	0.390	0.50	
40.0	40.015	40.4	0.385	0.50	

Temperature Accuracy in the Measurement. (DRY)					Unit : °C
Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty ( ± )	
30.0	30.013	30.5	0.487	0.50	
35.0	35.010	35.5	0.490	0.50	
40.0	40.015	40.5	0.485	0.50	

Temperature Accuracy in the Measurement. (GLOBE)					Unit : °C
Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty ( ± )	
30.0	30.013	30.4	0.387	0.50	
35.0	35.010	35.4	0.390	0.50	
40.0	40.015	40.4	0.385	0.50	

### Note:

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

### Measurement Uncertainty

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



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 Email: sale@cal-laboratory.com



CLC  
Accredited  
ISO/IEC 17025

NSC-TIS-TR 17025  
CALIBRATION 0659  
CLC

## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp<sup>®</sup>32

SERIAL NO. : TPH050046

CLID. NO. : 231801943

JOB CONTROL NO. : 221028109979

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

DATE OF RECEIVED : 28 October 2022

DATE OF ISSUED : 31 October 2022

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

Calibrated By :

Approved By :

31 October 2022

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

Certificate No. Q22109979

F3-011-04/01-12

page 1 of 3



@cccalibration



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ISO/IEC 17025

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 Email: sale@cal-laboratory.com



NSC-TIS-TR 17025  
CALIBRATION 0659  
CLC

## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp<sup>®</sup>32

SERIAL NO. : TPH050046

DATE OF CALIBRATION : 29 October 2022

#### ENVIRONMENT CONDITIONS :

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

#### PROCEDURE USED :

This instrument was calibrated under procedure No. 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. Q22109979

F3-011-04/01-12

page 2 of 3



@cccalibration



**CONDITION OF CALIBRATION ITEM : GOOD**

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

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

**CALIBRATION DATA**

**1. CORRECTION OF TEMPERATURE : WET**

Test point ( ° C )	Actual Temperature ( ° C )	DUC Reading ( ° C )	Correction ( ° C )	Uncertainty ± ( ° C )
30.0	30.01	30.0	+0.01	0.40
35.0	35.00	35.0	0.00	
40.0	40.01	39.8	+0.21	

**2. CORRECTION OF TEMPERATURE : DRY**

Test point ( ° C )	Actual Temperature ( ° C )	DUC Reading ( ° C )	Correction ( ° C )	Uncertainty ± ( ° C )
30.0	30.01	30.1	-0.09	0.40
35.0	35.00	35.1	-0.10	
40.0	40.01	40.0	+0.01	

**3. CORRECTION OF TEMPERATURE : GLOBE BULB**

Test point ( ° C )	Actual Temperature ( ° C )	DUC Reading ( ° C )	Correction ( ° C )	Uncertainty ± ( ° C )
30.0	30.01	30.0	+0.01	0.40
35.0	35.00	35.0	0.00	
40.0	40.01	39.8	+0.21	

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 ###





Heat Stress WBGT Meter Verification Report

Verification Data					
Heat Stress WBGT Meter No.	: B05	Verification Date	: 29 March 2023		
Brand	: 3M	Ambient Temp.	: 24.5 °C		
Model	: QUESTemp <sup>®</sup> 34	Barometric Pressure	: 1011 mmbar		
Serial No.	: TEH060047	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	12.6	-0.1	± 0.5		
Dry Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
47.1	47.1	0.0	± 0.5		
Globe Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
69.3	69.3	0.0	± 0.5		
UUC* = UNIT UNDER CALIBRATION					

Verified by : \_\_\_\_\_

Heat Stress WBGT Meter Verification Report

Verification Data					
Heat Stress WBGT Meter No.	: B07	Verification Date	: 29 March 2023		
Brand	: 3M	Ambient Temp.	: 24.5 °C		
Model	: QUESTemp <sup>®</sup> 34	Barometric Pressure	: 1011 mmbar		
Serial No.	: TEG040059	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	47.2	-0.1	± 0.5		
Globe Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
69.3	69.4	-0.1	± 0.5		
UUC* = UNIT UNDER CALIBRATION					

Verified by : \_\_\_\_\_

Heat Stress WBGT Meter Verification Report

Verification Data				
Heat Stress WBGT Meter No.	: B11	Verification Date	: 29 March 2023	
Brand	: 3M	Ambient Temp.	: 24.5 °C	
Model	: QUESTemp <sup>®</sup> 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	69.1	0.2	± 0.5	
UUC* = UNIT UNDER CALIBRATION				

Verified by : 

Heat Stress WBGT Meter Verification Report

Verification Data				
Heat Stress WBGT Meter No.	: B05	Verification Date	: 02/06/2023	
Brand	: 3M	Ambient Temp.	: 24.5 °C	
Model	: QUESTemp 34	Barometric Pressure	: 1011 mmbar	
Serial No.	: THH060047	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	12.3	0.2	± 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 B088\_2/23

Heat Stress WBGT Meter Verification Report					
Verification Data					
Heat Stress WBGT Meter No.	: B21	Verification Date	: 02/06/2023		
Brand	: METROSONICS	Ambient Temp.	: 24.5 °C		
Model	: hs-32	Barometric Pressure	: 1011 mmbar		
Serial No.	: MCE030011	Relative Humidity	: 49 %		
Verification Module (Electronic Sensor Check) :					
Verification Module No. :	21	WB = 12.5 °C , DB = 47.1 °C , G = 69.3 °C			
Result of Verification : Without Adjustment					
Wet Probe Temperature Measurement					
Verification Module Reading (°C)	12.5	UUC* Reading (°C)	12.5	Correction (°C)	0.0
				Tolerance Limit (°C)	± 0.5
Dry Probe Temperature Measurement					
Verification Module Reading (°C)	47.1	UUC* Reading (°C)	47.0	Correction (°C)	0.1
				Tolerance Limit (°C)	± 0.5
Globe Probe Temperature Measurement					
Verification Module Reading (°C)	69.3	UUC* Reading (°C)	69.5	Correction (°C)	-0.2
				Tolerance Limit (°C)	± 0.5
UUC* = UNIT UNDER CALIBRATION					

Verified by

Signature

N (Mr. Feera Jettumom)

Heat B088\_3/23

Heat Stress WBGT Meter Verification Report					
Verification Data					
Heat Stress WBGT Meter No.	: B28	Verification Date	: 02/06/2023		
Brand	: 3M	Ambient Temp.	: 24.5 °C		
Model	: QUESTemp 32	Barometric Pressure	: 1011 mmbar		
Serial No.	: TPH050046	Relative Humidity	: 49 %		
Verification Module (Electronic Sensor Check) :					
Verification Module No. :	21	WB = 12.5 °C , DB = 47.1 °C , G = 69.3 °C			
Result of Verification : Without Adjustment					
Wet Probe Temperature Measurement					
Verification Module Reading (°C)	12.5	UUC* Reading (°C)	12.4	Correction (°C)	0.1
				Tolerance Limit (°C)	± 0.5
Dry Probe Temperature Measurement					
Verification Module Reading (°C)	47.1	UUC* Reading (°C)	47.1	Correction (°C)	0.0
				Tolerance Limit (°C)	± 0.5
Globe Probe Temperature Measurement					
Verification Module Reading (°C)	69.3	UUC* Reading (°C)	69.2	Correction (°C)	0.1
				Tolerance Limit (°C)	± 0.5
UUC* = UNIT UNDER CALIBRATION					

Verified by

Signature

N (Mr. Feera Jettumom)