

# 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
<b>คุณภาพอากาศในบรรยากาศ</b>		
TSP	- High Volume Air Sampler No. B B04, B09, B18	- Digital Balance
PM <sub>10</sub>	- High Volume PM <sub>10</sub> Air Sampler No. B02, B12, B22	- Digital Balance
SO <sub>2</sub>	- Gas Sampler Box No. B02, B04, B07	- Spectrophotometer
NO <sub>2</sub>	- NO/NO <sub>2</sub> /NO <sub>x</sub> Analyzer No. B14, B20, B21	- NO/NO <sub>2</sub> /NO <sub>x</sub> Analyzer No. B14, B20, B21
<b>คุณภาพอากาศจากปล่อง</b>		
TSP	- Console No. B01 - Pitot Tube No. B35	- Digital Balance
SO <sub>2</sub>	- Personal Pump SKC No. B14 - Rotameter No. H-B07	-
NO <sub>x</sub>	- Vacuum Gauge	- Spectrophotometer
<b>คุณภาพอากาศในสถานประกอบการ</b>		
Total Dust	- Personal Pump SKC No. B06, B61, B67, B74, B89, R24 - Rotameter No. H-B01, B10	- Digital Balance
<b>ระดับเสียงในบรรยากาศ</b>		
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. B17, B25, B26, B32, B37, B38, B40	-
<b>ระดับเสียงในสถานประกอบการ</b>		
L <sub>eq</sub> 8 hr	- Acoustic Calibrator - Sound Level Meter No. B29, B36, B41, R50, R51, R52	-
<b>ระดับความร้อนในสถานประกอบการ</b>		
WBGT	- Digital Thermometer with Probe No. B07, B11, B17, B34	-

## เอกสารที่ 5-1

เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศ  
ในบรรยากาศ

High Volume Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard				Model : TE 50/25A	S/N : 30/95
Calibration Data					
High Volume Air Sampler Data		Calibration Data			
Recorder No.	Blower No.	Date	Actual Flowrate (l/min)	R <sup>2</sup>	
B01	B01	09/02/2022	y = 1.255x - 7.443	0.998	
B02	B02	02/02/2022	y = 1.075x + 1.871	0.999	
B03	B03	04/02/2022	y = 1.032x + 1.126	0.997	
B04	B04	04/02/2022	y = 1.158x - 3.770	0.995	
B05	B05	02/02/2022	y = 1.199x - 5.374	1.000	
B06	B06	01/02/2022	y = 1.215x - 6.623	0.995	
B07	B07	01/02/2022	y = 1.142x - 4.465	0.997	
B08	B08	02/02/2022	y = 1.241x - 8.074	0.999	
B09	B09	08/02/2022	y = 1.206x - 5.652	0.995	
B10	B10	07/02/2022	y = 1.095x + 0.184	0.998	
B11	B11	10/02/2022	y = 1.099x - 2.021	0.996	
B12	B12	09/02/2022	y = 1.169x - 3.784	1.000	
B13	B13	03/02/2022	y = 1.163x - 4.662	0.996	
B14	B14	07/02/2022	y = 1.169x - 3.363	0.998	
B15	B15	03/02/2022	y = 1.106x - 1.273	0.998	
B16	B16	09/02/2022	y = 1.218x - 6.757	0.997	
B17	B17	07/02/2022	y = 1.132x - 1.690	0.998	
B18	B18	16/02/2022	y = 1.233x - 7.560	0.999	
B19	B19	16/02/2022	y = 1.265x - 8.834	0.997	
B20	B20	03/02/2022	y = 1.199x - 6.304	0.998	
B21	B21	17/02/2022	y = 1.120x - 2.616	0.997	
B22	B22	08/02/2022	y = 1.216x - 6.597	0.995	
B23	B23	03/02/2022	y = 1.139x - 3.341	0.999	
B24	B24	03/02/2022	y = 1.126x - 2.172	1.000	
B25	B25	09/02/2022	y = 1.016x - 2.185	0.996	
B26	B26	04/02/2022	y = 1.123x - 2.540	0.997	
B27	B27	08/02/2022	y = 1.192x - 6.584	0.997	
B28	B28	04/02/2022	y = 1.254x - 8.360	0.995	
B29	B29	02/02/2022	y = 1.217x - 6.791	0.996	
B30	B30	04/02/2022	y = 1.162x - 4.303	0.997	
B31	B31	16/02/2022	y = 1.101x - 0.556	0.998	
B32	B32	04/02/2022	y = 1.208x - 5.034	0.997	
B33	B33	07/02/2022	y = 1.242x - 5.616	0.999	
B34	B34	09/02/2022	y = 1.240x - 8.273	0.999	

Calibrated by :

Approved by :

High Volume PM-10 Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard				Model : TE 50/25A	S/N : 30/95
Calibration Data					
High Volume PM-10 Data		Calibration Data			
Recorder No.	Blower No.	Date	Actual Flowrate (l/min)	R <sup>2</sup>	
B01	B01	02/02/2022	y = 1.199x - 0.729	0.999	
B02	B02	04/02/2022	y = 1.047x + 3.100	0.999	
B03	B03	07/02/2022	y = 1.212x + 3.555	0.997	
B04	B04	09/02/2022	y = 1.314x - 9.389	1.000	
B05	B05	03/02/2022	y = 1.207x - 5.472	0.995	
B06	B06	04/02/2022	y = 1.260x - 8.728	0.997	
B07	B07	04/02/2022	y = 1.212x - 5.353	0.996	
B08	B08	09/02/2022	y = 1.285x - 7.356	0.998	
B09	B09	08/02/2022	y = 1.243x - 6.277	1.000	
B10	B10	07/02/2022	y = 1.285x - 9.647	0.998	
B11	B11	02/02/2022	y = 1.240x - 6.135	0.995	
B12	B12	01/02/2022	y = 1.285x - 9.647	0.998	
B13	B13	04/02/2022	y = 1.302x - 9.419	0.996	
B14	B14	07/02/2022	y = 1.199x + 3.376	0.998	
B15	B15	04/02/2022	y = 1.118x - 0.993	0.995	
B16	B16	04/02/2022	y = 1.190x - 1.101	0.998	
B17	B17	03/02/2022	y = 1.201x - 2.953	0.998	
B18	B18	07/02/2022	y = 1.143x - 1.983	0.998	
B19	B19	03/02/2022	y = 1.036x + 1.865	0.998	
B20	B20	03/02/2022	y = 1.201x - 6.181	0.997	
B21	B21	04/02/2022	y = 1.158x - 0.828	0.998	
B22	B22	04/02/2022	y = 1.290x - 8.497	0.998	
B23	B23	07/02/2022	y = 1.090x - 0.542	1.000	
B24	B24	01/02/2022	y = 1.218x - 6.279	0.998	
B25	B25	01/02/2022	y = 1.156x - 3.313	0.997	
B26	B26	07/02/2022	y = 1.135x + 1.438	0.998	
B27	B27	02/02/2022	y = 1.260x - 8.474	0.998	
B28	B28	04/02/2022	y = 1.090x - 0.306	0.999	
B29	B29	04/02/2022	y = 1.262x - 8.639	1.000	
B30	B30	03/02/2022	y = 1.219x - 6.529	0.996	
B31	B31	17/02/2022	y = 1.059x + 0.716	0.997	
B32	B32	16/02/2022	y = 1.154x - 3.610	0.999	
B33	B33	03/02/2022	y = 1.258x - 8.776	0.999	
B34	B34	16/02/2022	y = 1.123x + 0.227	0.995	

Calibrated by :

Approved by :

Gas Sampler Box Calibration Report

Calibration Method : Dry Cal Primary Flowmeter Model : Dry Cal DCL-ML S/N : 136164

Gas Sampler Data		Calibration Data			
		Setting		Actual Flow Rate (ml/min)	
No.	Rotameter	Date	(Constant Flow) (ml/min)	Sampling Line A	Sampling Line B
				Standard Condition	Standard Condition
B01	2 (A&B)	03/03/2022	200	200.5	200.4
B02	2 (A&B)	03/03/2022	200	200.3	200.5
B03	2 (A&B)	03/03/2022	200	200.5	200.5
B04	2 (A&B)	03/03/2022	200	200.4	200.6
B05	2 (A&B)	03/03/2022	200	200.5	200.5
B06	2 (A&B)	03/03/2022	200	200.6	200.4
B07	2 (A&B)	03/03/2022	200	200.5	200.5
B08	2 (A&B)	03/03/2022	200	200.5	200.5
B09	2 (A&B)	04/03/2022	200	200.6	200.5
B10	2 (A&B)	04/03/2022	200	200.4	200.5
B11	2 (A&B)	04/03/2022	200	200.6	200.6
B12	2 (A&B)	04/03/2022	200	200.5	200.6
B13	2 (A&B)	04/03/2022	200	200.5	200.5
B14	2 (A&B)	04/03/2022	200	200.6	200.6
B15	2 (A&B)	04/03/2022	200	200.6	200.5
B16	2 (A&B)	04/03/2022	200	200.4	200.5
B17	2 (A&B)	04/03/2022	200	200.5	200.5

Calibrated by : Approved by :

CALIBRATION REPORT

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

DATE : 29 March 2022 BRAND : API MODEL : 200A  
NO. NOX-B14 SERIAL NO. 212

Brand : API Model : 700  
Last Cal. Date : 05 August 2021 Serial No. : 911

Standard Gas : Nitric Oxide (NO) Cylinder No. : A00917SK  
Certified Date : 01 June 2020 Expired Date : 01 June 2022 Cylinder Conc. : 49.9 ppm

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	%Diff
Zero	0	0.11	-
NO Span	400	400.1	0.025
NO <sub>x</sub> Span	400	400.2	0.050

API Model 200A 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	512	cc/min	500 ± 50
OZONE FLOW	79	cc/min	80 ± 15
PMT	103.3	mV	-20 - 150
AZERO	94.2	mV	-20 - 150
HVPS	675	V	420 - 900 constant
RCCELL TEMP	50.4	°C	50 ± 1
BOX TEMP	29.3	°C	8 - 48
PMT TEMP	7.2	°C	7 ± 2
MOLY TEMP	315.3	°C	315 ± 5
RCCELL 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 <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	1.4	mV	-20 to +150
NO <sub>x</sub> Offset	0.9	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 : 29 March 2022	BRAND : API	MODEL : TML-41M
NO. NOX-B20		SERIAL NO. N02782
Calibrator (Dilution System)		
Brand : API	Model : 700	
Last Cal. Date : 05 August 2021	Serial No. : 911	
Reference Standard Gas		
Standard Gas : Nitric Oxide (NO)	Cylinder No. : A00917SK	
Certified Date : 01 June 2020	Expired Date : 01 June 2022	Cylinder Conc. : 49.9 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	400.2
NO <sub>x</sub> Span	400	400.3
		Slope
		0
		400.0
		1.007
		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	508	cc/min	500 ± 50
OZONE FLOW	78	cc/min	80 ± 15
PMT	103.1	mV	-20 - 150
AZERO	94.0	mV	-20 - 150
HVPS	672	V	420 - 900 constant
RCCELL TEMP	50.1	°C	50 ± 1
BOX TEMP	29.2	°C	8 - 48
PMT TEMP	7.4	°C	7 ± 2
MOLY TEMP	315.2	°C	315 ± 5
RCCELL PRESS	8.4	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	1.007	-	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 : 29 March 2022	BRAND : API	MODEL : TML-41M
NO. NOX-B21		SERIAL NO. N02374
Calibrator (Dilution System)		
Brand : API	Model : 700	
Last Cal. Date : 05 August 2021	Serial No. : 911	
Reference Standard Gas		
Standard Gas : Nitric Oxide (NO)	Cylinder No. : A00917SK	
Certified Date : 01 June 2020	Expired Date : 01 June 2022	Cylinder Conc. : 49.9 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	399.8
NO <sub>x</sub> Span	400	400.1
		Slope
		0
		-0.050
		400.0
		1.003
		1.007

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	503	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	8.3	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	1.003	-	1.0 ± 0.3
NO <sub>x</sub> Slope	1.007	-	1.0 ± 0.3
NO Offset	1.2	mV	-20 to +150
NO <sub>x</sub> 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 :

Approved by :





QUALITY CALIBRATION CO.,LTD.  
235 Petekkasem 63/2 Road, Laksoong, Bangkok 10160  
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584  
www.qcalibration.com



CERTIFICATE No : 22M2570  
REFERENCE No : 64386-4

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## 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 : TEJNITHI 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.

F-G010 REV 02



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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  
AMBIENT TEMPERATURE : 22 $^{\circ}$  C  $\pm$  1 $^{\circ}$  C

### 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 :-

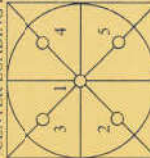
1. STANDARD WEIGHT SET  
E2  
OK-1-151  
SERIAL No  
CERTIFICATE No  
C02210415  
DUE DATE  
09-Feb-23
3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.  
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.  
5. THIS CERTIFICATE IS TRACEABLE TO THE 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	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

F-

<b>Lambda UV Preventive Maintenance (PM)</b>				
<b>Company Name:</b>	S.P.S. CONSULTING SERVICE CO., LTD.			
<b>Address:</b>	7, Soi Phaholyothin24, Ladyao, Jatujak, Bangkok			
<b>User Name:</b>		<b>WO Number:</b>	WO-01632701	
<b>Telephone Number:</b>	086-141-2523	<b>PM Number:</b>	1 of 6	
<b>Customer Support Engineer:</b>		<b>Certificate Number:</b>	UV2005-2022	
<b>Date PM Performed:</b> (DD-MMM-YYYY)	25-Jan-2022	<b>Next PM Due Date:</b> (DD-MMM-YYYY)	25-Jul-2022	

<b>Part Number</b>	<b>Release</b>	<b>Publication Date</b>	 <b>PerkinElmer®</b> <i>For the Better</i>
09370504	B	March 2013	

#### 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
Lambda 365	365K6121203	4.1.2	STD
-	-	-	-
-	-	-	-
-	-	-	-

## Parts Lists

Parts Included with the PM				
Part Number (if applicable)	Description	Quantity	Serial Number	Expiration Date (MM/YY)
B250 0099	Stray Light standard			
	NaI cell	1	1943	Jan-22
	NaNO2 cell	1	2963	
	KCl cell	1	31030	
	H2O	1	71497	
B050 7805	Secondary Standards for calibration of wavelength and photometric accuracy or use NBS/NIST 390 standards			
	Gray Glass G1	1	2926	Jan-22
	Gray Glass G2	1	3501	
	Gray Glass G3	1	2552	
	Holmium Glass	1	1085	



Additional Tools Required for PM					
Part Number (if applicable)	Description	Quantity	Serial #	Calibration Due Date (MM/YY)	
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-
Additional Reagents and Standards Required for PM					
Part Number (if applicable)	Description	Quantity	Batch/Lot #	Expiration Date (MM/YY)	
-	-	-	-	-	-
-	-	-	-	-	-
-	-	-	-	-	-

## 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. Test:

Refer to **Appendix A** for the specifications of the instrument being tested.

- ☒ D2 Wavelength accuracy

	Actual Value	Specification
Accuracy at 656.1 nm	656.05	± 0.1

☒ Holmium Oxide wavelength accuracy. (Specification  $\pm 0.5$  nm.)

Filter ID #		1085	
Test	Calibration Value	Actual Value	Deviation
279.3 nm	278.1	278.05	-0.08
360.8 nm	416.3	416.2	-0.05

☒ Scattered Light.

Test	Filter ID #	Result	Specification
NaI @ 220 nm	1943	0.0031	$< 0.02\%$ T
NaNO <sub>2</sub> @ 340 nm	2963	0.0097	$< 0.02\%$ T
KCl @ 198 nm	31030	0.0993	$< 1\%$ T

☒ Baseline Flatness.

Corrected Baseline	Specification
0.0475	$< 0.002$ A

☒ Noise Test @ 700 nm.

Actual Value	Specification
0.0000000	$< 0.00005$ A

☒ Photometric Accuracy.

Filter 1 ID #		2926		
Test	Calibrated Value	Actual Value	Deviation	Specification
440 nm	0.3483	0.3453	0.0030	$\pm 0.0047$ A
546 nm	0.3029	0.3007	0.0022	$\pm 0.0047$ A
635 nm	0.3200	0.3192	0.0008	$\pm 0.0047$ A
Filter 2 ID #		3501		
Test	Calibrated Value	Actual Value	Deviation	Specification
440 nm	1.001	0.9972	0.0038	$\pm 0.0047$ A
546 nm	0.9797	0.9775	0.0022	$\pm 0.0047$ A
635 nm	1.0285	1.0285	0.0000	$\pm 0.0047$ A
Filter 3 ID #		2552		
Test	Calibrated Value	Actual Value	Deviation	Specification
440 nm	0.489	0.4866	0.0024	$\pm 0.0067$ A
546 nm	0.4582	0.4541	0.0041	$\pm 0.0067$ A
635 nm	0.5046	0.5020	0.0026	$\pm 0.0067$ A



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.
- ☒ Update Logbook.



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:  25-Jan-2022 (DD-MM-YYYY)
Authorized Customer Representative:	Date:  25-Jan-2022 (DD-MM-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 :

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

(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
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	0.2421	-0.0015	0.0101	2.00	
		40	0.4905	0.4865	-0.0040	0.0115	2.00	
		60	0.7453	0.7403	-0.0050	0.0067	2.00	
		80	0.9920	0.9919	-0.0001	0.0071	2.00	
		100	1.2487	1.2614	0.0127	0.0073	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 5-2

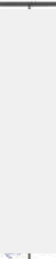

เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศ  
จากปล่อง

## Console Calibration Report

Calibration Method		Critical Offices		
Calibration Data				
Console Data		Calibration Data		
No.	Serial No.	Date	y	$\Delta H_{\infty}$ (mmH <sub>2</sub> O)
B01	1563	02/03/2022	0.998	50.11
B02	8002514	02/03/2022	0.996	49.25
B03	1503016	03/03/2022	0.998	50.20
B04	00006659	03/03/2022	1.005	49.64
B05	00007428	03/03/2022	1.002	49.80
R01	1561	02/03/2022	1.003	50.18
R02	8002513	03/03/2022	0.999	49.38
R03	1570	04/03/2022	1.003	49.14
R04	8002519	04/03/2022	0.999	49.52
R05	1503015	01/03/2022	1.007	50.08

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

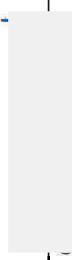
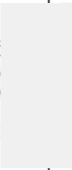
Accept Value of  $\Delta H_{\infty}$  (test) is  $46.7 \pm 6.4$  (mmH<sub>2</sub>O)

Calibrated by : 	Approved by : 
--	--

## Pitot Tube Calibration Report

Calibration Method			Standard Pitot Tube		
Calibration Data					
Pitot Tube Data			Calibration Data		
No.	Type of Pitot	Coefficient of Standard Pitot	Date	Avg. of Cp (test)	
				Side A	Side B
B03	S	0.99	01/02/2022	0.83	0.84
B04	S	0.99	02/02/2022	0.84	0.84
B05	S	0.99	01/02/2022	0.84	0.84
B07	S	0.99	01/02/2022	0.84	0.84
B08	S	0.99	01/02/2022	0.84	0.85
B09	S	0.99	02/02/2022	0.84	0.84
B11	S	0.99	02/02/2022	0.83	0.84
B16	S	0.99	02/02/2022	0.83	0.84
B18	S	0.99	03/02/2022	0.84	0.84
B19	S	0.99	03/02/2022	0.85	0.84
B21	S	0.99	02/02/2022	0.84	0.84
B24	S	0.99	04/02/2022	0.85	0.84
B27	S	0.99	04/02/2022	0.84	0.84
B30	S	0.99	04/02/2022	0.84	0.84
B31	S	0.99	02/02/2022	0.83	0.84
B33	S	0.99	02/02/2022	0.84	0.84
B35	S	0.99	03/02/2022	0.84	0.84

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

Calibrated by : 	Approved by : 
---	---

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-II

S/N : 136164

Pitot Tube Calibration Report

Calibration Method

Standard Pitot Tube

Calibration Data

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

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

Calibrated by :

Approved by :

Environmental Conditions

Temperature : 25 ± 3 °C

Pressure : 1010 ± 15 mmbar

Personal Pump Data

Date

Serial No.

Model

Flow Rate (m³/min)

Settling

Actual (Q act.)

Value From Calibration Curve

R²

Y

X

1

2

3

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บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด  
S.P.S. CONSULTING SERVICE CO., LTD.  
7 ซอยพหลโยธิน 24 แขวงพญาไท เขตพญาไท กรุงเทพฯ 10900  
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900  
Tel : (662) 339-4376-27 Fax : (662) 513-4221 E-mail : sales@spsc.com, www.spsc.com

### Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter				Model : Defender 510-II				S/N : 136164					
Rotameter Data				Calibration Data									
No.	Brand	Model	Date	Flow Rate (cm³/min)						Value From Calibration Curve			
				Flow Rate (Reading)			Actual (Q std.)						
				1	2	3	1	2	3	R²			
H-801	Dwyer	VFB-65	01/04/2022	500	1,000	2,000	505.5	988.5	1973.5	0.990x + 8.613	1.000		
H-802	Dwyer	VFB-65	04/04/2022	500	1,000	2,000	495.5	997.8	1995.3	0.998x - 4.832	1.000		
H-803	Dwyer	VFB-65	01/04/2022	500	1,000	2,000	499.3	987.0	2009.2	1.004x - 13.566	0.999		
H-804	Dwyer	VFB-65	01/04/2022	500	1,000	2,000	500.4	999.1	2008.7	0.998x - 2.137	1.000		
H-805	Dwyer	VFB-65	01/04/2022	500	1,000	2,000	498.6	987.4	1972.3	0.991x + 20.608	1.000		
H-806	Dwyer	VFB-65	05/04/2022	500	1,000	2,000	501.0	983.4	1981.4	1.006x + 12.163	0.999		
H-807	Dwyer	VFB-65	01/04/2022	500	1,000	2,000	504.5	988.6	2018.3	1.001x + 1.713	1.000		
H-808	Dwyer	VFB-65	04/04/2022	500	1,000	2,000	498.8	999.2	1975.4	0.998x - 3.887	0.999		
H-809	Dwyer	VFB-65	01/04/2022	500	1,000	2,000	503.7	1007.0	2014.3	0.994x - 14.557	1.000		
H-810	Dwyer	VFB-65	01/04/2022	500	1,000	2,000	493.7	988.6	2012.4	0.998x + 0.535	1.000		

Calibrated by :  Approved by : 

CAL

Calibratech Co., Ltd.

7/106-7 Moo 2, Sukdaphachuan 3 Rd., Banggood, Pakkret, Nonthaburi 11120  
Tel: (02) 964-6211 Fax: (02) 964-5155, e-mail: calibratech.co@yahoo.com, calibratech.co@gmail.com



MSC-TSR-TS17025  
CALIBRATION 0036

## Certificate of Calibration

Certificate No. : 64-220066-3

Page : 1 of 2

Submitted by :

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

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

Equipment :

Vacuum Gauge

Manufacturer :

HI-LIGHT

Model : N/A

ID No. :

3

Range :

0 in Hg to -30 in Hg Resolution : 1 in Hg

Environment :

Ambient Temperature :

(20 ± 2) °C

Relative Humidity :

(50 ± 10) %

Date of Received : 02 July 2021

Date of Calibration : 05 July 2021

Date of Issue : 05 July 2021

Calibrated by :

Calibration Method :

In-house method CAL-M2201 based on BS EN 837-1:2016 with Pressure Calibrator

Reference Standard Instruments :

This certification is traceable to the International System of Units

Pressure Calibrator & Pressure Sensors Modules

ID No.

Cert. No.

Due Date

Traceability

220007

MP-0036-20

11 Mar 2022

National Institute of Metrology (Thailand), (NIMT)

220001

MP-0036-20

11 Mar 2022

National Institute of Metrology (Thailand), (NIMT)

Approved by :

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full except with the prior written approval of the Calibratech Co., Ltd.

CAL-F0031-03



## Certificate of Calibration

Certificate No. : 64-220066-3

Page : 2 of 2

Result of Calibration : Without Adjustment

Function : Vacuum measurement

Condition of calibration :

1 Scale and conversion factor is 1 kPa = 0.295 in Hg

2 Angle of mounting from horizontal at 90°

3 UUC reading after tightly tapped

4 Reference plane of UUC at center of Gauge

5 UUC calibrated by using clean air as pressure media

6 UUC Condition As-Received : Good

Standard Reading ( in Hg )	UUC Reading ( in Hg )	Correction ( in Hg )
0.00	0	0.0
-4.81	-5	0.2
-9.92	-10	0.1
-15.10	-15	-0.1
-20.29	-20	-0.3
-30.33	-30	-0.3
-30.32	-30	-0.3
-20.31	-20	-0.3
-15.07	-15	-0.1
-9.89	-10	0.1
-4.79	-5	0.2
0.00	0	0.0

Remark

UUC : Unit Under Calibration

The uncertainty is combined hysteresis

The uncertainty of measurement was with in  $\pm 0.39$  in Hg

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

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

-o0o-



QUALITY CALIBRATION CO., LTD.

235 Petchkasem 63/2 Road, Laksong, Banglae, Bangkok 10160  
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584  
www.qcalibration.com



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 :

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 ± 1mbar  
AMBIENT TEMPERATURE : 22° C ± 1° C  
RELATIVE HUMIDITY : 49 %RH ± 10 % RH

RECEIVED DATE : 11-Mar-22  
CALIBRATION DATE : 11-Mar-22

XSR 105DU  
B926859981

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

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT MODEL SERIAL No CERTIFICATE No DUE DATE  
1) STANDARD WEIGHT SET E2 QK-1151 C02210415 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 (± 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  
CARRIED OUT AT THE CUSTOMER'S PLACE AT PRODUCTION AREA  
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:	F	WO Number:	WO-01632701
Telephone Number:	086-141-2523	PM Number:	1 of 6
Customer Support Engineer:		Certificate Number:	UV2005-2022
Date PM Performed: (DD-MMM-YYYY)	25-Jan-2022	Next PM Due Date: (DD-MMM-YYYY)	25-Jul-2022

Part Number	Release	Publication Date
09370504	B	March 2013

PerkinElmer

### 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
Lambda 365	365K6121203	4.1.2 STD	-
-	-	-	-
-	-	-	-
-	-	-	-

## Parts Lists

Parts Included with the PM				
Part Number (if applicable)	Description	Quantity	Serial Number	Expiration Date (MM/YY)
B250 0099	Stray Light standard			
	NaI cell	1	1943	Jan-22
	NaNO <sub>2</sub> cell	1	2963	
	KCl cell	1	31030	
	H <sub>2</sub> O	1	71497	
B050 7805	Secondary Standards for calibration of wavelength and photometric accuracy or use NBS/NIST 390 standards			
	Gray Glass G1	1	2926	Jan-22
	Gray Glass G2	1	3501	
	Gray Glass G3	1	2552	
	Holmium Glass	1	1085	

## Additional Tools Required for PM

Part Number (if applicable)	Description	Quantity	Serial #	Calibration Due Date (MM/YY)
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-

## Additional Reagents and Standards Required for PM

Part Number (if applicable)	Description	Quantity	Batch/Lot #	Expiration Date (MM/YY)
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-



## 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. Test:

Refer to Appendix A for the specifications of the instrument being tested.

- ☒ D2 Wavelength accuracy

	Actual Value	Specification
Accuracy at 656.1 nm	656.05	± 0.1

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

Filter ID #		1085	
Test	Calibration Value	Actual Value	Deviation
279.3 nm	278.1	278.05	-0.08
360.8 nm	416.3	416.2	-0.05

- ☒ Scattered Light.

Test	Filter ID #	Result	Specification
NaI @ 220 nm	1943	0.0031	< 0.02 %T
NaNO <sub>2</sub> @ 340 nm	2963	0.0097	< 0.02 %T
KCl @ 198 nm	31030	0.0993	< 1 %T

- ☒ Baseline Flatness.

Corrected Baseline	Specification
0.0475	< 0.002 A

- ☒ Noise Test @ 700 nm.

Actual Value	Specification
0.0000000	< 0.000005 A



☒ Photometric Accuracy.

Filter 1 ID #		2926		
Test	Calibrated Value	Actual Value	Deviation	Specification
440 nm	0.3483	0.3453	0.0030	± 0.0047 A
546 nm	0.3029	0.3007	0.0022	± 0.0047 A
635 nm	0.3200	0.3192	0.0008	± 0.0047 A
Filter 2 ID #		3501		
Test	Calibrated Value	Actual Value	Deviation	Specification
440 nm	1.001	0.9972	0.0038	± 0.0047 A
546 nm	0.9797	0.9775	0.0022	± 0.0047 A
635 nm	1.0285	1.0285	0.0000	± 0.0047 A
Filter 3 ID #		2552		
Test	Calibrated Value	Actual Value	Deviation	Specification
440 nm	0.489	0.4866	0.0024	± 0.0067 A
546 nm	0.4582	0.4541	0.0041	± 0.0067 A
635 nm	0.5046	0.5020	0.0026	± 0.0067 A



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.
- ☒ Update Logbook.

## Additional Comments

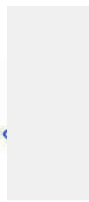
Additional Comments Regarding the PM

## Review

The preventive maintenance checks and if applicable performance tests for Lambda UV have been completed.

This Lambda UV Passes ☒ Fails ☐ the preventive maintenance.

### Review of Preventive Maintenance:

Authorized PerkinElmer Representative:	Date:
	25-Jan-2022 (DD-MM-YYYY)
Authorized Customer Representative:	Date:
	25-Jan-2022 (DD-MM-YYYY)

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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

Cert. No. : SP21012  
Pages 1 of 3

## 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

Cert. No. : SP21012  
Job No. : VC64SP0012  
Pages : 2 of 3

## Calibration Method :

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

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

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

## Condition of this result of calibration :

## 1. Certified reference materials

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-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	
	640.50	640.7	0.20	0.16	2.00	
RM-DL	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	
Neutral Density glass filter	590.0	29381	0.5	0.5076	0.5064	-0.0012	0.0028	2.00	
		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	
	635.0	29381	0.5	0.5364	0.5342	-0.0022	0.0031	2.00	
		29360	1.0	0.9751	0.9737	-0.0015	0.0028	2.00	
Neutral Density glass filter	635.0	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	

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	0.2421	-0.0015	0.0101	2.00	
		40	0.4905	0.4865	-0.0040	0.0115	2.00	
		60	0.7453	0.7403	-0.0050	0.0067	2.00	
		80	0.9920	0.9919	-0.0001	0.0071	2.00	
		100	1.2487	1.2614	0.0127	0.0073	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  $\leq 1.0$  T(%), Absorbance  $\geq 2.0$  A

\*\*Stray light not TISI Accredited

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

End of Calibration Certificate



### เอกสารที่ 5-3

เอกสารสอบเทียบเครื่องมือการตรวจคุณภาพอากาศ  
ในสถานประกอบการ (Working Area)

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter	Model : Defender 510-H	S/N : 136164
--	------------------------	--------------

Environmental Conditions	± 3 °C
Temperature	± 15 mmbar
Pressure	

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter	Model : Defender 510-H	S/N : 136164
--	------------------------	--------------

Environmental Conditions	± 3 °C
Temperature	± 15 mmbar
Pressure	

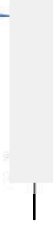

Personal Pump Data				Calibration Data					Value From Calibration Curve			
No.	Brand	Model	Serial No.	Date	Flow Rate (m <sup>3</sup> /min)			Setting	Actual (Q act.)			R <sup>2</sup>
					1	2	3		1	2	3	
B01	SKC	224-PCNR4	691166	05/01/2022	1,000	1,500	2,000	995	1,496	1,995	0.9994 ± 1.638	1,000
B02	SKC	224-PCNR4	691166	05/01/2022	1,000	1,500	2,000	998	1,504	2,001	1,011 ± -24.13	0.999
B03	SKC	224-PCNR4	612668	05/01/2022	1,000	1,500	2,000	995	1,490	1,995	1,001 ± -6.653	1,000
B04	SKC	224-PCNR4	692804	05/01/2022	1,000	1,500	2,000	996	1,496	1,993	0.999 ± -4.391	1,000
B05	SKC	224-PCNR4	612683	05/01/2022	1,000	1,500	2,000	1,003	1,500	2,003	1,012 ± -21.92	0.999
B06	SKC	224-PCNR4	692188	05/01/2022	1,000	1,500	2,000	996	1,504	2,000	1,012 ± -26.66	0.999
B07	SKC	224-PCNR4	692692	05/01/2022	1,000	1,500	2,000	998	1,492	1,994	0.996 ± -1.89	1,000
B08	SKC	224-PCNR4	693100	05/01/2022	1,000	1,500	2,000	1,003	1,499	2,003	1,011 ± -21.92	0.999
B09	SKC	224-PCNR4	696179	05/01/2022	1,000	1,500	2,000	997	1,490	1,994	0.994 ± -3.65	1,000
B10	SKC	224-PCNR4	691160	06/01/2022	1,000	1,500	2,000	994	1,504	2,001	1,016 ± -32.04	0.999
B11	SKC	224-PCNR4	694315	06/01/2022	1,000	1,500	2,000	994	1,490	1,998	1,004 ± -10.40	1,000
B12	SKC	224-PCNR4	694656	06/01/2022	1,000	1,500	2,000	1,001	1,503	2,003	1,012 ± -22.18	0.999
B13	SKC	224-PCNR4	692673	06/01/2022	1,000	1,500	2,000	995	1,498	1,994	1,000 ± -3.701	1,000
B14	SKC	224-PCNR4	692613	06/01/2022	1,000	1,500	2,000	998	1,491	1,988	0.992 ± -6.26	1,000
B15	SKC	224-PCNR4	696174	07/01/2022	1,000	1,500	2,000	1,003	1,501	2,004	1,012 ± -22.06	0.999
B16	SKC	224-PCNR4	696477	07/01/2022	1,000	1,500	2,000	993	1,504	2,000	1,015 ± -31.46	0.999
B17	SKC	224-PCNR4	696660	07/01/2022	1,000	1,500	2,000	997	1,495	1,992	0.995 ± -2.68	1,000
B18	SKC	224-PCNR4	691164	07/01/2022	1,000	1,500	2,000	1,003	1,501	2,001	1,009 ± -16.66	0.999
B19	SKC	224-PCNR4	691199	07/01/2022	1,000	1,500	2,000	992	1,499	1,997	1,003 ± -9.53	1,000
B20	SKC	224-PCNR4	691187	07/01/2022	1,000	1,500	2,000	992	1,504	1,999	1,016 ± -31.95	0.999
B21	SKC	224-PCNR4	691331	07/01/2022	1,000	1,500	2,000	993	1,499	1,992	1,000 ± -5.273	1,000
B22	SKC	224-PCNR4	691164	07/01/2022	1,000	1,500	2,000	1,003	1,501	2,003	1,016 ± -18.16	0.999
B23	SKC	224-PCNR4	692663	07/01/2022	1,000	1,500	2,000	993	1,505	2,002	1,017 ± -34.63	0.999
B24	SKC	224-PCNR4	692663	07/01/2022	1,000	1,500	2,000	1,000	1,501	2,005	1,016 ± -28.38	0.999
B25	SKC	224-PCNR4	798489	06/01/2022	1,000	1,500	2,000	1,000	1,495	1,997	0.997 ± -2.61	1,000
B26	SKC	224-PCNR4	798479	06/01/2022	1,000	1,500	2,000	997	1,497	1,990	0.994 ± -3.261	1,000
B27	SKC	224-PCNR4	691173	06/01/2022	1,000	1,500	2,000	994	1,503	2,001	1,015 ± -31.93	0.999
B28	SKC	224-PCNR4	691170	06/01/2022	1,000	1,500	2,000	1,000	1,500	2,003	1,015 ± -27.02	0.999
B29	SKC	224-PCNR4	696172	06/01/2022	1,000	1,500	2,000	999	1,494	1,998	1,002 ± -6.65	1,000
B30	SKC	224-PCNR4	691498	06/01/2022	1,000	1,500	2,000	1,003	1,500	2,004	1,013 ± -24.06	0.999
B31	SKC	224-PCNR4	691169	06/01/2022	1,000	1,500	2,000	995	1,495	1,995	1,001 ± -4.894	1,000
B32	SKC	224-PCNR4	691167	06/01/2022	1,000	1,500	2,000	994	1,504	2,001	1,014 ± -26.68	0.999
B33	SKC	224-PCNR4	691156	06/01/2022	1,000	1,500	2,000	996	1,496	1,991	0.995 ± -3.63	1,000
B34	SKC	224-PCNR4	692682	06/01/2022	1,000	1,500	2,000	1,001	1,501	2,002	1,012 ± -22.31	0.999
B35	SKC	224-PCNR4	692682	06/01/2022	1,000	1,500	2,000	993	1,498	1,996	1,002 ± -8.44	1,000
B36	SKC	224-PCNR4	693104	05/01/2022	1,000	1,500	2,000	1,000	1,497	1,999	0.999 ± -3.531	1,000
B37	SKC	224-PCNR4	692656	05/01/2022	1,000	1,500	2,000	994	1,504	2,002	1,016 ± -31.04	0.999
B38	SKC	224-PCNR4	693107	10/01/2022	1,000	1,500	2,000	999	1,497	1,996	1,000 ± -1.875	1,000
B39	SKC	224-PCNR4	694337	10/01/2022	1,000	1,500	2,000	1,002	1,500	2,002	1,012 ± -23.40	0.999
B40	SKC	224-PCNR4	798449	10/01/2022	1,000	1,500	2,000	993	1,505	2,000	1,016 ± -32.92	0.999

Calibrated by :	Approved by :
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Personal Pump Data				Calibration Data							Value From Calibration Curve		
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)				Setting	Actual (Q <sub>act</sub> )			R <sup>2</sup>
					1	2	3	1		2	3		
B41	SKC	224-PCNR4	612609	10/01/2022	1,000	1,500	2,000	998	1,496	1,989	0.994 ± 2.680	1,000	
B42	SKC	224-PCNR4	626041	07/01/2022	1,000	1,500	2,000	1,003	1,498	1,993	0.990 ± 11.710	1,000	
B43	SKC	224-PCNR4	604366	05/01/2022	1,000	1,500	2,000	998	1,500	1,992	0.992 ± 8.392	1,000	
B44	SKC	224-PCNR6	629341	07/01/2022	1,000	1,500	2,000	1,004	1,500	2,003	1,011 ± 21.139	0.999	
B45	SKC	224-PCNR4	628594	07/01/2022	1,000	1,500	2,000	997	1,498	1,992	0.995 ± 2.728	1,000	
B46	SKC	224-PCNR6	656743	07/01/2022	1,000	1,500	2,000	994	1,504	2,002	1,015 ± 32.087	0.999	
B47	SKC	224-PCNR6	656747	07/01/2022	1,000	1,500	2,000	1,002	1,501	2,003	1,013 ± 23.580	0.999	
B48	SKC	224-PCNR4	656753	07/01/2022	1,000	1,500	2,000	1,000	1,494	1,996	0.996 ± 1.567	1,000	
B49	SKC	224-PCNR6	656780	07/01/2022	1,000	1,500	2,000	1,002	1,501	2,004	1,012 ± 22.236	0.999	
B50	SKC	224-PCNR6	650400	07/01/2022	1,000	1,500	2,000	1,000	1,493	1,996	0.995 ± 3.641	1,000	
B51	SKC	224-PCNR4	600363	07/01/2022	1,000	1,500	2,000	995	1,504	2,000	1,013 ± 27.704	0.999	
B52	SKC	224-PCNR6	693186	07/01/2022	1,000	1,500	2,000	995	1,498	1,994	0.997 ± 0.283	1,000	
B53	SKC	224-PCNR4	707670	10/01/2022	1,000	1,500	2,000	1,002	1,499	2,004	1,012 ± 23.580	0.999	
B54	SKC	224-PCNR3	609821	05/01/2022	1,000	1,500	2,000	994	1,501	2,001	1,015 ± 32.043	0.999	
B55	SKC	224-PCNR3	510710	06/01/2022	1,000	1,500	2,000	1,000	1,494	1,994	0.994 ± 4.830	1,000	
B56	SKC	224-PCNR3	511400	06/01/2022	1,000	1,500	2,000	1,004	1,502	2,002	1,013 ± 19.248	0.999	
B57	SKC	224-PCNR3	510798	06/01/2022	1,000	1,500	2,000	997	1,492	1,996	0.996 ± 1.747	1,000	
B58	SKC	224-PCNR3	509832	06/01/2022	1,000	1,500	2,000	997	1,499	2,000	1,011 ± 27.010	0.999	
B59	SKC	224-PCNR3	509892	06/01/2022	1,000	1,500	2,000	997	1,495	1,991	0.995 ± 3.833	1,000	
B60	SKC	224-PCNR3	512635	06/01/2022	1,000	1,500	2,000	1,002	1,500	2,004	1,013 ± 24.688	0.999	
B61	SKC	224-PCNR3	503915	06/01/2022	1,000	1,500	2,000	994	1,488	1,999	1,005 ± 12.631	1,000	
B62	SKC	224-PCNR3	506975	10/01/2022	1,000	1,500	2,000	994	1,491	1,995	1,002 ± 0.609	1,000	
B63	SKC	224-PCNR3	511432	10/01/2022	1,000	1,500	2,000	992	1,501	2,000	1,016 ± 33.306	0.999	
B64	SKC	224-PCNR3	508302	10/01/2022	1,000	1,500	2,000	998	1,493	1,990	0.994 ± 4.272	1,000	
B65	SKC	224-PCNR3	508310	10/01/2022	1,000	1,500	2,000	1,002	1,500	2,004	1,012 ± 23.077	0.999	
B66	SKC	224-PCNR3	509861	10/01/2022	1,000	1,500	2,000	997	1,494	1,994	0.993 ± 3.953	1,000	
B67	SKC	224-PCNR3	509875	10/01/2022	1,000	1,500	2,000	993	1,497	2,002	1,017 ± 34.005	0.999	
B68	SKC	224-PCNR3	509872	13/01/2022	1,000	1,500	2,000	1,000	1,495	1,994	0.995 ± 4.188	1,000	
B69	SKC	224-PCNR3	508375	13/01/2022	1,000	1,500	2,000	1,002	1,501	2,002	1,011 ± 21.984	0.999	
B70	SKC	224-PCNR3	510823	13/01/2022	1,000	1,500	2,000	995	1,490	1,997	1,003 ± 7.267	1,000	
B71	SKC	224-PCNR3	508367	13/01/2022	1,000	1,500	2,000	991	1,506	2,001	1,017 ± 35.429	0.999	
B72	SKC	224-PCNR3	505977	13/01/2022	1,000	1,500	2,000	1,001	1,498	1,991	0.991 ± 4.882	1,000	
B73	SKC	224-PCNR3	512606	13/01/2022	1,000	1,500	2,000	1,001	1,501	2,004	1,013 ± 23.520	0.999	
B74	SKC	224-PCNR3	505993	13/01/2022	1,000	1,500	2,000	996	1,495	1,995	1,000 ± 5.161	1,000	
B75	SKC	224-PCNR3	509820	13/01/2022	1,000	1,500	2,000	998	1,499	1,992	0.996 ± 1.831	1,000	
B76	SKC	224-PCNR3	609811	13/01/2022	1,000	1,500	2,000	995	1,496	1,998	1,003 ± 9.050	1,000	
B77	SKC	224-PCNR3	508307	13/01/2022	1,000	1,500	2,000	1,001	1,500	2,004	1,014 ± 26.955	0.999	
B78	SKC	224-PCNR3	510677	12/01/2022	1,000	1,500	2,000	994	1,504	1,994	1,013 ± 28.238	0.999	
B79	SKC	224-PCNR3	510920	12/01/2022	1,000	1,500	2,000	994	1,493	1,994	0.993 ± 4.304	1,000	

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	Calibration Data									
				Flow Rate (Reading)			Flow Rate (m³/mh)			Value From Calibration Curve			
				1	2	3	1	2	3	Actual (Q std.)	y	R²	
H-101	Dwyer	VFB-65	05/01/2022	500	1,000	2,000	497.9	988.8	1983.7	0.998x - 4.774	1.000		
H-102	Dwyer	VFB-65	05/01/2022	500	1,000	2,000	498.7	1002.2	1983.0	0.998x - 1.083	1.000		
H-103	Dwyer	VFB-65	06/01/2022	500	1,000	2,000	497.9	996.3	2004.2	1.003x - 5.511	1.000		
H-104	Dwyer	VFB-65	06/01/2022	500	1,000	2,000	498.8	999.1	1985.1	0.998x - 1.448	1.000		
H-105	Dwyer	VFB-65	06/01/2022	500	1,000	2,000	497.4	997.6	1993.3	0.993x + 6.450	1.000		
H-106	Dwyer	VFB-65	07/01/2022	500	1,000	2,000	497.2	998.8	1985.9	0.992x + 5.181	1.000		
H-107	Dwyer	VFB-65	07/01/2022	500	1,000	2,000	498.9	998.3	1991.6	0.995x + 3.563	1.000		
H-108	Dwyer	VFB-65	06/01/2022	500	1,000	2,000	496.2	992.4	1984.0	0.997x - 1.707	1.000		
H-109	Dwyer	VFB-65	07/01/2022	500	1,000	2,000	502.5	999.1	2007.2	1.003x - 4.310	1.000		
H-110	Dwyer	VFB-65	05/01/2022	500	1,000	2,000	497.3	993.9	2017.0	0.994x + 4.485	1.000		

Calibrated by : 	Approved by : 
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Personal Pump Calibration Report			
Calibration Method : Dry Cal Primary Flowmeter		Model : Defender 510-H	S/N : 136164

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

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R <sup>2</sup>
B80	SKC	224-PCXR3	504560	12/01/2022	1,000	1,500	2,000	1,003	1,499	2,002	1.010x - 20.915	0.999
B81	SKC	224-PCXR3	503480	10/07/2022	1,000	1,500	2,000	994	1,499	2,000	1.015x - 31.401	0.999
B82	SKC	224-PCXR3	505673	10/01/2022	1,000	1,500	2,000	993	1,499	1,996	1.003x - 7.857	1.000
B83	SKC	224-PCXR3	510785	12/01/2022	1,000	1,500	2,000	1,000	1,500	2,002	1.012x - 23.546	0.999
B84	SKC	224-PCXR3	508333	13/07/2022	1,000	1,500	2,000	995	1,497	1,992	0.997x - 0.016	1.000
B85	SKC	224-PCXR3	505757	10/01/2022	1,000	1,500	2,000	993	1,502	1,999	1.014x - 30.555	0.999
B86	SKC	224-PCXR3	512635	10/01/2022	1,000	1,500	2,000	1,002	1,500	2,004	1.013x - 23.520	0.999
B87	SKC	224-PCXR3	504324	13/07/2022	1,000	1,500	2,000	997	1,499	1,997	1.005x - 1.667	1.000
B88	SKC	224-PCXR3	508307	13/01/2022	1,000	1,500	2,000	996	1,495	1,992	0.996x + 0.461	1.000
B89	SKC	224-PCXR3	509400	13/01/2022	1,000	1,500	2,000	1,000	1,501	2,003	1.013x - 25.006	0.999
B90	SKC	224-PCXR3	508506	13/07/2022	1,000	1,500	2,000	992	1,502	2,001	1.017x - 33.531	0.999
B91	SKC	224-PCXR3	510919	13/01/2022	1,000	1,500	2,000	998	1,498	1,997	1.001x - 4.563	1.000
B92	SKC	224-PCXR3	510987	13/01/2022	1,000	1,500	2,000	1,003	1,501	2,004	1.012x - 21.996	0.999
B93	SKC	224-PCXR3	509445	13/01/2022	1,000	1,500	2,000	1,000	1,498	1,999	1.000x - 3.059	1.000

Calibrated by : 	Approved by : 
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# QUALITY CALIBRATION CO., LTD.

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

www.qcalibration.com



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 :  
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.

F-G010 REV 02



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CERTIFICATE No : 22M2570

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL BALANCE  
MANUFACTURER : METTLER TOLEDO  
MODEL : XSR 105DU  
ID No : B926859981  
RECEIVED DATE : 11-Mar-22  
CALIBRATION DATE : 11-Mar-22  
RELATIVE HUMIDITY : 49 %RH  $\pm$  10 % RH  
AIR PRESSURE : 1008mbar  $\pm$  1mbar  
AMBIENT TEMPERATURE : 22°C  $\pm$  1°C

### 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  
QK-1-151  
SERIAL No : C02210415  
DUE DATE : 09-Feb-23
- 2) TARE FUNCTION : NORMAL
- 3) ZERO SETTING FUNCTION : NORMAL
- 4) REPEATABILITY OF READING AT 20 g WAS 0.000014 g
- 5) DEPARTURE FROM NOMINAL VALUE/LINEARITY

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:-

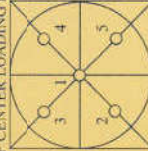
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

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 (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

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMERS 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

F-G010



Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter	Model : Defender 510-H	S/N : 136164
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Environmental Conditions	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.)			Y		R <sup>2</sup>	
B01	SKC	224-PCXR4	582101	01/04/2022	1,000	1,400	2,000	994	1,407	1,898	1.001x - 3.749	1,000		
B02	SKC	224-PCXR4	625166	04/04/2022	1,000	1,500	2,000	1,002	1,505	2,001	1.010x - 20.465	0.999		
B03	SKC	224-PCXR4	612968	04/04/2022	1,000	1,500	2,000	998	1,494	2,000	1.000x - 12.986	1,000		
B04	SKC	224-PCXR4	602604	01/04/2022	1,000	1,500	2,000	1,000	1,502	1,996	1.001x - 2.928	1,000		
B05	SKC	224-PCXR4	612993	12/04/2022	1,000	1,500	2,000	1,003	1,499	2,003	1.012x - 23.001	0.999		
B06	SKC	224-PCXR4	362186	01/04/2022	1,000	1,500	2,000	995	1,508	1,989	1.012x - 25.219	0.998		
B07	SKC	224-PCXR4	652622	01/04/2022	1,000	1,500	2,000	998	1,492	1,995	0.992x - 6.804	1,000		
B08	SKC	224-PCXR4	828100	12/04/2022	1,000	1,500	2,000	1,002	1,499	2,002	1.012x - 22.750	0.999		
B09	SKC	224-PCXR4	628470	01/04/2022	1,000	1,500	2,000	997	1,490	1,994	0.994x - 8.231	1,000		
B10	SKC	224-PCXR4	091950	04/04/2022	1,000	1,500	2,000	994	1,493	2,001	1.010x - 32.394	0.999		
B11	SKC	224-PCXR4	564315	06/04/2022	1,000	1,500	2,000	995	1,490	1,998	1.002x - 0.054	1,000		
B12	SKC	224-PCXR4	034660	01/04/2022	1,000	1,500	2,000	1,003	1,493	2,003	1.011x - 19.603	0.999		
B13	SKC	224-PCXR4	602072	12/04/2022	1,000	1,500	2,000	995	1,500	1,999	1.001x - 4.072	1,000		
B14	SKC	224-PCXR4	626113	05/04/2022	1,000	1,500	2,000	998	1,491	1,988	0.992x - 5.727	1,000		

Approved by :

Personal Pump Calibration Report

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

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>	
					Setting									
B41	SKC	224-PCXR4	612669	04/04/2022	1,000	1,500	2,000	998	1,498	1,989	0.994x + 3.839	1,000	0.994x + 3.839	1,000
B42	SKC	224-PCXR4	619041	01/04/2022	1,000	1,500	2,000	1,003	1,498	1,992	0.990x + 12.248	1,000	0.990x + 12.248	1,000
B43	SKC	224-PCXR4	034636	11/04/2022	1,000	1,500	2,000	1,001	1,501	1,992	0.990x + 12.839	1,000	0.990x + 12.839	1,000
B44	SKC	224-PCXR8	639341	01/04/2022	1,000	1,500	2,000	1,002	1,501	2,002	1.011x - 21.577	0.999	1.011x - 21.577	0.999
B45	SKC	224-PCXR8	639394	12/04/2022	1,000	1,500	2,000	997	1,498	1,992	0.995x + 3.928	1,000	0.995x + 3.928	1,000
B46	SKC	224-PCXR8	666743	04/04/2022	1,000	1,500	2,000	994	1,504	2,002	1.016x + 33.204	0.999	1.016x + 33.204	0.999
B47	SKC	224-PCXR8	666747	01/04/2022	1,000	1,500	2,000	1,002	1,500	2,004	1.013x - 24.202	0.999	1.013x - 24.202	0.999
B48	SKC	224-PCXR8	666750	01/04/2022	1,000	1,500	2,000	999	1,494	1,997	0.999x + 1.198	1,000	0.999x + 1.198	1,000
B49	SKC	224-PCXR8	666780	12/04/2022	1,000	1,500	2,000	1,003	1,502	2,003	1.011x - 21.031	0.999	1.011x - 21.031	0.999
B50	SKC	224-PCXR8	660400	01/04/2022	1,000	1,500	2,000	1,002	1,495	2,002	1.001x + 2.960	1,000	1.001x + 2.960	1,000
B51	SKC	224-PCXR8	603033	01/04/2022	1,000	1,500	2,000	995	1,504	2,000	1.013x - 20.268	0.999	1.013x - 20.268	0.999
B52	SKC	224-PCXR8	093186	11/04/2022	1,000	1,500	2,000	995	1,498	1,994	0.997x + 1.240	1,000	0.997x + 1.240	1,000
B53	SKC	224-PCXR8	707670	01/04/2022	1,000	1,500	2,000	1,002	1,499	2,004	1.013x - 22.742	0.999	1.013x - 22.742	0.999
B54	SKC	224-PCXR8	609821	11/04/2022	1,000	1,500	2,000	993	1,501	2,001	1.016x - 33.718	0.999	1.016x - 33.718	0.999
B55	SKC	224-PCXR8	510716	01/04/2022	1,000	1,500	2,000	1,000	1,494	1,994	0.994x - 4.535	1,000	0.994x - 4.535	1,000
B56	SKC	224-PCXR8	511450	01/04/2022	1,000	1,500	2,000	1,002	1,500	2,001	1.011x - 20.684	0.999	1.011x - 20.684	0.999
B57	SKC	224-PCXR8	510798	12/04/2022	1,000	1,500	2,000	997	1,493	1,998	1.001x + 3.998	1,000	1.001x + 3.998	1,000
B58	SKC	224-PCXR8	509852	04/04/2022	1,000	1,500	2,000	1,001	1,498	2,000	1.007x + 19.531	0.999	1.007x + 19.531	0.999
B59	SKC	224-PCXR8	509862	01/04/2022	1,000	1,500	2,000	996	1,503	1,995	0.998x + 2.516	1,000	0.998x + 2.516	1,000
B60	SKC	224-PCXR8	512655	01/04/2022	1,000	1,500	2,000	1,002	1,500	2,004	1.013x - 23.891	0.998	1.013x - 23.891	0.998
B61	SKC	224-PCXR8	509315	12/04/2022	1,000	1,500	2,000	994	1,489	1,999	1.004x - 11.786	1,000	1.004x - 11.786	1,000
B62	SKC	224-PCXR8	506975	12/04/2022	1,000	1,500	2,000	999	1,494	1,995	0.997x - 0.003	1,000	0.997x - 0.003	1,000
B63	SKC	224-PCXR8	511432	01/04/2022	1,000	1,500	2,000	991	1,501	2,000	1.017x - 36.139	0.999	1.017x - 36.139	0.999
B64	SKC	224-PCXR8	508392	04/04/2022	1,000	1,500	2,000	997	1,493	1,990	0.994x + 3.992	1,000	0.994x + 3.992	1,000
B65	SKC	224-PCXR8	508310	01/04/2022	1,000	1,500	2,000	1,002	1,500	2,003	1.013x - 23.109	0.999	1.013x - 23.109	0.999
B66	SKC	224-PCXR8	509881	12/04/2022	1,000	1,500	2,000	1,002	1,491	1,991	0.987x + 14.701	1,000	0.987x + 14.701	1,000
B67	SKC	224-PCXR8	509298	12/04/2022	1,000	1,500	2,000	993	1,507	2,004	1.017x + 33.104	0.999	1.017x + 33.104	0.999
B68	SKC	224-PCXR8	508872	12/04/2022	1,000	1,500	2,000	1,002	1,491	1,997	0.994x + 8.556	1,000	0.994x + 8.556	1,000
B69	SKC	224-PCXR8	508375	01/04/2022	1,000	1,500	2,000	1,001	1,500	2,000	1.010x - 21.659	0.999	1.010x - 21.659	0.999
B70	SKC	224-PCXR8	510623	11/04/2022	1,000	1,500	2,000	992	1,503	1,997	1.002x - 6.693	1,000	1.002x - 6.693	1,000
B71	SKC	224-PCXR8	508387	12/04/2022	1,000	1,500	2,000	991	1,506	2,002	1.018x - 36.227	0.999	1.018x - 36.227	0.999
B72	SKC	224-PCXR8	505977	12/04/2022	1,000	1,500	2,000	1,001	1,498	1,993	0.992x + 7.087	1,000	0.992x + 7.087	1,000
B73	SKC	224-PCXR8	512606	01/04/2022	1,000	1,500	2,000	1,001	1,501	2,005	1.014x - 24.517	0.999	1.014x - 24.517	0.999
B74	SKC	224-PCXR8	509993	12/04/2022	1,000	1,500	2,000	996	1,495	1,994	0.999x + 4.453	1,000	0.999x + 4.453	1,000
B75	SKC	224-PCXR8	509850	12/04/2022	1,000	1,500	2,000	996	1,499	1,992	0.995x + 2.459	1,000	0.995x + 2.459	1,000
B76	SKC	224-PCXR8	609811	12/04/2022	1,000	1,500	2,000	992	1,498	1,996	1.007x + 15.040	1,000	1.007x + 15.040	1,000
B77	SKC	224-PCXR8	608301	12/04/2022	1,000	1,500	2,000	1,000	1,500	2,003	1.014x - 26.643	0.999	1.014x - 26.643	0.999
B78	SKC	224-PCXR8	510677	01/04/2022	1,000	1,500	2,000	996	1,503	1,999	1.012x - 27.520	0.999	1.012x - 27.520	0.999
B79	SKC	224-PCXR8	510950	01/04/2022	1,000	1,500	2,000	994	1,493	1,994	0.999x + 3.708	1,000	0.999x + 3.708	1,000

Calibrated by :

Approved by :

Personal Pump Calibration Report														
Calibration Method : Dry Cal Primary Flowmeter					Model : Defender 510-H									
Environmental Conditions														
Temperature : 25 ± 3 °C														
Pressure : 1010 ± 15 mmbar														
Personal Pump Data														
No.	Brand	Model	Serial No.	Date	Calibration Data									
					Flow Rate (ml/min)									
					Setting									
					1	2	3	1	2	3				
										Actual (Q act.)				
										Value From Calibration Curve				
										R <sup>2</sup>				
R01	SKC	224-PCXR4	602407	04/04/2022	1,000	1,500	2,000	993	1,508	2,004	1,020x - 35.784	0.999		
R02	SKC	224-PCXR4	626460	04/04/2022	1,000	2,000	3,000	999	1,499	1,990	0.988x + 12.627	1,000		
R03	SKC	224-PCXR4	691992	04/04/2022	1,000	1,500	2,000	1,003	1,500	2,004	1,013x - 22.479	0.999		
R04	SKC	224-PCXR4	691672	01/04/2022	1,000	1,500	2,000	998	1,493	1,993	0.998x - 2.561	1,000		
R05	SKC	224-PCXR4	708470	01/04/2022	1,000	1,500	2,000	994	1,506	1,999	1,015x - 20.635	0.999		
R06	SKC	224-PCXR4	708466	04/04/2022	1,000	1,500	2,000	994	1,498	1,994	1,002x - 7.438	1,000		
R07	SKC	224-PCXR4	798480	04/04/2022	1,000	1,500	2,000	994	1,490	2,000	1,008x - 16.831	1,000		
R08	SKC	224-PCXR4	892315	01/04/2022	1,000	1,500	2,000	1,001	1,502	2,005	1,016x - 26.627	0.999		
R09	SKC	224-PCXR4	034660	01/04/2022	1,000	1,500	2,000	991	1,504	2,002	1,018x - 36.538	0.999		
R10	SKC	224-PCXR4	091765	01/04/2022	1,000	1,500	2,000	996	1,312	1,993	1,000x + 0.219	1,000		
R11	SKC	224-PCXR4	091763	12/04/2022	1,000	1,500	2,000	1,001	1,499	2,002	1,012x - 23.923	0.999		
R12	SKC	224-PCXR4	091666	12/04/2022	1,000	1,500	2,000	997	1,501	1,999	1,001x - 4.886	1,000		
R13	SKC	224-PCXR4	091638	04/04/2022	1,000	1,500	2,000	1,002	1,498	1,993	0.991x + 10.793	1,000		
R14	SKC	224-PCXR4	091764	04/04/2022	1,000	1,500	2,000	994	1,502	1,998	1,013x - 23.236	0.999		
R15	SKC	224-PCXR6	528437	01/04/2022	1,000	1,500	2,000	1,002	1,500	2,004	1,016x - 24.345	0.999		
R16	SKC	224-PCXR6	528643	04/04/2022	1,000	1,500	2,000	998	1,497	1,994	0.997x + 0.060	1,000		
R17	SKC	224-PCXR6	528645	04/04/2022	1,000	1,500	2,000	994	1,509	2,000	1,015x - 30.671	0.999		
R18	SKC	224-PCXR6	609766	04/04/2022	1,000	1,500	2,000	991	1,496	1,998	1,002x - 7.678	1,000		
R19	SKC	224-PCXR6	566802	01/04/2022	1,000	1,500	2,000	1,003	1,499	2,000	1,010x - 20.189	0.999		
R20	SKC	224-PCXR6	528089	04/04/2022	1,000	1,500	2,000	990	1,501	2,003	1,020x - 40.636	0.999		
R21	SKC	224-PCXR6	665728	01/04/2022	1,000	1,500	2,000	999	1,493	1,999	1,000x - 5.364	1,000		
R22	SKC	224-PCXR6	707444	04/04/2022	1,000	1,500	2,000	1,002	1,500	2,001	1,011x - 21.215	0.999		
R23	SKC	224-PCXR6	761067	11/04/2022	1,000	1,500	2,000	999	1,494	1,992	0.994x + 3.095	1,000		
R24	SKC	224-PCXR6	707093	01/04/2022	1,000	1,500	2,000	996	1,505	2,001	1,014x - 29.040	0.999		
R25	SKC	224-PCXR6	761052	01/04/2022	1,000	1,500	2,000	998	1,500	1,992	0.992x + 7.639	1,000		
R26	SKC	224-PCXR6	707056	12/04/2022	1,000	1,500	2,000	1,002	1,500	2,004	1,013x - 24.417	0.999		
R27	SKC	224-PCXR6	707066	04/04/2022	1,000	1,500	2,000	996	1,503	2,001	1,013x - 28.725	0.999		
R28	SKC	224-PCXR6	707481	11/04/2022	1,000	1,500	2,000	1,004	1,500	2,003	1,010x - 19.368	0.999		
R29	SKC	224-PCXR6	707402	01/04/2022	1,000	1,500	2,000	1,003	1,493	1,991	0.988x + 14.326	1,000		
R30	SKC	224-PCXR6	093811	01/04/2022	1,000	1,500	2,000	998	1,495	1,994	0.998x - 1.266	1,000		
R31	SKC	224-PCXR6	093183	01/04/2022	1,000	1,500	2,000	1,001	1,501	2,001	1,012x - 23.001	0.999		
R32	SKC	224-PCXR6	671950	04/04/2022	1,000	1,500	2,000	1,000	1,498	1,994	0.994x + 7.762	1,000		
R33	SKC	224-PCXR6	628254	12/04/2022	1,000	1,500	2,000	992	1,502	1,999	1,016x - 34.141	0.999		
R34	SKC	224-PCXR4	628131	01/04/2022	1,000	1,500	2,000	1,002	1,496	2,004	1,012x - 24.294	0.999		
R35	SKC	224-PCXR6	707460	04/04/2022	1,000	1,500	2,000	998	1,498	1,995	0.994x + 5.872	1,000		
R36	SKC	224-PCXR6	707446	01/04/2022	1,000	1,500	2,000	1,003	1,500	2,001	1,010x - 18.192	0.999		
R37	SKC	224-PCXR6	707432	01/04/2022	1,000	1,500	2,000	999	1,499	1,998	0.998x + 0.854	1,000		
R38	SKC	224-PCXR6	707549	01/04/2022	1,000	1,500	2,000	996	1,500	2,002	1,015x - 31.640	0.999		
R39	SKC	224-PCXR6	761096	12/04/2022	1,000	1,500	2,000	1,001	1,496	1,994	0.997x + 2.652	1,000		
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)					Value From Calibration Curve		
				Actual (Q act.)					y	R <sup>2</sup>	
				1	2	3	1	2			3
H-801	Dwyer	VTB-65	01/04/2022	500	1,000	2,000	988.5	1973.6	0.990x + 8.611	1,000	
H-802	Dwyer	VTB-65	04/04/2022	500	1,000	2,000	989.5	1985.3	0.998x - 4.832	1,000	
H-803	Dwyer	VTB-65	01/04/2022	500	1,000	2,000	987.6	2009.2	1.004x - 15.366	0.999	
H-804	Dwyer	VTB-65	01/04/2022	500	1,000	2,000	993.1	2008.7	0.998x - 2.127	1,000	
H-805	Dwyer	VTB-65	01/04/2022	500	1,000	2,000	986.6	1972.3	0.981x + 20.608	1,000	
H-806	Dwyer	VTB-65	05/04/2022	500	1,000	2,000	983.4	1983.4	1.008x + 12.163	0.999	
H-807	Dwyer	VTB-65	01/04/2022	500	1,000	2,000	988.6	2018.3	1.001x + 1.713	1,000	
H-808	Dwyer	VTB-65	04/04/2022	500	1,000	2,000	989.2	1976.4	0.998x - 3.367	0.999	
H-809	Dwyer	VTB-65	01/04/2022	500	1,000	2,000	983.7	2014.3	0.994x - 14.537	1,000	
H-810	Dwyer	VTB-65	01/04/2022	500	1,000	2,000	983.7	2012.4	0.998x + 0.533	1,000	
Calibrated by :				Approved 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 : [REDACTED]

CALIBRATION DATE : 11-Mar-22

APPROVED BY : [REDACTED]

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 :-

1. STANDARD WEIGHT SET  
E2  
OK-1-151  
SERIAL No  
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&amp;MEASURES

## RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

2. TARE FUNCTION : NORMAL

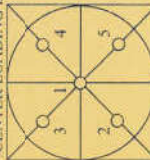
3. REPEATABILITY OF READING AT 20 g WAS 0.000014 g

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

**เอกสารที่ 5-4**

เอกสารสอบเทียบเครื่องมือการตรวจระดับเสียง  
โดยทั่วไปและเสียงในสถานประกอบการ  
(Working Area)





THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0528

MTC No. EEL. BP. 17/0564

## CALIBRATION CERTIFICATE

Submitted by : S.P.S. Consulting Services 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 DE-193A S/N 122037.

2. Measuring Amplifier Brüel&Kjaer 2636 S/N 1537484.

3. Programmable Attenuator Tama-gawa 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 generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

This instrument has been calibrated against standards maintained at Electrical and Electronic Standards

Laboratory (EEL), which are traceable to the International System of Units through the National Institute of

Metrology (Thailand).

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

Date of Receipt : 6 May 2021

Date of Calibration : 15 May 2021

1 / 2

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 : tungs@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

### 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 : sunalee@tistr.or.th

FM.BLMTC.002 Rev.4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0528

MTC No. EEL. BP. 17/0564

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
1/2 inch Brüel&Kjaer 4180	93.96	-0.04	± 0.10	IEC60942:2003 Class 1 ±0.40 dB

### 2. Frequency

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

### 3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit
1/2 inch Brüel&Kjaer 4180	1.26	± 0.50	IEC60942:2003 Class 1 ±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.)

Approved by :

.....  
(Mr.)  
Acting Director

Noise B\_181/22

### 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	15 May 2021		
		Due Date	15 May 2022		
Calibration Data					
Sound Level Meter Data			Calibration Data		
SLIM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]
ACO-B17	ACO	6236	00172042	29 March 2022	Before Adjustment 93.9 After Adjustment 94.0
ACO-B25	ACO	6236	00182006	29 March 2022	94.0 94.0
ACO-B26	ACO	6236	00182007	29 March 2022	94.0 94.0
ACO-B32	ACO	6236	00182014	29 March 2022	94.0 94.0
ACO-B37	ACO	6236	00192028	29 March 2022	94.1 94.0
ACO-B38	ACO	6236	00192029	29 March 2022	94.0 94.0
ACO-B40	ACO	6236	00192031	29 March 2022	94.0 94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.96 ± 0.40 dB

Calibrated by :

Approved by :

Noise B\_179\_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	15 May 2021		
		Due Date	15 May 2022		
Calibration Data					
Sound Level Meter Data			Calibration Data		
SLIM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]
ACO-R50	ACO	6236	00192062	01 April 2022	Before Adjustment 93.9 After Adjustment 94.0
ACO-R51	ACO	6236	00192063	01 April 2022	94.1 94.0
ACO-R52	ACO	6236	00192064	01 April 2022	94.1 94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.96 ± 0.40 dB

Calibrated by :

Approved by :

Note B\_308\_1/22

## Sound Level Meter Calibration Report

Acoustic Calibrator Data			
Brand	ACO	Number	AC 03/56
Model	2127	Serial No.	1300006
Calibration Range	94 dB, 1000 Hz	Last Calibration	28 April 2022
		Due Date	28 April 2023

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
ACO-B29	ACO	6236	00192011	01 June 2022	94.0	94.0
ACO-B36	ACO	6236	00192027	01 June 2022	93.9	94.0
ACO-B41	ACO	6236	00192032	01 June 2022	93.9	94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.9 ± 0.10 dB	

Calibrated by :

Approved by :

*[Signature]*

## เอกสารที่ 5-5

เอกสารสอบเทียบเครื่องมือการตรวจค่าความร้อน  
ในสถานประกอบการ (Working Area)





# CALIBRATION LABORATORY Co., LTD.

2710-11, 55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230  
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cali-lab.com E-mail: info@cali-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. : 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 :

Calibration Engineer



Approved By :

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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getcalibration



# CALIBRATION LABORATORY Co., LTD.

2710-11, 55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230  
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cali-lab.com E-mail: info@cali-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 : 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



getcalibration



# CALIBRATION LABORATORY CO., LTD.

270-11, 14, 55 Soi Prasert Manukit 28 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230  
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-lab.com Email: info@cal-lab.com



ISO/IEC 17025  
CALIBRATION 0659

## 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. 19C0870655 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



@cccalibration



# CALIBRATION LABORATORY CO., LTD.

270-11, 14, 55 Soi Prasert Manukit 28 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230  
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-lab.com Email: info@cal-lab.com



ISO/IEC 17025  
CALIBRATION 0659

## 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

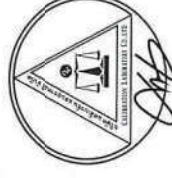
DATE OF RECEIVED : 26 October 2021

DATE OF ISSUED : 29 October 2021

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

Calibrated By :

Calibration Engineer



Approved By :

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. Q21102932

F3-011-04/01-12

page 1 of 3



@cccalibration



CALIBRATION LABORATORY Co., LTD.

210-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230  
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-lab-thailand.com E-mail: info@cal-lab-thailand.com



CLC  
Accredited  
ISO/IEC 17025  
CALIBRATION 0659

## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)  
MANUFACTURER : 3M  
MODEL / TYPE : QUESTemp® 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

page 2 of 3



calibration



CALIBRATION LABORATORY Co., LTD.

210-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230  
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-lab-thailand.com E-mail: info@cal-lab-thailand.com



CLC  
Accredited  
ISO/IEC 17025  
CALIBRATION 0659

#### 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

page 3 of 3



calibration





## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)  
MANUFACTURER : 3M  
MODEL / TYPE : QUESTemp<sup>®</sup>46  
SERIAL NO. : TSJ060005  
CLID. NO. : 232100966  
JOB CONTROL NO. : 210403031526

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

DATE OF RECEIVED : 03 April 2021

DATE OF ISSUED : 17 April 2021

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

Calibrated By :

Calibration Engineer



Approved By :

Authorized Signatory

17 April 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. Q21031526

F3-011-04/01-12

page 1 of 3



calibration



## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)  
MANUFACTURER : 3M  
MODEL / TYPE : QUESTemp<sup>®</sup>46  
SERIAL NO. : TSJ060005  
DATE OF CALIBRATION : 06 April 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 as calibration guidelines.

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  $k = 2$ , 90 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. Q21031526

F3-011-04/01-12

page 2 of 3



calibration





# CALIBRATION LABORATORY CO., LTD.

21/0-11, 14, 55 Soi Prasert Manukit 20 Yaek 4, Prasert Manukit Rd., Ladprao, Bangkok 10250

Tel: 02-578-0353-4 Fax: 02-578-2872 www.call-lab.com E-mail: call@call-lab.com



NSC-TIS 17625  
CALIBRATION 0659  
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	29.98	31.4	-1.42	0.40
35.0	34.99	36.3	-1.31	
40.0	40.01	41.3	-1.29	

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	31.0	-1.02	0.40
35.0	34.99	35.9	-0.91	
40.0	40.01	40.9	-0.89	

##### 3. CORRECTION OF TEMPERATURE [GLOBE BULB]

Test point ( ° C )	Actual Temperature ( ° C )	DUC Reading ( ° C )	Correction ( ° C )	Uncertainty ± ( ° C )
30.0	29.98	31.0	-1.02	0.40
35.0	34.99	36.0	-1.01	
40.0	40.01	40.9	-0.89	

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. Q21031526

F3-011-04/01-12

page 3 of 3



@cdcalibration



Heat B022\_1/22

## Heat Stress WBGT Meter Verification Report

Verification Data			
Heat Stress WBGT Meter No.	: B11	Verification Date	: 01 April 2022
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)	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)	47.2
		Correction (°C)	-0.1
			Tolerance Limit (°C)
			± 0.5
Globe Probe Temperature Measurement			
Verification Module Reading (°C)	69.3	UUC* Reading (°C)	69.2
		Correction (°C)	0.1
			Tolerance Limit (°C)
			± 0.5
UUC* = UNIT UNDER CALIBRATION			

Verified by :

Approved by :

Heat B022\_2/22

Heat Stress WBGT Meter Verification Report					
Verification Data					
Heat Stress WBGT Meter No.	: B17	Verification Date	: 01 April 2022		
Brand	: 3M	Ambient Temp.	: 24.5 °C		
Model	: QUESTemp <sup>®</sup> 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	12.4	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 :

Approved by :

Heat B022\_3/22

Heat Stress WBGT Meter Verification Report					
Verification Data					
Heat Stress WBGT Meter No.	: B34	Verification Date	: 01 April 2022		
Brand	: 3M	Ambient Temp.	: 24.5 °C		
Model	: QUESTemp <sup>o</sup> 46	Barometric Pressure	: 1011 mmbar		
Serial No.	: TSJ060005	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	69.5	-0.2	± 0.5		
UUC* = UNIT UNDER CALIBRATION					

Verified by :

Approved by :



# 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-lab.co.th E-mail: sale@cal-lab.co.th



## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp<sup>o</sup> 34

SERIAL NO. : TEG040059

CLID. NO. : 231802517

JOB CONTROL NO. : 220423041339

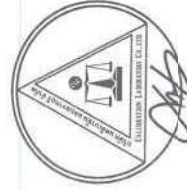
CUSTOMER : S.P.S. CONSULTING SERVICE CO., LTD.  
7 SOI PHAHOLYOTHIN 24 ROAD., JOMPOL,  
CHATUCHAK, BANGKOK 10900

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 :

Calibration Engineer



Approved By :

Authorized Signatory

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. Q22041339

F3-011-04/01-12

page 1 of 3



@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-lab.co.th E-mail: sale@cal-lab.co.th



## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp<sup>o</sup> 34

SERIAL NO. : TEG040059

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 SN. 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. Q22041339

F3-011-04/01-12

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@calibration





CALIBRATION LABORATORY CO., LTD.

210-11,14,55 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



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CALIBRATION 0059  
CIC



Accredited  
ISO/IEC 17025  
CIC

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NSC-TISI-TIS 17025  
CALIBRATION 0059  
CIC

## 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	29.6	+0.40	0.40
35.0	34.99	34.6	+0.39	
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	29.6	+0.40	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	29.9	+0.10	0.40
35.0	34.99	34.7	+0.29	
40.0	39.97	39.6	+0.37	

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. Q22041339

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@calibration

## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M  
MODEL / TYPE : QUESTemp<sup>34</sup>  
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

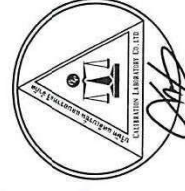
DATE OF RECEIVED : 26 October 2021

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 :

Calibration Engineer



Approved By :

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

page 1 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: 02-578-2872 www.cal-laboratory.com E-mail: sale@cal-laboratory.com



CILC  
Accredited  
ISO/IEC 17025

NSC-TISI-TIS 17025  
CALIBRATION 0059  
CILC

## REPORT OF CALIBRATION

### FOR

NOMENCLATURE	:	DIGITAL THERMOHYGRO METER (THERMAL ENVIRONMENT MONITOR)
MANUFACTURER	:	3M
MODEL / TYPE	:	QUESTemp <sup>34</sup>
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



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CILC  
Accredited  
ISO/IEC 17025

NSC-TISI-TIS 17025  
CALIBRATION 0059  
CILC

#### 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	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 ( $^\circ\text{C}$ )	Actual Temperature ( $^\circ\text{C}$ )	DUC Reading ( $^\circ\text{C}$ )	Correction ( $^\circ\text{C}$ )	Uncertainty $\pm$ ( $^\circ\text{C}$ )
30.0	30.07	30.2	-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 ( $^\circ\text{C}$ )	Actual Temperature ( $^\circ\text{C}$ )	DUC Reading ( $^\circ\text{C}$ )	Correction ( $^\circ\text{C}$ )	Uncertainty $\pm$ ( $^\circ\text{C}$ )
30.0	30.07	30.1	-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

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@clcalibration





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## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp<sup>®</sup> 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

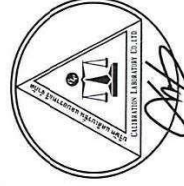
DATE OF RECEIVED : 26 October 2021

DATE OF ISSUED : 29 October 2021

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

Calibrated By :

Calibration Engineer



Approved By :

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. Q21102932

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Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-lab.com E-mail: sale@cal-lab.com



## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp<sup>®</sup> 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  $k = 2$ , 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:2013)"

Certificate No. Q21102932

F3-011-04/01-12

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# 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



NSC-TIS 17025  
CALIBRATION 0059  
CLC



ISO/IEC 17025

## 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	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 ( ° C )	Actual Temperature ( ° C )	DUC Reading ( ° C )	Correction ( ° C )	Uncertainty ± ( ° 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 ( ° C )	Actual Temperature ( ° C )	DUC Reading ( ° C )	Correction ( ° C )	Uncertainty ± ( ° 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

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page 3 of 3



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**บริษัท เอส.พี.เอส. คอนсалต์ติ้ง เซอร์วิส จำกัด**  
**S.P.S. CONSULTING SERVICE CO., LTD.**  
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจตุจักร กรุงเทพฯ 10900  
7 Soi Phaholyothin 24, Phaholyothin Rd., Jomtiat, Chatuchak, Bangkok 10900  
Tel: (062) 939-4370-72 Fax: (062) 503-4221 E-mail: sps@spscs.com www.spscs.com

Heat B070\_1/22

Heat Stress WBGT Meter Verification Report						
Verification Data						
Heat Stress WBGT Meter No.	: B07	Verification Date	: 01 June 2022			
Brand	: 3M	Ambient Temp.	: 24.5 °C			
Model	: QUESTTemp <sup>34</sup>	Barometric Pressure	: 1011 mmbar			
Serial No.	: TEG040059	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)
Dry Probe Temperature Measurement						
Verification Module Reading (°C)	47.1	UUC* Reading (°C)	47.0	Correction (°C)	0.1	Tolerance Limit (°C)
Globe Probe Temperature Measurement						
Verification Module Reading (°C)	69.3	UUC* Reading (°C)	69.4	Correction (°C)	-0.1	Tolerance Limit (°C)
UUC* = UNIT UNDER CALIBRATION						

Verified by : —

Approved by : —



Heat B070\_2/22

Heat Stress WBGT Meter Verification Report					
Verification Data					
Heat Stress WBGT Meter No.	: B11	Verification Date	: 01 June 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 :

Approved by :



Heat B070\_3/22

Heat Stress WBGT Meter Verification Report					
Verification Data					
Heat Stress WBGT Meter No.	: B17	Verification Date	: 01 June 2022		
Brand	: 3M	Ambient Temp.	: 24.5 °C		
Model	: QUESTemp 34	Barometric Pressure	: 1011 mmbar		
Serial No.	: TEL050029	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	47.0	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 :

Approved by :