

ภาคผนวกที่ 5

เอกสารการสอบเทียบเครื่องมือ

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

ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม

รายการตรวจวัด	เครื่องมือเก็บตัวอย่าง	เครื่องมือตรวจวิเคราะห์
1. คุณภาพอากาศในบรรยากาศ <ul style="list-style-type: none"> TSP 	<ul style="list-style-type: none"> High Volume Air Sampler No. B02, B14, B35 	<ul style="list-style-type: none"> Digital Balance
<ul style="list-style-type: none"> PM₁₀ 	<ul style="list-style-type: none"> High Volume PM-10 Air Sampler No. B14, B15, B20 	<ul style="list-style-type: none"> Digital Balance
<ul style="list-style-type: none"> SO₂ 	<ul style="list-style-type: none"> Gas Sampler Box No. B03, B08, B09 	<ul style="list-style-type: none"> Spectrophotometer
<ul style="list-style-type: none"> NO₂ 	<ul style="list-style-type: none"> NO₂ Analyzer No. B10, B20, B22 	<ul style="list-style-type: none"> NO₂ Analyzer No. B10, B20, B22
2. ระดับเสียงโดยทั่วไป <ul style="list-style-type: none"> L_{eq} 1 hr L_{eq} 24 hr L_{max} L₉₀ 	<ul style="list-style-type: none"> Acoustic Calibrator Sound Level Meter No. B30, B33, B34, B37, B38, B40, B41 	-
3. คุณภาพอากาศจากปล่องระบาย <ul style="list-style-type: none"> TSP 	<ul style="list-style-type: none"> Console No. B03 Pitot Tube No. B49 	<ul style="list-style-type: none"> Digital Balance
<ul style="list-style-type: none"> SO₂ 	<ul style="list-style-type: none"> Personal Pump SKC No. B40 Rotameter No. B08 	-
<ul style="list-style-type: none"> NO_x 	<ul style="list-style-type: none"> Vacuum Gauge 	<ul style="list-style-type: none"> Spectrophotometer
4. คุณภาพอากาศในสถานประกอบการ <ul style="list-style-type: none"> Total Dust 	<ul style="list-style-type: none"> Personal Pump SKC No. B11, B36, B66, B75, B81, B84 Rotameter No. H-B06, B07 	<ul style="list-style-type: none"> Digital Balance
5. ระดับเสียงในสถานประกอบการ <ul style="list-style-type: none"> L_{eq} 8 hr L_{max} 	<ul style="list-style-type: none"> Acoustic Calibrator Sound Level Meter No. ACO-B18, B29, B33 Sound Level Meter No. CR-B06, B09, B10 	-
6. ความร้อนในสถานประกอบการ <ul style="list-style-type: none"> WBGT 	<ul style="list-style-type: none"> Digital Thermometer with Probe No. B07, B11, B12, B17, B21, B22 	-

เอกสารที่ 5-1

เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศในบรรยากาศ



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

High Volume Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

Calibration Data

High Volume Air Sampler Data		Calibration Data		
Recorder No.	Blower No.	Date	Actual Flowrate (ft^3/min)	R^2
B01	B01	01/02/2024	$y = 1.224x - 3.492$	0.996
B02	B02	01/02/2024	$y = 1.143x + 1.630$	0.999
B03	B03	01/02/2024	$y = 1.160x - 2.783$	1.000
B04	B04	02/02/2024	$y = 1.267x - 5.884$	0.997
B05	B05	03/02/2024	$y = 1.261x - 7.123$	0.999
B06	B06	02/02/2024	$y = 1.245x - 5.024$	0.999
B07	B07	03/02/2024	$y = 1.209x - 6.025$	0.997
B08	B08	02/02/2024	$y = 1.239x - 5.648$	0.997
B09	B09	02/02/2024	$y = 1.244x - 5.247$	0.997
B10	B10	02/02/2024	$y = 1.153x + 0.064$	0.998
B11	B11	01/02/2024	$y = 1.110x - 1.064$	1.000
B12	B12	03/02/2024	$y = 1.227x - 6.093$	0.999
B13	B13	01/02/2024	$y = 1.286x - 7.460$	1.000
B14	B14	02/02/2024	$y = 1.220x - 5.066$	0.999
B15	B15	02/02/2024	$y = 1.150x - 1.264$	0.999
B16	B16	03/02/2024	$y = 1.177x - 3.231$	0.996
B17	B17	02/02/2024	$y = 1.235x - 5.039$	0.999
B18	B18	03/02/2024	$y = 1.210x - 5.028$	0.998
B19	B19	03/02/2024	$y = 1.215x - 7.087$	0.998
B20	B20	02/02/2024	$y = 1.204x - 4.119$	0.996
B21	B21	02/02/2024	$y = 1.190x - 4.960$	0.999
B22	B22	02/02/2024	$y = 1.208x - 7.133$	0.996
B23	B23	01/02/2024	$y = 1.217x - 4.085$	0.998
B24	B24	01/02/2024	$y = 1.145x - 2.502$	1.000
B25	B25	02/02/2024	$y = 1.090x + 1.068$	0.999
B26	B26	03/02/2024	$y = 1.234x - 5.493$	0.998
B27	B27	01/02/2024	$y = 1.168x - 4.382$	0.999
B28	B28	02/02/2024	$y = 1.237x - 7.982$	0.999
B29	B29	03/02/2024	$y = 1.166x - 2.530$	0.996
B30	B30	02/02/2024	$y = 1.212x - 4.090$	0.997
B31	B31	02/02/2024	$y = 1.195x - 4.732$	0.999
B32	B32	03/02/2024	$y = 1.169x - 0.802$	0.996



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

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Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

Calibration Data

High Volume Air Sampler Data		Calibration Data		
Recorder No.	Blower No.	Date	Actual Flowrate (ft^3/min)	R^2
B35	B35	02/02/2024	$y = 1.188x - 3.435$	0.996
B36	B36	01/02/2024	$y = 1.201x - 4.036$	0.999
B37	B37	01/02/2024	$y = 1.196x - 2.671$	0.998
B38	B38	02/02/2024	$y = 1.232x - 6.552$	0.997
B39	B39	03/02/2024	$y = 1.164x - 0.902$	0.997
B40	B40	01/02/2024	$y = 1.225x - 6.117$	0.999
B41	B41	02/02/2024	$y = 1.265x - 6.140$	0.999
B42	B42	02/02/2024	$y = 1.187x - 3.625$	0.999
B43	B43	01/02/2024	$y = 1.233x - 2.707$	0.997
B44	B44	01/02/2024	$y = 1.202x - 3.263$	0.996
R01	R01	01/02/2024	$y = 1.214x - 4.512$	0.999
R02	R02	02/02/2024	$y = 1.222x - 5.522$	0.999
R03	R03	03/02/2024	$y = 1.204x - 5.785$	0.999
R04	R04	01/02/2024	$y = 1.220x - 5.355$	0.999
R05	R05	01/02/2024	$y = 1.190x - 5.262$	0.997
R06	R06	02/02/2024	$y = 1.223x - 6.383$	0.998
R07	R07	02/02/2024	$y = 1.084x + 0.577$	0.999
R08	R08	01/02/2024	$y = 1.157x - 2.531$	0.999
R09	R09	01/02/2024	$y = 1.194x - 3.227$	0.998
R10	R10	02/02/2024	$y = 1.196x - 4.625$	0.998
R11	R11	02/02/2024	$y = 1.143x - 2.176$	1.000
R12	R12	02/02/2024	$y = 1.165x - 4.124$	0.998
R13	R13	03/02/2024	$y = 1.133x - 1.833$	0.997
R14	R14	01/02/2024	$y = 1.216x - 3.559$	0.995
R15	R15	01/02/2024	$y = 1.183x - 5.143$	0.999
R16	R16	01/02/2024	$y = 1.227x - 7.151$	0.999
R17	R17	02/02/2024	$y = 1.181x - 3.964$	0.996
R18	R18	02/02/2024	$y = 1.195x - 3.915$	0.997
R19	R19	03/02/2024	$y = 1.215x - 6.609$	1.000
R20	R20	03/02/2024	$y = 1.208x - 5.309$	0.998



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

High Volume PM-10 Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

Calibration Data

High Volume PM-10 Data		Calibration Data		
Recorder No.	Blower No.	Date	Actual Flowrate (ft ³ /min)	R ²
B01	B01	02/02/2024	y = 1.147x-0.194	0.996
B02	B02	01/02/2024	y = 1.060x+2.506	1.000
B03	B03	01/02/2024	y = 1.216x-3.895	0.996
B04	B04	01/02/2024	y = 1.224x-5.960	0.999
B05	B05	02/02/2024	y = 1.220x-5.384	0.999
B06	B06	02/02/2024	y = 1.197x-4.228	0.998
B07	B07	03/02/2024	y = 1.206x-4.865	0.996
B08	B08	01/02/2024	y = 1.171x-1.266	0.998
B09	B09	01/02/2024	y = 1.198x-5.197	0.997
B10	B10	01/02/2024	y = 1.219x-5.339	0.997
B11	B11	03/02/2024	y = 1.211x-3.765	0.999
B12	B12	05/02/2024	y = 1.203x-3.968	0.997
B13	B13	05/02/2024	y = 1.158x-1.909	0.996
B14	B14	03/02/2024	y = 1.190x-3.316	0.999
B15	B15	01/02/2024	y = 1.163x-1.150	0.999
B16	B16	01/02/2024	y = 1.170x+0.508	0.999
B17	B17	01/02/2024	y = 1.186x-2.843	0.997
B18	B18	01/02/2024	y = 1.207x-1.821	1.000
B19	B19	03/02/2024	y = 1.178x-2.990	0.999
B20	B20	02/02/2024	y = 1.206x-5.507	0.997
B21	B21	03/02/2024	y = 1.172x-0.702	0.999
B22	B22	02/02/2024	y = 1.175x-1.992	0.996
B23	B23	02/02/2024	y = 1.196x-3.382	0.998
B24	B24	01/02/2024	y = 1.181x-2.463	0.999
B25	B25	01/02/2024	y = 1.204x-3.960	0.997
B26	B26	01/02/2024	y = 1.216x-5.354	0.998
B27	B27	03/02/2024	y = 1.178x-4.891	0.997
B28	B28	02/02/2024	y = 1.226x-6.323	0.999
B29	B29	05/02/2024	y = 1.174x-3.753	0.997
B30	B30	03/02/2024	y = 1.179x-3.207	0.998
B31	B31	03/02/2024	y = 1.189x-1.040	0.997
B32	B32	01/02/2024	y = 1.222x-3.815	0.999
B33	B33	01/02/2024	y = 1.159x-1.689	0.996
B34	B34	01/02/2024	y = 1.191x-1.278	0.995

Calibr



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

Gas Sampler Box Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Dry Cal DCL-ML

S/N : 136164

Calibration Data

Gas Sampler		Calibration Data					
No.	Rotameter	Date	Setting (Constant Flow) (mL/min)	Actual Flow Rate (mL/min)			
				Sampling Line A		Sampling Line B	
				Normal Condition	Standard Condition	Normal Condition	Standard Condition
B01	2 (A&B)	01/12/2023	200	200.5	200.4	200.7	200.6
B02	2 (A&B)	02/12/2023	200	200.7	200.6	200.4	200.3
B03	2 (A&B)	02/12/2023	200	200.6	200.5	200.9	200.8
B04	2 (A&B)	01/12/2023	200	200.9	200.8	200.7	200.6
B05	2 (A&B)	01/12/2023	200	200.5	200.4	200.9	200.8
B06	2 (A&B)	02/12/2023	200	200.8	200.7	200.5	200.4
B07	2 (A&B)	04/12/2023	200	200.6	200.5	200.8	200.7
B08	2 (A&B)	04/12/2023	200	200.7	200.6	200.4	200.3
B09	2 (A&B)	01/12/2023	200	200.5	200.4	200.9	200.8
B10	2 (A&B)	02/12/2023	200	200.6	200.5	200.8	200.7
B11	2 (A&B)	04/12/2023	200	200.7	200.6	200.5	200.4
B12	2 (A&B)	04/12/2023	200	200.5	200.4	200.8	200.7
B13	2 (A&B)	02/12/2023	200	200.4	200.3	200.6	200.5
B14	2 (A&B)	01/12/2023	200	200.5	200.4	200.7	200.6
B15	2 (A&B)	04/12/2023	200	200.3	200.2	200.5	200.4
B16	2 (A&B)	02/12/2023	200	200.8	200.7	200.6	200.5
B17	2 (A&B)	01/12/2023	200	200.5	200.4	200.7	200.6



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

CALIBRATION REPORT					
CHEMILUMINESCENT NO / NO ₂ / NO _x ANALYZER					
DATE :	23 February 2024	BRAND :	API	MODEL :	200E
NO.	NOX-B10	SERIAL NO.	4465		
Calibrator (Dilution System)					
Brand	Teledyne		Model	700E	
Last Cal. Date	30 October 2023		Serial No.	201-S	
Reference Standard Gas					
Standard Gas	Nitric Oxide (NO)		Cylinder No.	A00726SV	
Certified Date	05 January 2023		Expired Date	05 January 2026	
Cylinder Conc.	48.8 ppm				
CALIBRATING CONDITION					
Pressure	1011	mmbar	Temp.	24.5	°C
% RH	49				
CALIBRATION SETTING					
Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
Set Point	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	-0.11	-	0	-
NO Span	400	399.9	-0.025	400.0	1.006
NO _x Span	400	400.1	0.025	400.0	1.010
API Model 200E NO _x Analyzer Check List					
Test Values	Observed Value	Units	Nominal Range		
RANGE	500	PPB	500 standard		
STABILITY (Zero Gas)	0.1	PPB	< 2 with zero air		
SAMPLE FLOW	507	cc/min	500 ± 50		
OZONE FLOW	78	cc/min	80 ± 15		
PMT	103.0	mV	-20 - 150		
AZERO	93.8	mV	-20 - 150		
HVPS	670	V	420 - 900 constant		
RCELL TEMP	50.3	°C	50 ± 1		
BOX TEMP	29.1	°C	8 - 48		
PMT TEMP	7.2	°C	7 ± 2		
MOLY TEMP	314.9	°C	315 ± 5		
RCELL PRESS	8.4	IN-Hg-A	2 - 10 constant		
SAMPLE PRESS	28.6	IN-Hg-A	25 - 30 constant		
NO Span Conc	400	PPB	20 - 20,000		
NO _x Span Conc	400	PPB	20 - 20,000		
NO Slope	1.006	-	1.0 ± 0.3		
NO _x Slope	1.010	-	1.0 ± 0.3		
NO Offset	1.4	mV	-20 to +150		
NO _x Offset	0.9	mV	-20 to 150		
Stability at Zero	0.1	PPB	< 0.2		
Stability at Span	0.2	PPB	< 2.0pb @ 400.0pb span gas		



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
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CALIBRATION REPORT					
CHEMILUMINESCENT NO / NO ₂ / NO _x ANALYZER					
DATE :	23 February 2024	BRAND :	API	MODEL :	TML-41M
NO.	NOX-B20	SERIAL NO.	N02782		
Calibrator (Dilution System)					
Brand	Teledyne		Model	700E	
Last Cal. Date	30 October 2023		Serial No.	201-S	
Reference Standard Gas					
Standard Gas	Nitric Oxide (NO)		Cylinder No.	A00726SV	
Certified Date	05 January 2023		Expired Date	05 January 2026	
Cylinder Conc.	48.8 ppm				
CALIBRATING CONDITION					
Pressure	1011	mmbar	Temp.	24.5	°C
% RH	49				
CALIBRATION SETTING					
Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
Set Point	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	-0.11	-	0	-
NO Span	400	400.1	0.025	400.0	1.010
NO _x Span	400	400.3	0.075	400.0	1.014
API Model TML-41M NO _x Analyzer Check List					
Test Values	Observed Value	Units	Nominal Range		
RANGE	500	PPB	500 standard		
STABILITY (Zero Gas)	0.1	PPB	< 2 with zero air		
SAMPLE FLOW	512	cc/min	500 ± 50		
OZONE FLOW	79	cc/min	80 ± 15		
PMT	103.3	mV	-20 - 150		
AZERO	94.1	mV	-20 - 150		
HVPS	673	V	420 - 900 constant		
RCELL TEMP	50.2	°C	50 ± 1		
BOX TEMP	29.4	°C	8 - 48		
PMT TEMP	7.3	°C	7 ± 2		
MOLY TEMP	315.2	°C	315 ± 5		
RCELL PRESS	8.2	IN-Hg-A	2 - 10 constant		
SAMPLE PRESS	28.4	IN-Hg-A	25 - 30 constant		
NO Span Conc	400	PPB	20 - 20,000		
NO _x Span Conc	400	PPB	20 - 20,000		
NO Slope	1.010	-	1.0 ± 0.3		
NO _x Slope	1.014	-	1.0 ± 0.3		
NO Offset	1.7	mV	-20 to +150		
NO _x Offset	1.0	mV	-20 to 150		
Stability at Zero	0.1	PPB	< 0.2		
Stability at Span	0.2	PPB	< 2.0pb @ 400.0pb span gas		



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7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
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CALIBRATION REPORT

CHEMILUMINESCENT NO / NO₂ / NO_x ANALYZER

DATE : 23 February 2024 BRAND : API MODEL : TML-41M
NO. NOX-B22 SERIAL NO. NO1618

Calibrator (Dilution System)

Brand : Teledyne Model : 700E
Last Cal. Date : 30 October 2023 Serial No. : 201-S

Reference Standard Gas

Standard Gas : Nitric Oxide (NO) Cylinder No. : A00726SV
Certified Date : 05 January 2023 Expired Date : 05 January 2026 Cylinder Conc. : 48.8 ppm

CALIBRATING CONDITION

Pressure 1011 mmbar Temp. 24.5 °C % RH 49

CALIBRATION SETTING

Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	-0.10	-	0	-
NO Span	400	399.8	-0.050	400.0	1.008
NO _x Span	400	400.2	0.050	400.0	1.012

API Model TML-41M NO_x Analyzer Check List

Test Values	Observed Value	Units	Nominal Range
RANGE	500	PPB	500 standard
STABILITY (Zero Gas)	0.1	PPB	< 2 with zero air
SAMPLE FLOW	509	cc/min	500 ± 50
OZONE FLOW	79	cc/min	80 ± 15
PMT	103.1	mV	-20 - 150
AZERO	93.9	mV	-20 - 150
HVPS	675	V	420 - 900 constant
RCELL TEMP	50.1	°C	50 ± 1
BOX TEMP	29.2	°C	8 - 48
PMT TEMP	7.4	°C	7 ± 2
MOLY TEMP	314.8	°C	315 ± 5
RCELL PRESS	8.5	IN-Hg-A	2 - 10 constant
SAMPLE PRESS	28.7	IN-Hg-A	25 - 30 constant
NO Span Conc	400	PPB	20 - 20,000
NO _x Span Conc	400	PPB	20 - 20,000
NO Slope	1.008	-	1.0 ± 0.3
NO _x Slope	1.012	-	1.0 ± 0.3
NO Offset	1.5	mV	-20 to +150
NO _x 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



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



CERTIFICATE No : 24M2227
REFERENCE No : 72448-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : METTLER TOLEDO
MODEL : XS105DU
SERIAL No : 1126422905
ID No : BA05/50
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 08-Mar-24

APPROVED BY :

ISSUED DATE : 14-Mar-24

RECEIVED DATE : 08-Mar-24

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



CERTIFICATE No : 24M2227

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS105DU
MANUFACTURER : METTLER TOLEDO S/N : 1126422905
ID No : BA05/50 RECEIVED DATE : 08-Mar-24
AIR PRESSURE : 1010mbar \pm 1mbar CALIBRATION DATE : 08-Mar-24
AMBIENT TEMPERATURE : 25° C \pm 1° C RELATIVE HUMIDITY : 53 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

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

3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.

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

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

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

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

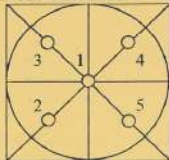
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0.000055 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.00000	0.00000	0.000065
0.02	0.02001	-0.00001	0.000065
0.10	0.10002	-0.00002	0.000066
0.20	0.20001	-0.00001	0.000066
0.50	0.50001	-0.00001	0.000065
1.00	1.00003	-0.00003	0.000066
2.00	2.00001	-0.00001	0.000067
5.00	5.00001	-0.00001	0.000068
10.00	9.99994	0.00006	0.000070
20.00	20.00008	-0.00008	0.000078
50.00	50.0000	0.0000	0.00013
100.00	100.0001	-0.0001	0.00019
120.00	120.0001	-0.0001	0.00022

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.0000
2	50.0000
3	50.0000
4	50.0000
5	50.0000
OFF-CENTER LOADING	0.0000

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

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

END OF CALIBRATION REPORT

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : SP23016

Pages 1 of 3

Calibration Certificate

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

Calibrated by :

Nathakorn Pienthaian

Approved by :

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

Continuation of Calibration Certificate

Cert. No. : SP23016
Job No. : VC66SP0014
Pages : 2 of 3

Calibration Method :

This instrument was calibrated by using on-site calibration procedure In-house method : CP-SP-01
The calibration procedure to direct measurement wavelength accuracy by using wavelength standard solution, Photometric accuracy by using absorbance standard filter and absorbance standard solution
The calibration procedure used was based on ASTM E275-01, ASTM E925-02

Condition of this result of calibration :

1. Certified reference materials

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

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

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

3.1 The UK National Physical Laboratory (NPL)

3.2 The National Institute of Standards and Technology, NIST.

Result of calibration : Wavelength Accuracy

(Without adjustment)

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

UUC* = Unit Under Calibration

Continuation of Calibration Certificate

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

Result of calibration : Photometric Accuracy

(Without adjustment)

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

UUC* = Unit Under Calibration

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

Resolution of Wavelength Mode 0.1 nm

Resolution of Photometric Mode 0.0001 A

Parameter Setting

Measurement Mode Wavelength, Absorbance

Wavelength Scan 1100 nm-190 nm

Scanning Speed 7.5 nm/min

Data Pitch 0.1 nm

Band width(Wavelength) 1.0 nm

Band width(Vis) 1.0 nm

Band width(Uv) 1.0 nm

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

**Specific Acceptance :

Transmission ≤ 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

เอกสารสอบเทียบเครื่องมือการตรวจวัดคุณภาพอากาศจากปล่อง



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

Console Calibration Report

Calibration Method

Critical Orifices

Calibration Data

Console Data		Calibration Data		
No.	Serial No.	Date	y	DH _g (mmH ₂ O)
B01	1563	01/12/2023	0.998	50.05
B02	8002514	02/12/2023	1.006	49.58
B03	1503016	01/12/2023	1.003	50.16
B04	00006659	04/12/2023	0.998	49.71
B05	00007428	04/12/2023	0.999	49.24
R01	1561	02/12/2023	1.005	49.98
R02	8002513	03/12/2023	1.003	49.90
R03	1570	04/12/2023	0.996	49.68
R04	8002519	01/12/2023	1.002	49.43
R05	1503015	01/12/2023	0.997	50.24

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

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



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Pitot Tube Calibration Report

Calibration Method

Standard Pitot Tube

Calibration Data

Pitot Tube Data			Calibration Data		
No.	Type of Pitot	Coefficient of Standard Pitot	Date	Avg. of Cp (test)	
				Side A	Side B
B03	S	0.99	01/02/2024	0.84	0.83
B04	S	0.99	02/02/2024	0.85	0.84
B05	S	0.99	02/02/2024	0.84	0.84
B07	S	0.99	01/02/2024	0.84	0.85
B08	S	0.99	01/02/2024	0.83	0.84
B09	S	0.99	03/02/2024	0.84	0.85
B11	S	0.99	03/02/2024	0.84	0.84
B16	S	0.99	01/02/2024	0.83	0.84
B18	S	0.99	02/02/2024	0.84	0.84
B19	S	0.99	02/02/2024	0.84	0.83
B21	S	0.99	01/02/2024	0.84	0.85
B24	S	0.99	02/02/2024	0.85	0.84
B27	S	0.99	01/02/2024	0.84	0.84
B30	S	0.99	02/02/2024	0.84	0.83
B31	S	0.99	02/02/2024	0.84	0.85
B33	S	0.99	01/02/2024	0.84	0.84
B35	S	0.99	01/02/2024	0.85	0.84

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



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Pitot Tube Calibration Report

Calibration Method

Standard Pitot Tube

Calibration Data

Pitot Tube Data			Calibration Data		
No.	Type of Pitot	Coefficient of Standard Pitot	Date	Avg. of Cp (test)	
				Side A	Side B
B36	S	0.99	02/02/2024	0.84	0.83
B37	S	0.99	02/02/2024	0.84	0.84
B38	S	0.99	01/02/2024	0.84	0.84
B39	S	0.99	02/02/2024	0.85	0.84
B40	S	0.99	02/02/2024	0.84	0.83
B41	S	0.99	01/02/2024	0.84	0.85
B44	S	0.99	01/02/2024	0.85	0.84
B45	S	0.99	02/02/2024	0.83	0.84
B46	S	0.99	01/02/2024	0.84	0.85
B47	S	0.99	03/02/2024	0.84	0.84
B48	S	0.99	03/02/2024	0.84	0.85
B49	S	0.99	01/02/2024	0.83	0.84
B54	S	0.99	01/02/2024	0.84	0.85
B56	S	0.99	02/02/2024	0.84	0.84
B57	S	0.99	01/02/2024	0.83	0.84
B58	S	0.99	02/02/2024	0.84	0.85

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



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

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

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

Personal Pump Data					Calibration Data							
No.	Brand	Model	Serial No.	Date	Flow Rate (mL/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R ²
B01	SKC	224-PCXR4	262101	03/01/2024	1,000	1,500	2,000	993	1,497	1,998	1.002x - 4.467	1.000
B02	SKC	224-PCXR4	626166	03/01/2024	1,000	1,500	2,000	1,003	1,505	2,001	1.009x - 19.803	0.999
B03	SKC	224-PCXR4	612968	03/01/2024	1,000	1,500	2,000	996	1,494	2,001	1.006x - 12.799	1.000
B04	SKC	224-PCXR4	602804	04/01/2024	1,000	1,500	2,000	1,000	1,502	1,994	0.999x + 0.239	1.000
B05	SKC	224-PCXR4	612693	04/01/2024	1,000	1,500	2,000	1,003	1,500	2,002	1.011x - 21.266	0.999
B06	SKC	224-PCXR4	262188	05/01/2024	1,000	1,500	2,000	1,002	1,508	2,006	1.007x - 12.077	0.999
B07	SKC	224-PCXR4	626262	05/01/2024	1,000	1,500	2,000	998	1,492	1,997	0.994x + 4.810	1.000
B08	SKC	224-PCXR4	626100	04/01/2024	1,000	1,500	2,000	1,002	1,500	2,003	1.013x - 24.585	0.999
B09	SKC	224-PCXR4	626479	05/01/2024	1,000	1,500	2,000	998	1,490	1,994	0.993x + 3.837	1.000
B10	SKC	224-PCXR4	091950	04/01/2024	1,000	1,500	2,000	993	1,502	2,001	1.017x - 34.867	0.999
B11	SKC	224-PCXR4	564315	05/01/2024	1,000	1,500	2,000	996	1,492	1,999	1.004x - 7.965	1.000
B12	SKC	224-PCXR4	034656	05/01/2024	1,000	1,500	2,000	1,003	1,502	2,003	1.010x - 19.683	0.999
B13	SKC	224-PCXR4	602073	04/01/2024	1,000	1,500	2,000	997	1,500	1,998	1.000x - 0.862	1.000
B14	SKC	224-PCXR4	626313	03/01/2024	1,000	1,500	2,000	999	1,492	1,989	0.991x + 8.479	1.000
B15	SKC	224-PCXR4	626474	03/01/2024	1,000	1,500	2,000	1,002	1,502	2,005	1.012x - 21.697	0.999
B16	SKC	224-PCXR4	626477	04/01/2024	1,000	1,500	2,000	995	1,504	2,001	1.007x - 16.807	1.000
B17	SKC	224-PCXR4	626860	04/01/2024	1,000	1,500	2,000	997	1,494	1,991	0.997x + 0.331	1.000
B18	SKC	224-PCXR4	691484	05/01/2024	1,000	1,500	2,000	1,003	1,500	2,002	1.009x - 17.214	0.999
B19	SKC	224-PCXR4	691599	05/01/2024	1,000	1,500	2,000	993	1,503	1,999	1.005x - 8.906	1.000
B20	SKC	224-PCXR4	691587	05/01/2024	1,000	1,500	2,000	991	1,504	2,000	1.016x - 33.407	0.999
B21	SKC	224-PCXR4	691531	04/01/2024	1,000	1,500	2,000	993	1,499	1,995	1.001x - 5.540	1.000
B22	SKC	224-PCXR4	691654	03/01/2024	1,000	1,500	2,000	1,003	1,501	2,004	1.011x - 19.966	0.999
B23	SKC	224-PCXR4	798393	03/01/2024	1,000	1,500	2,000	993	1,507	2,002	1.017x - 33.276	0.999
B24	SKC	224-PCXR4	626363	03/01/2024	1,000	1,500	2,000	1,000	1,502	2,001	1.012x - 23.859	0.999
B25	SKC	224-PCXR4	798489	03/01/2024	1,000	1,500	2,000	1,001	1,492	2,001	0.998x + 0.694	1.000
B26	SKC	224-PCXR4	798479	04/01/2024	1,000	1,500	2,000	1,000	1,500	1,993	0.996x + 4.204	1.000
B27	SKC	224-PCXR4	691673	04/01/2024	1,000	1,500	2,000	994	1,503	2,002	1.016x - 30.902	0.999
B28	SKC	224-PCXR4	691570	05/01/2024	1,000	1,500	2,000	1,003	1,500	2,001	1.009x - 18.263	0.999
B29	SKC	224-PCXR4	626472	04/01/2024	1,000	1,500	2,000	1,002	1,498	2,000	1.002x - 3.909	1.000
B30	SKC	224-PCXR4	691489	04/01/2024	1,000	1,500	2,000	1,003	1,509	2,006	1.008x - 11.399	1.000
B31	SKC	224-PCXR4	691509	03/01/2024	1,000	1,500	2,000	993	1,496	1,997	1.005x - 11.275	1.000
B32	SKC	224-PCXR4	091567	03/01/2024	1,000	1,500	2,000	991	1,503	2,000	1.015x - 30.886	0.999
B33	SKC	224-PCXR4	091756	05/01/2024	1,000	1,500	2,000	993	1,498	1,992	0.999x - 2.317	1.000
B34	SKC	224-PCXR4	612962	05/01/2024	1,000	1,500	2,000	1,002	1,501	2,002	1.007x - 13.995	1.000
B35	SKC	224-PCXR4	602682	05/01/2024	1,000	1,500	2,000	996	1,498	1,996	1.000x - 5.285	1.000
B36	SKC	224-PCXR4	626164	04/01/2024	1,000	1,500	2,000	999	1,510	1,999	1.004x - 10.131	0.999
B37	SKC	224-PCXR4	626256	05/01/2024	1,000	1,500	2,000	994	1,506	1,999	1.013x - 28.454	0.999
B38	SKC	224-PCXR4	626167	03/01/2024	1,000	1,500	2,000	997	1,498	1,998	1.003x - 5.983	1.000
B39	SKC	224-PCXR4	034637	03/01/2024	1,000	1,500	2,000	1,005	1,501	2,001	1.006x - 15.188	0.999
B40	SKC	224-PCXR4	798349	05/01/2024	1,000	1,500	2,000	994	1,505	2,000	1.014x - 29.004	0.999



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S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jomjol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

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

Personal Pump Data					Calibration Data							
No.	Brand	Model	Serial No.	Date	Flow Rate (mL/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R ²
841	SKC	224-PCXR4	612669	05/01/2024	1,000	1,500	2,000	999	1,496	1,991	0.996x + 1.914	1.000
842	SKC	224-PCXR4	626041	03/01/2024	1,000	1,500	2,000	1,004	1,498	1,991	0.986x + 19.248	1.000
843	SKC	224-PCXR4	034636	03/01/2024	1,000	1,500	2,000	1,000	1,501	1,992	0.991x + 11.482	1.000
844	SKC	224-PCXR8	529341	03/01/2024	1,000	1,500	2,000	1,002	1,502	2,002	1.004x - 6.860	1.000
845	SKC	224-PCXR8	529594	03/01/2024	1,000	1,500	2,000	1,001	1,501	1,987	0.987x + 16.026	1.000
846	SKC	224-PCXR8	566743	04/01/2024	1,000	1,500	2,000	995	1,506	2,002	1.013x - 27.915	0.999
847	SKC	224-PCXR8	566747	04/01/2024	1,000	1,500	2,000	1,002	1,502	2,004	1.010x - 21.769	0.999
848	SKC	224-PCXR8	566753	04/01/2024	1,000	1,500	2,000	1,000	1,493	1,998	0.997x + 0.239	1.000
849	SKC	224-PCXR8	566780	04/01/2024	1,000	1,500	2,000	1,003	1,502	2,006	1.011x - 21.550	0.999
850	SKC	224-PCXR8	500400	03/01/2024	1,000	1,500	2,000	1,001	1,496	2,002	1.001x - 2.900	1.000
851	SKC	224-PCXR8	500363	03/01/2024	1,000	1,500	2,000	996	1,502	2,000	1.011x - 25.709	0.999
852	SKC	224-PCXR8	093186	03/01/2024	1,000	1,500	2,000	994	1,496	1,992	0.995x + 1.751	1.000
853	SKC	224-PCXR8	707670	05/01/2024	1,000	1,500	2,000	1,002	1,501	2,002	1.008x - 16.042	0.999
854	SKC	224-PCXR3	509821	05/01/2024	1,000	1,500	2,000	995	1,501	2,002	1.016x - 32.282	0.999
855	SKC	224-PCXR3	510710	05/01/2024	1,000	1,500	2,000	1,004	1,495	1,992	0.991x + 7.666	1.000
856	SKC	224-PCXR3	511450	05/01/2024	1,000	1,500	2,000	1,002	1,500	2,001	1.005x - 8.559	1.000
857	SKC	224-PCXR3	510798	03/01/2024	1,000	1,500	2,000	997	1,492	1,999	0.999x - 2.122	1.000
858	SKC	224-PCXR3	509852	03/01/2024	1,000	1,500	2,000	1,000	1,500	1,999	1.007x - 19.073	0.999
859	SKC	224-PCXR3	509862	04/01/2024	1,000	1,500	2,000	995	1,503	1,995	0.998x + 2.118	1.000
860	SKC	224-PCXR3	512655	04/01/2024	1,000	1,500	2,000	1,004	1,510	2,004	1.005x - 6.421	0.999
861	SKC	224-PCXR3	503915	04/01/2024	1,000	1,500	2,000	993	1,492	1,999	1.003x - 11.706	1.000
862	SKC	224-PCXR3	505975	03/01/2024	1,000	1,500	2,000	999	1,494	1,996	0.996x + 0.822	1.000
863	SKC	224-PCXR3	511432	03/01/2024	1,000	1,500	2,000	990	1,501	2,000	1.017x - 36.259	0.999
864	SKC	224-PCXR3	508302	03/01/2024	1,000	1,500	2,000	998	1,492	1,989	0.990x + 10.175	1.000
865	SKC	224-PCXR3	508310	03/01/2024	1,000	1,500	2,000	1,002	1,501	2,002	1.007x - 13.537	1.000
866	SKC	224-PCXR3	509861	04/01/2024	1,000	1,500	2,000	1,002	1,491	1,992	0.988x + 13.744	1.000
867	SKC	224-PCXR3	506295	04/01/2024	1,000	1,500	2,000	995	1,508	2,004	1.007x - 12.843	1.000
868	SKC	224-PCXR3	505872	04/01/2024	1,000	1,500	2,000	1,002	1,491	1,998	0.995x + 4.040	1.000
869	SKC	224-PCXR3	508375	04/01/2024	1,000	1,500	2,000	1,003	1,499	2,000	1.009x - 18.977	0.999
870	SKC	224-PCXR3	510623	05/01/2024	1,000	1,500	2,000	992	1,493	1,996	1.002x - 7.730	1.000
871	SKC	224-PCXR3	508367	05/01/2024	1,000	1,500	2,000	994	1,506	2,002	1.015x - 31.561	0.999
872	SKC	224-PCXR3	505977	03/01/2024	1,000	1,500	2,000	1,003	1,499	1,994	0.991x + 9.042	1.000
873	SKC	224-PCXR3	512606	04/01/2024	1,000	1,500	2,000	1,001	1,501	2,004	1.008x - 14.346	1.000
874	SKC	224-PCXR3	505993	04/01/2024	1,000	1,500	2,000	996	1,497	1,995	1.001x - 7.036	1.000
875	SKC	224-PCXR3	509820	05/01/2024	1,000	1,500	2,000	996	1,496	1,991	0.996x + 1.432	1.000
876	SKC	224-PCXR3	509811	05/01/2024	1,000	1,500	2,000	993	1,499	1,999	1.006x - 14.283	1.000
877	SKC	224-PCXR3	508301	05/01/2024	1,000	1,500	2,000	1,001	1,501	2,003	1.013x - 25.406	0.999
878	SKC	224-PCXR3	510677	05/01/2024	1,000	1,500	2,000	995	1,503	1,999	1.012x - 27.520	0.999
879	SKC	224-PCXR3	510920	05/01/2024	1,000	1,500	2,000	994	1,494	1,994	1.001x - 6.176	1.000



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

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

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (mL/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R ²
880	SKC	224-PCXR3	504569	05/01/2024	1,000	1,500	2,000	1,002	1,498	2,002	1.012x - 24.186	0.999
881	SKC	224-PCXR3	503480	05/01/2024	1,000	1,500	2,000	996	1,499	2,000	1.014x - 30.165	0.999
882	SKC	224-PCXR3	505673	04/01/2024	1,000	1,500	2,000	994	1,498	1,996	1.000x - 4.746	1.000
883	SKC	224-PCXR3	510785	04/01/2024	1,000	1,500	2,000	1,010	1,500	1,999	1.003x - 7.793	0.999
884	SKC	224-PCXR3	508333	04/01/2024	1,000	1,500	2,000	997	1,498	1,991	0.993x + 4.810	1.000
885	SKC	224-PCXR3	505757	05/01/2024	1,000	1,500	2,000	994	1,502	1,998	1.006x - 14.562	1.000
886	SKC	224-PCXR3	512625	03/01/2024	1,000	1,500	2,000	1,015	1,503	2,004	0.999x + 3.063	0.999
887	SKC	224-PCXR3	504324	03/01/2024	1,000	1,500	2,000	1,000	1,496	2,000	1.000x - 0.710	1.000
888	SKC	224-PCXR3	508307	03/01/2024	1,000	1,500	2,000	995	1,498	1,993	0.997x + 0.574	1.000
889	SKC	224-PCXR3	509860	03/01/2024	1,000	1,500	2,000	1,000	1,499	2,004	1.010x - 17.509	1.000
890	SKC	224-PCXR3	508366	04/01/2024	1,000	1,500	2,000	995	1,508	2,000	1.005x - 10.091	1.000
891	SKC	224-PCXR3	510919	04/01/2024	1,000	1,500	2,000	1,000	1,500	1,997	0.992x + 7.522	1.000
892	SKC	224-PCXR3	510987	04/01/2024	1,000	1,500	2,000	1,002	1,501	1,999	0.999x + 1.097	1.000
893	SKC	224-PCXR3	509845	04/01/2024	1,000	1,500	2,000	996	1,496	2,004	1.009x - 15.822	1.000
894	SKC	224-PCXR8	A127871	05/01/2024	1,000	1,500	2,000	1,000	1,499	2,002	1.007x - 19.184	0.999
895	SKC	224-PCXR8	A127921	05/01/2024	1,000	1,500	2,000	994	1,502	2,002	1.015x - 30.559	0.999
896	SKC	224-PCXR8	A127942	04/01/2024	1,000	1,500	2,000	998	1,499	1,996	1.001x - 3.486	1.000
897	SKC	224-PCXR8	A127955	05/01/2024	1,000	1,500	2,000	1,003	1,501	2,003	1.010x - 20.082	0.999
898	SKC	224-PCXR8	A127956	05/01/2024	1,000	1,500	2,000	996	1,497	1,998	1.003x - 6.330	1.000



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



CALIBRATION LABORATORY Co., LTD.

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



Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

Rotameter Data			Calibration Data								
No.	Brand	Model	Date	Flow Rate (ml/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	y	R ²
H-801	Dwyer	VFB-65	04/01/2024	500	1,000	2,000	506.5	991.1	1974.3	0.989x + 9.286	1.000
H-802	Dwyer	VFB-65	04/01/2024	500	1,000	2,000	496.7	997.6	1996.1	0.994x + 4.509	1.000
H-803	Dwyer	VFB-65	04/01/2024	500	1,000	2,000	497.6	988.8	2009.6	1.004x - 14.177	0.999
H-804	Dwyer	VFB-65	03/01/2024	500	1,000	2,000	501.6	998.7	2006.5	0.997x - 0.777	1.000
H-805	Dwyer	VFB-65	05/01/2024	500	1,000	2,000	500.4	997.3	1974.3	0.980x + 21.602	0.999
H-806	Dwyer	VFB-65	05/01/2024	500	1,000	2,000	504.9	994.8	1984.0	1.003x - 5.213	1.000
H-807	Dwyer	VFB-65	03/01/2024	500	1,000	2,000	502.6	990.6	2016.7	1.001x - 0.998	1.000
H-808	Dwyer	VFB-65	04/01/2024	500	1,000	2,000	499.7	998.7	1979.8	0.996x + 3.580	0.999
H-809	Dwyer	VFB-65	04/01/2024	500	1,000	2,000	504.1	1004.3	2010.7	0.993x + 13.998	1.000
H-810	Dwyer	VFB-65	03/01/2024	500	1,000	2,000	496.2	999.3	2009.2	0.996x + 3.860	1.000

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : HI-LIGHT
MODEL / TYPE : N/A
SERIAL NO. : N/A[64-220066-3]
CLID. NO. : 212201114
JOB CONTROL NO. : 230725081569

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

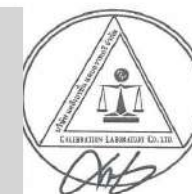
DATE OF RECEIVED : 25 July 2023

DATE OF ISSUED : 31 July 2023

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

Calibrated By : Sittipong Pimdee
Calibration Engineer

Approved By :



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. Q23081569

F3-011-04/01-12

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@clccalibration



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



CALIBRATION LABORATORY Co., LTD.

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



REPORT OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : HI-LIGHT
MODEL / TYPE : N/A
SERIAL NO. : N/A[64-220066-3]
DATE OF CALIBRATION : 26 July 2023
DUE DATE OF CALIBRATION : 26 July 2024

ENVIRONMENT CONDITIONS :

Temperature : $(23 \pm 2) ^\circ\text{C}$

Relative Humidity : $(55 \pm 10) \% \text{RH}$

PROCEDURE USED :

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

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

REFERENCE STANDARD USED :

Document Process Calibrator, Fluke Model 741B S/N. 8295020 with Pressure Module Model 700PD5 S/N. 89404505.

TRACEABILITY :

The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand).

Certificate No. MP-0035-23, Due Date 02 February 2024.

UNCERTAINTY :

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

Certificate No. Q23081569

F3-011-04/01-12

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@clccalibration

CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

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

CALIBRATION DATA

CORRECTION OF PRESSURE

DUC Test point (inHg)	STD Reading (kPa)		Conversion to inHg		Correction (inHg)	
	Up	Down	Up	Down	Up	Down
0	0.00	0.00	0.0	0.0	0.0	0.0
-5	-16.66	-16.69	-4.9	-4.9	+0.1	+0.1
-10	-33.79	-33.79	-10.0	-10.0	0.0	0.0
-15	-50.76	-50.76	-15.0	-15.0	0.0	0.0
-20	-67.79	-67.82	-20.0	-20.0	0.0	0.0
-25	-84.68	-84.72	-25.0	-25.0	0.0	0.0
-30	-101.51	-101.51	-30.0	-30.0	0.0	0.0

Uncertainty of measurement ± 0.2 inHg

Transmitting fluid : Air.

Technical Note. Conversion factor 1 kPa ; 0.2953003 inHg

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

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

End of Certificate

Certificate No. Q23081569

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@clccalibration



CERTIFICATE No : 24M2227
REFERENCE No : 72448-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : METTLER TOLEDO
MODEL : XS105DU
SERIAL No : 1126422905
ID No : BA05/50
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 08-Mar-24

APPROVED BY :

ISSUED DATE :

RECEIVED DATE : 08-Mar-24



CERTIFICATE No : 24M2227

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS105DU
MANUFACTURER : METTLER TOLEDO S/N : 1126422905
ID No : BA05/50 RECEIVED DATE : 08-Mar-24
AIR PRESSURE : 1010mbar \pm 1mbar CALIBRATION DATE : 08-Mar-24
AMBIENT TEMPERATURE : 25° C \pm 1° C RELATIVE HUMIDITY : 53 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

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

3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.

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

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

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

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

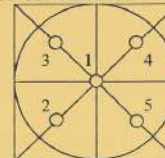
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0.000055 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.00000	0.00000	0.000065
0.02	0.02001	-0.00001	0.000065
0.10	0.10002	-0.00002	0.000066
0.20	0.20001	-0.00001	0.000066
0.50	0.50001	-0.00001	0.000065
1.00	1.00003	-0.00003	0.000066
2.00	2.00001	-0.00001	0.000067
5.00	5.00001	-0.00001	0.000068
10.00	9.99994	0.00006	0.000070
20.00	20.00008	-0.00008	0.000078
50.00	50.0000	0.0000	0.00013
100.00	100.0001	-0.0001	0.00019
120.00	120.0001	-0.0001	0.00022

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.0000
2	50.0000
3	50.0000
4	50.0000
5	50.0000
OFF-CENTER LOADING	0.0000

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

END OF CALIBRATION REPORT

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : SP23016
Pages 1 of 3

Calibration Certificate

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

Calibrated by : Nathakorn Pisutpaisan

Approved by :

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

SITHIPORN
associates

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : SP23016
Job No. : VC66SP0014
Pages : 2 of 3

Calibration Method :

This instrument was calibrated by using on-site calibration procedure In-house method : CP-SP-01
The calibration procedure to direct measurement wavelength accuracy by using wavelength standard solution, Photometric accuracy by using absorbance standard filter and absorbance standard solution
The calibration procedure used was based on ASTM E275-01, ASTM E925-02

Condition of this result of calibration :

1. Certified reference materials

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

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

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

- 3.1 The UK National Physical Laboratory (NPL)
- 3.2 The National Institute of Standards and Technology, NIST.

Result of calibration : Wavelength Accuracy

(Without adjustment)

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

UUC* = Unit Under Calibration

Continuation of Calibration Certificate

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

Result of calibration : Photometric Accuracy

(Without adjustment)

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

UUC* = Unit Under Calibration

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

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

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

**Specific Acceptance :
Transmission ≤ 1.0 T(%), Absorbance ≥ 2.0 A
**Stray light not TISI Accredited

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

————— **End of Calibration Certificate** —————

เอกสารที่ 5-3

เอกสารสอบเทียบเครื่องมือการตรวจคุณภาพอากาศ
ในสถานประกอบการ (Working Area)



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

Personal Pump Calibration Report

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

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

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (mL/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R ²
B01	SKC	224-PCXR4	262101	03/01/2024	1,000	1,500	2,000	993	1,497	1,998	1.002x - 4.467	1.000
B02	SKC	224-PCXR4	626166	03/01/2024	1,000	1,500	2,000	1,003	1,505	2,001	1.009x - 19.803	0.999
B03	SKC	224-PCXR4	612968	03/01/2024	1,000	1,500	2,000	996	1,494	2,001	1.006x - 12.799	1.000
B04	SKC	224-PCXR4	602804	04/01/2024	1,000	1,500	2,000	1,000	1,502	1,994	0.999x + 0.239	1.000
B05	SKC	224-PCXR4	612693	04/01/2024	1,000	1,500	2,000	1,003	1,500	2,002	1.011x - 21.266	0.999
B06	SKC	224-PCXR4	262188	05/01/2024	1,000	1,500	2,000	1,002	1,508	2,006	1.007x - 12.077	0.999
B07	SKC	224-PCXR4	626262	05/01/2024	1,000	1,500	2,000	998	1,492	1,997	0.994x + 4.810	1.000
B08	SKC	224-PCXR4	626100	04/01/2024	1,000	1,500	2,000	1,002	1,500	2,003	1.013x - 24.585	0.999
B09	SKC	224-PCXR4	626479	05/01/2024	1,000	1,500	2,000	998	1,490	1,994	0.993x + 3.837	1.000
B10	SKC	224-PCXR4	091950	04/01/2024	1,000	1,500	2,000	993	1,502	2,001	1.017x - 34.867	0.999
B11	SKC	224-PCXR8	564515	05/01/2024	1,000	1,500	2,000	996	1,492	1,999	1.004x - 7.965	1.000
B12	SKC	224-PCXR4	034656	05/01/2024	1,000	1,500	2,000	1,003	1,502	2,003	1.010x - 19.683	0.999
B13	SKC	224-PCXR4	602073	04/01/2024	1,000	1,500	2,000	997	1,500	1,998	1.000x - 0.862	1.000
B14	SKC	224-PCXR4	626313	03/01/2024	1,000	1,500	2,000	999	1,492	1,989	0.991x + 8.479	1.000
B15	SKC	224-PCXR4	626474	03/01/2024	1,000	1,500	2,000	1,002	1,502	2,005	1.012x - 21.697	0.999
B16	SKC	224-PCXR4	626477	04/01/2024	1,000	1,500	2,000	995	1,504	2,001	1.007x - 16.807	1.000
B17	SKC	224-PCXR4	626860	04/01/2024	1,000	1,500	2,000	997	1,494	1,991	0.997x + 0.331	1.000
B18	SKC	224-PCXR4	691484	05/01/2024	1,000	1,500	2,000	1,003	1,500	2,002	1.009x - 17.214	0.999
B19	SKC	224-PCXR4	691599	05/01/2024	1,000	1,500	2,000	993	1,503	1,999	1.005x - 8.906	1.000
B20	SKC	224-PCXR4	691587	05/01/2024	1,000	1,500	2,000	991	1,504	2,000	1.016x - 33.407	0.999
B21	SKC	224-PCXR4	691531	04/01/2024	1,000	1,500	2,000	993	1,499	1,995	1.001x - 5.540	1.000
B22	SKC	224-PCXR4	691654	03/01/2024	1,000	1,500	2,000	1,003	1,501	2,004	1.011x - 19.966	0.999
B23	SKC	224-PCXR4	798393	03/01/2024	1,000	1,500	2,000	993	1,507	2,002	1.017x - 33.276	0.999
B24	SKC	224-PCXR4	626363	03/01/2024	1,000	1,500	2,000	1,000	1,502	2,001	1.012x - 23.859	0.999
B25	SKC	224-PCXR4	798489	03/01/2024	1,000	1,500	2,000	1,001	1,492	2,001	0.998x + 0.694	1.000
B26	SKC	224-PCXR4	798479	04/01/2024	1,000	1,500	2,000	1,000	1,500	1,993	0.996x + 4.204	1.000
B27	SKC	224-PCXR4	691673	04/01/2024	1,000	1,500	2,000	994	1,503	2,002	1.016x - 30.902	0.999
B28	SKC	224-PCXR4	691570	05/01/2024	1,000	1,500	2,000	1,003	1,500	2,001	1.009x - 18.263	0.999
B29	SKC	224-PCXR4	626472	04/01/2024	1,000	1,500	2,000	1,002	1,498	2,000	1.002x - 3.909	1.000
B30	SKC	224-PCXR4	691489	04/01/2024	1,000	1,500	2,000	1,003	1,509	2,006	1.008x - 11.399	1.000
B31	SKC	224-PCXR4	691509	03/01/2024	1,000	1,500	2,000	993	1,496	1,997	1.005x - 11.275	1.000
B32	SKC	224-PCXR4	091567	03/01/2024	1,000	1,500	2,000	991	1,503	2,000	1.015x - 30.886	0.999
B33	SKC	224-PCXR4	091756	05/01/2024	1,000	1,500	2,000	993	1,498	1,992	0.999x - 2.317	1.000
B34	SKC	224-PCXR4	612962	05/01/2024	1,000	1,500	2,000	1,002	1,501	2,002	1.007x - 13.995	1.000
B35	SKC	224-PCXR4	602682	05/01/2024	1,000	1,500	2,000	996	1,498	1,996	1.000x - 5.285	1.000
B36	SKC	224-PCXR4	626164	04/01/2024	1,000	1,500	2,000	999	1,510	1,999	1.004x - 10.131	0.999
B37	SKC	224-PCXR4	626256	05/01/2024	1,000	1,500	2,000	994	1,506	1,999	1.013x - 28.454	0.999
B38	SKC	224-PCXR4	626167	03/01/2024	1,000	1,500	2,000	997	1,498	1,998	1.003x - 5.983	1.000
B39	SKC	224-PCXR4	034637	03/01/2024	1,000	1,500	2,000	1,005	1,501	2,001	1.006x - 15.188	0.999
B40	SKC	224-PCXR4	798349	05/01/2024	1,000	1,500	2,000	998	1,505	2,000	1.016x - 29.004	0.999



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
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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 mmbar

Personal Pump Data					Calibration Data							
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R ²
B41	SKC	224-PCXR4	612669	05/01/2024	1,000	1,500	2,000	999	1,496	1,991	0.996x + 1.914	1.000
B42	SKC	224-PCXR4	626041	03/01/2024	1,000	1,500	2,000	1,004	1,498	1,991	0.986x + 19.248	1.000
B43	SKC	224-PCXR4	034636	03/01/2024	1,000	1,500	2,000	1,000	1,501	1,992	0.991x + 11.682	1.000
B44	SKC	224-PCXR8	529341	03/01/2024	1,000	1,500	2,000	1,002	1,502	2,002	1.004x - 6.860	1.000
B45	SKC	224-PCXR8	529594	03/01/2024	1,000	1,500	2,000	1,001	1,501	1,987	0.987x + 16.026	1.000
B46	SKC	224-PCXR8	566743	04/01/2024	1,000	1,500	2,000	995	1,506	2,002	1.013x - 27.915	0.999
B47	SKC	224-PCXR8	566747	04/01/2024	1,000	1,500	2,000	1,002	1,502	2,004	1.010x + 21.769	0.999
B48	SKC	224-PCXR8	566753	04/01/2024	1,000	1,500	2,000	1,000	1,493	1,998	0.997x + 0.239	1.000
B49	SKC	224-PCXR8	566780	04/01/2024	1,000	1,500	2,000	1,003	1,502	2,006	1.011x - 21.550	0.999
B50	SKC	224-PCXR8	500400	03/01/2024	1,000	1,500	2,000	1,001	1,496	2,002	1.001x - 2.900	1.000
B51	SKC	224-PCXR8	500363	03/01/2024	1,000	1,500	2,000	996	1,502	2,000	1.011x - 25.709	0.999
B52	SKC	224-PCXR8	093186	03/01/2024	1,000	1,500	2,000	994	1,496	1,992	0.995x + 1.751	1.000
B53	SKC	224-PCXR8	707670	05/01/2024	1,000	1,500	2,000	1,002	1,501	2,002	1.008x - 16.042	0.999
B54	SKC	224-PCXR3	509821	05/01/2024	1,000	1,500	2,000	995	1,501	2,002	1.016x - 32.282	0.999
B55	SKC	224-PCXR3	510710	05/01/2024	1,000	1,500	2,000	1,004	1,495	1,992	0.991x + 7.666	1.000
B56	SKC	224-PCXR3	511450	05/01/2024	1,000	1,500	2,000	1,002	1,500	2,001	1.005x - 8.559	1.000
B57	SKC	224-PCXR3	510798	03/01/2024	1,000	1,500	2,000	997	1,492	1,999	0.999x - 2.122	1.000
B58	SKC	224-PCXR3	509852	03/01/2024	1,000	1,500	2,000	1,000	1,500	1,999	1.007x - 19.073	0.999
B59	SKC	224-PCXR3	509862	04/01/2024	1,000	1,500	2,000	995	1,503	1,995	0.998x + 2.118	1.000
B60	SKC	224-PCXR3	512655	04/01/2024	1,000	1,500	2,000	1,004	1,510	2,004	1.005x - 6.421	0.999
B61	SKC	224-PCXR3	503915	04/01/2024	1,000	1,500	2,000	993	1,492	1,999	1.003x - 11.706	1.000
B62	SKC	224-PCXR3	505975	03/01/2024	1,000	1,500	2,000	999	1,494	1,996	0.996x + 0.822	1.000
B63	SKC	224-PCXR3	511432	03/01/2024	1,000	1,500	2,000	990	1,501	2,000	1.017x - 36.259	0.999
B64	SKC	224-PCXR3	508302	03/01/2024	1,000	1,500	2,000	998	1,492	1,989	0.990x + 10.175	1.000
B65	SKC	224-PCXR3	508310	03/01/2024	1,000	1,500	2,000	1,002	1,501	2,002	1.007x - 13.537	1.000
B66	SKC	224-PCXR3	509861	04/01/2024	1,000	1,500	2,000	1,002	1,491	1,992	0.988x + 13.744	1.000
B67	SKC	224-PCXR3	506295	04/01/2024	1,000	1,500	2,000	995	1,508	2,004	1.007x - 12.843	1.000
B68	SKC	224-PCXR3	505872	04/01/2024	1,000	1,500	2,000	1,002	1,491	1,998	0.995x + 4.040	1.000
B69	SKC	224-PCXR3	508375	04/01/2024	1,000	1,500	2,000	1,003	1,499	2,000	1.009x - 18.977	0.999
B70	SKC	224-PCXR3	510523	05/01/2024	1,000	1,500	2,000	992	1,493	1,996	1.002x - 7.730	1.000
B71	SKC	224-PCXR3	508367	05/01/2024	1,000	1,500	2,000	994	1,506	2,002	1.015x - 31.561	0.999
B72	SKC	224-PCXR3	505977	03/01/2024	1,000	1,500	2,000	1,003	1,499	1,994	0.991x + 9.042	1.000
B73	SKC	224-PCXR3	512606	04/01/2024	1,000	1,500	2,000	1,001	1,501	2,004	1.008x - 14.346	1.000
B74	SKC	224-PCXR3	505993	04/01/2024	1,000	1,500	2,000	996	1,497	1,995	1.001x - 7.034	1.000
B75	SKC	224-PCXR3	509820	05/01/2024	1,000	1,500	2,000	996	1,496	1,991	0.996x + 1.432	1.000
B76	SKC	224-PCXR3	509811	05/01/2024	1,000	1,500	2,000	993	1,499	1,999	1.006x - 14.283	1.000
B77	SKC	224-PCXR3	508301	05/01/2024	1,000	1,500	2,000	1,001	1,501	2,003	1.013x - 25.406	0.999
B78	SKC	224-PCXR3	510677	05/01/2024	1,000	1,500	2,000	995	1,503	1,999	1.012x - 27.520	0.999
B79	SKC	224-PCXR3	510920	05/01/2024	1,000	1,500	2,000	994	1,494	1,994	1.001x - 6.178	1.000



Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature	25	± 3	°C
Pressure	1010	± 15	mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R ²
880	SKC	224-PCXR3	504569	05/01/2024	1,000	1,500	2,000	1,002	1,498	2,002	1.012x - 24.186	0.999
881	SKC	224-PCXR3	503480	05/01/2024	1,000	1,500	2,000	996	1,499	2,000	1.014x - 30.165	0.999
882	SKC	224-PCXR3	505673	04/01/2024	1,000	1,500	2,000	994	1,498	1,996	1.000x - 4.746	1.000
883	SKC	224-PCXR3	510785	04/01/2024	1,000	1,500	2,000	1,010	1,500	1,999	1.003x - 7.793	0.999
884	SKC	224-PCXR3	508333	04/01/2024	1,000	1,500	2,000	997	1,498	1,991	0.993x + 4.810	1.000
885	SKC	224-PCXR3	505757	05/01/2024	1,000	1,500	2,000	994	1,502	1,998	1.006x - 14.562	1.000
886	SKC	224-PCXR3	512625	03/01/2024	1,000	1,500	2,000	1,015	1,503	2,004	0.999x + 3.063	0.999
887	SKC	224-PCXR3	504324	03/01/2024	1,000	1,500	2,000	1,000	1,496	2,000	1.000x - 0.710	1.000
888	SKC	224-PCXR3	508307	03/01/2024	1,000	1,500	2,000	995	1,498	1,993	0.997x + 0.574	1.000
889	SKC	224-PCXR3	509860	03/01/2024	1,000	1,500	2,000	1,000	1,499	2,004	1.010x - 17.509	1.000
890	SKC	224-PCXR3	508366	04/01/2024	1,000	1,500	2,000	995	1,508	2,000	1.005x - 10.091	1.000
891	SKC	224-PCXR3	510919	04/01/2024	1,000	1,500	2,000	1,000	1,500	1,997	0.992x + 7.522	1.000
892	SKC	224-PCXR3	510987	04/01/2024	1,000	1,500	2,000	1,002	1,501	1,999	0.999x + 1.097	1.000
893	SKC	224-PCXR3	509845	04/01/2024	1,000	1,500	2,000	996	1,496	2,004	1.009x - 15.822	1.000
894	SKC	224-PCXR8	A127871	05/01/2024	1,000	1,500	2,000	1,000	1,499	2,002	1.007x - 19.184	0.999
895	SKC	224-PCXR8	A127921	05/01/2024	1,000	1,500	2,000	994	1,502	2,002	1.015x - 30.559	0.999
896	SKC	224-PCXR8	A127942	04/01/2024	1,000	1,500	2,000	998	1,499	1,996	1.001x - 3.486	1.000
897	SKC	224-PCXR8	A127955	05/01/2024	1,000	1,500	2,000	1,003	1,501	2,003	1.010x - 20.082	0.999
898	SKC	224-PCXR8	A127956	05/01/2024	1,000	1,500	2,000	996	1,497	1,998	1.003x - 6.330	1.000



Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

Rotameter Data			Calibration Data								
No.	Brand	Model	Date	Flow Rate (mL/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	y	R ²
H-801	Dwyer	VFB-65	04/01/2024	500	1,800	2,000	506.5	991.1	1974.3	0.989x + 9.286	1.000
H-802	Dwyer	VFB-65	04/01/2024	500	1,800	2,000	496.7	997.6	1996.1	1.006x + 5.509	1.000
H-803	Dwyer	VFB-65	04/01/2024	500	1,800	2,000	497.6	988.8	2009.6	1.004x - 14.177	0.999
H-804	Dwyer	VFB-65	03/01/2024	500	1,800	2,000	501.6	998.7	2006.5	0.997x - 0.777	1.000
H-805	Dwyer	VFB-65	05/01/2024	500	1,800	2,000	500.4	997.3	1974.3	0.980x + 21.602	0.999
H-806	Dwyer	VFB-65	05/01/2024	500	1,800	2,000	504.9	994.8	1984.0	1.003x + 5.213	1.000
H-807	Dwyer	VFB-65	03/01/2024	500	1,800	2,000	502.6	990.6	2016.7	1.001x - 0.998	1.000
H-808	Dwyer	VFB-65	04/01/2024	500	1,800	2,000	499.7	998.7	1979.8	0.996x + 3.580	0.999
H-809	Dwyer	VFB-65	04/01/2024	500	1,800	2,000	504.1	1004.3	2010.7	0.993x + 13.998	1.000
H-810	Dwyer	VFB-65	04/01/2024	500	1,800	2,000	500.4	997.3	1974.3	0.980x + 21.602	0.999

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

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature 25 ± 3 °C
Pressure 1010 ± 15 mmbar

Personal Pump Data				Calibration Data									
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve		
					Setting			Actual (Q std.)					
					1	2	3	1	2	3	y	R ²	
B01	SKC	224-PCXR4	262101	05/04/2024	1,000	1,500	2,000	993	1,496	1,998	1.001x - 3.430	1.000	
B02	SKC	224-PCXR4	626166	05/04/2024	1,000	1,500	2,000	1,004	1,506	2,000	1.007x - 16.572	0.999	
B03	SKC	224-PCXR4	612968	09/04/2024	1,000	1,500	2,000	997	1,498	2,004	1.008x - 13.756	1.000	
B04	SKC	224-PCXR4	602804	08/04/2024	1,000	1,500	2,000	1,001	1,511	1,993	0.997x + 4.427	1.000	
B05	SKC	224-PCXR4	612693	08/04/2024	1,000	1,500	2,000	1,005	1,510	2,002	1.009x - 16.400	0.999	
B06	SKC	224-PCXR4	262188	08/04/2024	1,000	1,500	2,000	1,003	1,510	2,004	1.005x - 8.687	0.999	
B07	SKC	224-PCXR4	626262	05/04/2024	1,000	1,500	2,000	997	1,500	1,996	0.995x + 4.930	1.000	
B08	SKC	224-PCXR4	626100	04/04/2024	1,000	1,500	2,000	1,003	1,508	2,002	1.011x - 19.679	0.999	
B09	SKC	224-PCXR4	626479	08/04/2024	1,000	1,500	2,000	996	1,499	1,994	0.994x + 3.159	1.000	
B10	SKC	224-PCXR4	091950	04/04/2024	1,000	1,500	2,000	995	1,512	2,000	1.015x - 30.041	0.998	
B11	SKC	224-PCXR8	564315	08/04/2024	1,000	1,500	2,000	994	1,494	2,000	1.006x - 10.717	1.000	
B12	SKC	224-PCXR4	034656	08/04/2024	1,000	1,500	2,000	1,005	1,511	2,002	1.008x - 14.857	0.999	
B13	SKC	224-PCXR4	602073	05/04/2024	1,000	1,500	2,000	998	1,501	1,997	0.998x + 2.728	1.000	
B14	SKC	224-PCXR4	626313	04/04/2024	1,000	1,500	2,000	998	1,491	1,991	0.994x + 4.411	1.000	
B15	SKC	224-PCXR4	626474	04/04/2024	1,000	1,500	2,000	1,004	1,505	2,003	1.009x - 16.951	0.999	
B16	SKC	224-PCXR4	626477	04/04/2024	1,000	1,500	2,000	997	1,502	2,000	1.005x - 13.936	1.000	
B17	SKC	224-PCXR4	626860	05/04/2024	1,000	1,500	2,000	998	1,495	1,990	0.995x + 3.661	1.000	
B18	SKC	224-PCXR4	691484	05/04/2024	1,000	1,500	2,000	1,004	1,506	2,001	1.007x - 12.627	0.999	
B19	SKC	224-PCXR4	691599	08/04/2024	1,000	1,500	2,000	994	1,507	1,997	1.003x - 4.519	1.000	
B20	SKC	224-PCXR4	691587	08/04/2024	1,000	1,500	2,000	993	1,514	1,999	1.013x - 27.943	0.998	
B21	SKC	224-PCXR4	691531	08/04/2024	1,000	1,500	2,000	997	1,498	1,993	0.996x - 1.121	1.000	
B22	SKC	224-PCXR4	691654	08/04/2024	1,000	1,500	2,000	1,002	1,500	2,005	1.013x - 23.316	0.999	
B23	SKC	224-PCXR4	798393	09/04/2024	1,000	1,500	2,000	995	1,506	1,999	1.014x - 28.370	0.999	
B24	SKC	224-PCXR4	626363	04/04/2024	1,000	1,500	2,000	997	1,505	2,003	1.016x - 28.805	0.999	
B25	SKC	224-PCXR4	798489	04/04/2024	1,000	1,500	2,000	1,000	1,494	2,002	0.999x - 1.300	1.000	
B26	SKC	224-PCXR4	798479	05/04/2024	1,000	1,500	2,000	1,001	1,501	1,997	0.998x + 2.010	1.000	
B27	SKC	224-PCXR4	691673	08/04/2024	1,000	1,500	2,000	995	1,505	2,001	1.014x - 28.031	0.999	
B28	SKC	224-PCXR4	691570	08/04/2024	1,000	1,500	2,000	1,004	1,498	2,000	1.007x - 15.302	0.999	
B29	SKC	224-PCXR4	626472	08/04/2024	1,000	1,500	2,000	1,003	1,496	2,003	1.003x - 5.903	1.000	
B30	SKC	224-PCXR4	691489	05/04/2024	1,000	1,500	2,000	1,005	1,511	2,005	1.007x - 8.527	0.999	
B31	SKC	224-PCXR4	691509	09/04/2024	1,000	1,500	2,000	991	1,495	1,998	1.006x - 14.067	1.000	
B32	SKC	224-PCXR4	091567	05/04/2024	1,000	1,500	2,000	993	1,504	1,999	1.013x - 26.659	0.999	
B33	SKC	224-PCXR4	091756	05/04/2024	1,000	1,500	2,000	994	1,500	1,995	1.000x - 2.836	1.000	
B34	SKC	224-PCXR4	612962	08/04/2024	1,000	1,500	2,000	1,004	1,503	2,001	1.006x - 11.243	0.999	
B35	SKC	224-PCXR4	602682	08/04/2024	1,000	1,500	2,000	997	1,496	1,995	0.996x - 2.772	1.000	
B36	SKC	224-PCXR4	626164	05/04/2024	1,000	1,500	2,000	997	1,506	2,000	1.006x - 14.139	0.999	
B37	SKC	224-PCXR4	626256	04/04/2024	1,000	1,500	2,000	997	1,507	1,998	1.010x - 23.269	0.999	
B38	SKC	224-PCXR4	626167	04/04/2024	1,000	1,500	2,000	996	1,496	1,997	1.004x - 7.259	1.000	
B39	SKC	224-PCXR4	034637	04/04/2024	1,000	1,500	2,000	1,007	1,499	2,000	1.003x - 11.120	0.999	
B40	SKC	224-PCXR4	798349	08/04/2024	1,000	1,500	2,000	995	1,506	2,001	1.013x - 26.810	0.999	



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

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature 25 ± 3 °C
Pressure 1010 ± 15 mmbar

Personal Pump Data					Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve		
					Setting			Actual (Q std.)					
					1	2	3	1	2	3	y	R ²	
B41	SKC	224-PCXR4	612669	05/04/2024	1,000	1,500	2,000	1,001	1,498	1,990	0.994x + 6.342	1.000	
B42	SKC	224-PCXR4	626041	04/04/2024	1,000	1,500	2,000	1,006	1,496	1,990	0.984x + 20.844	1.000	
B43	SKC	224-PCXR4	034636	04/04/2024	1,000	1,500	2,000	998	1,498	1,989	0.989x + 12.360	1.000	
B44	SKC	224-PCXR8	529341	09/04/2024	1,000	1,500	2,000	1,000	1,501	2,002	1.005x - 9.213	1.000	
B45	SKC	224-PCXR8	529594	04/04/2024	1,000	1,500	2,000	1,002	1,502	1,989	0.988x + 16.584	1.000	
B46	SKC	224-PCXR8	566743	04/04/2024	1,000	1,500	2,000	996	1,507	2,001	1.012x - 24.724	0.999	
B47	SKC	224-PCXR8	566747	08/04/2024	1,000	1,500	2,000	1,005	1,500	2,002	1.007x - 16.424	0.999	
B48	SKC	224-PCXR8	566753	09/04/2024	1,000	1,500	2,000	998	1,492	1,997	0.996x - 1.157	1.000	
B49	SKC	224-PCXR8	566780	08/04/2024	1,000	1,500	2,000	1,004	1,503	2,005	1.009x - 18.040	0.999	
B50	SKC	224-PCXR8	500400	04/04/2024	1,000	1,500	2,000	1,003	1,495	2,003	1.000x - 1.783	1.000	
B51	SKC	224-PCXR8	500363	04/04/2024	1,000	1,500	2,000	995	1,500	2,002	1.013x - 28.701	0.999	
B52	SKC	224-PCXR8	093186	04/04/2024	1,000	1,500	2,000	992	1,494	1,991	0.996x + 8.116	1.000	
B53	SKC	224-PCXR8	707670	08/04/2024	1,000	1,500	2,000	1,000	1,502	2,001	1.009x - 16.999	0.999	
B54	SKC	224-PCXR3	509821	08/04/2024	1,000	1,500	2,000	996	1,503	2,002	1.015x - 30.009	0.999	
B55	SKC	224-PCXR3	510710	05/04/2024	1,000	1,500	2,000	1,000	1,494	1,993	0.995x + 8.965	1.000	
B56	SKC	224-PCXR3	511450	09/04/2024	1,000	1,500	2,000	1,004	1,499	2,000	1.002x - 4.651	1.000	
B57	SKC	224-PCXR3	510798	08/04/2024	1,000	1,500	2,000	996	1,494	1,998	1.000x - 2.680	1.000	
B58	SKC	224-PCXR3	509852	08/04/2024	1,000	1,500	2,000	1,002	1,501	2,000	1.006x - 16.480	0.999	
B59	SKC	224-PCXR3	509862	08/04/2024	1,000	1,500	2,000	997	1,501	1,998	0.999x + 1.041	1.000	
B60	SKC	224-PCXR3	512655	05/04/2024	1,000	1,500	2,000	1,005	1,507	2,003	1.003x - 8.627	1.000	
B61	SKC	224-PCXR3	503915	05/04/2024	1,000	1,500	2,000	993	1,490	2,000	1.004x - 12.823	1.000	
B62	SKC	224-PCXR3	505975	05/04/2024	1,000	1,500	2,000	1,001	1,495	1,997	0.995x + 2.616	1.000	
B63	SKC	224-PCXR3	511432	05/04/2024	1,000	1,500	2,000	993	1,503	1,999	1.014x - 30.715	0.999	
B64	SKC	224-PCXR3	508302	08/04/2024	1,000	1,500	2,000	1,000	1,493	1,987	0.988x + 15.991	1.000	
B65	SKC	224-PCXR3	508310	09/04/2024	1,000	1,500	2,000	1,003	1,500	2,003	1.006x - 12.021	1.000	
B66	SKC	224-PCXR3	509861	08/04/2024	1,000	1,500	2,000	1,004	1,489	1,990	0.986x + 16.775	1.000	
B67	SKC	224-PCXR3	506295	04/04/2024	1,000	1,500	2,000	997	1,506	2,003	1.004x - 8.094	1.000	
B68	SKC	224-PCXR3	505872	04/04/2024	1,000	1,500	2,000	1,004	1,490	1,997	0.992x + 7.829	1.000	
B69	SKC	224-PCXR3	508375	04/04/2024	1,000	1,500	2,000	1,005	1,500	1,998	1.006x - 13.832	0.999	
B70	SKC	224-PCXR3	510623	08/04/2024	1,000	1,500	2,000	995	1,491	1,996	1.000x - 4.938	1.000	
B71	SKC	224-PCXR3	508367	09/04/2024	1,000	1,500	2,000	996	1,506	2,000	1.012x - 27.572	0.999	
B72	SKC	224-PCXR3	605977	04/04/2024	1,000	1,500	2,000	1,001	1,500	1,995	0.994x + 5.791	1.000	
B73	SKC	224-PCXR3	512606	04/04/2024	1,000	1,500	2,000	1,002	1,499	2,002	1.007x - 12.671	1.000	
B74	SKC	224-PCXR3	505993	04/04/2024	1,000	1,500	2,000	995	1,495	1,996	1.003x - 9.987	1.000	
B75	SKC	224-PCXR3	509920	05/04/2024	1,000	1,500	2,000	998	1,497	1,993	0.997x + 1.432	1.000	
B76	SKC	224-PCXR3	509811	05/04/2024	1,000	1,500	2,000	992	1,497	2,000	1.008x - 17.753	1.000	
B77	SKC	224-PCXR3	508301	05/04/2024	1,000	1,500	2,000	1,004	1,499	2,001	1.010x - 19.793	0.999	
B78	SKC	224-PCXR3	510677	08/04/2024	1,000	1,500	2,000	997	1,505	2,001	1.013x - 27.321	0.999	
B79	SKC	224-PCXR3	510920	09/04/2024	1,000	1,500	2,000	995	1,495	1,993	1.000x - 4.702	1.000	

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature 25 ± 3 °C
 Pressure 1010 ± 15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (mL/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R ²
B80	SKC	224-PCXR3	504569	09/04/2024	1,000	1,500	2,000	1,003	1,501	2,004	1.013x - 23.428	0.999
B81	SKC	224-PCXR3	503480	04/04/2024	1,000	1,500	2,000	998	1,499	2,003	1.015x - 30.384	0.999
B82	SKC	224-PCXR3	505673	04/04/2024	1,000	1,500	2,000	995	1,496	1,998	1.001x - 5.105	1.000
B83	SKC	224-PCXR3	510785	08/04/2024	1,000	1,500	2,000	1,012	1,499	2,000	1.002x - 7.135	0.999
B84	SKC	224-PCXR3	508333	08/04/2024	1,000	1,500	2,000	998	1,500	1,990	0.991x + 8.599	1.000
B85	SKC	224-PCXR3	505757	09/04/2024	1,000	1,500	2,000	993	1,503	2,000	1.008x - 16.396	1.000
B86	SKC	224-PCXR3	512625	04/04/2024	1,000	1,500	2,000	1,011	1,501	2,002	1.000x + 0.072	0.999
B87	SKC	224-PCXR3	504324	04/04/2024	1,000	1,500	2,000	998	1,495	2,001	1.003x - 4.758	1.000
B88	SKC	224-PCXR3	500307	08/04/2024	1,000	1,500	2,000	997	1,500	1,994	0.996x + 3.047	1.000
B89	SKC	224-PCXR3	509860	04/04/2024	1,000	1,500	2,000	1,001	1,501	2,006	1.011x - 17.174	1.000
B90	SKC	224-PCXR3	508366	08/04/2024	1,000	1,500	2,000	997	1,510	2,001	1.004x - 8.814	1.000
B91	SKC	224-PCXR3	510919	04/04/2024	1,000	1,500	2,000	1,001	1,502	1,998	0.993x + 7.522	1.000
B92	SKC	224-PCXR3	510907	04/04/2024	1,000	1,500	2,000	1,000	1,504	2,000	1.001x + 0.858	1.000
B93	SKC	224-PCXR3	502845	08/04/2024	1,000	1,500	2,000	998	1,495	2,003	1.007x - 13.389	1.000
B94	SKC	224-PCXR8	A127871	08/04/2024	1,000	1,500	2,000	1,001	1,501	2,004	1.008x - 19.942	0.999
B95	SKC	224-PCXR8	A127921	08/04/2024	1,000	1,500	2,000	996	1,504	2,005	1.016x - 31.417	0.999
B96	SKC	224-PCXR8	A127942	08/04/2024	1,000	1,500	2,000	999	1,500	2,006	1.003x - 5.715	1.000
B97	SKC	224-PCXR8	A127955	08/04/2024	1,000	1,500	2,000	1,004	1,502	2,005	1.011x - 20.122	0.999
B98	SKC	224-PCXR8	A127956	08/04/2024	1,000	1,500	2,000	995	1,496	2,000	1.004x - 9.122	1.000

Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

Rotameter Data			Calibration Data								
No.	Brand	Model	Date	Flow Rate (mL/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	y	R ²
H-801	Dwyer	VFB-65	06/04/2024	500	1,000	2,000	504.3	992.1	1976.8	0.991x + 6.353	1.000
H-802	Dwyer	VFB-65	04/04/2024	500	1,000	2,000	496.5	998.8	1996.7	0.995x + 4.247	1.000
H-803	Dwyer	VFB-65	05/04/2024	500	1,000	2,000	498.6	991.4	2011.0	1.003x - 12.161	0.999
H-804	Dwyer	VFB-65	04/04/2024	500	1,000	2,000	501.4	1000.9	2008.3	0.998x - 1.566	1.000
H-805	Dwyer	VFB-65	08/04/2024	500	1,000	2,000	502.9	999.5	1974.5	0.979x + 24.520	0.999
H-806	Dwyer	VFB-65	04/04/2024	500	1,000	2,000	504.7	996.0	1984.4	1.005x - 6.145	1.000
H-807	Dwyer	VFB-65	05/04/2024	500	1,000	2,000	502.8	992.8	2017.1	1.000x - 0.160	1.000
H-808	Dwyer	VFB-65	04/04/2024	500	1,000	2,000	500.3	1000.7	1980.2	0.995x + 5.203	0.999
H-809	Dwyer	VFB-65	09/04/2024	500	1,000	2,000	503.3	1005.0	2011.1	0.994x + 13.348	1.000
H-810	Dwyer	VFB-65	08/04/2024	500	1,000	2,000	498.2	1001.7	2008.8	0.995x + 5.854	1.000



CERTIFICATE No : 24M2227
REFERENCE No : 72448-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : METTLER TOLEDO
MODEL : XS105DU
SERIAL No : 1126422905
ID No : BA05/50
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : S.P.S. CONSULTING SERVICE CO., LTD.
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN RD.,
JOMPOL, CHATUCHAK, BANGKOK 10900

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 08-Mar-24

APPROVED BY :

ISSUED DATE : 14-Mar-24

RECEIVED DATE : 08-Mar-24



CERTIFICATE No : 24M2227

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XS105DU
MANUFACTURER : METTLER TOLEDO S/N : 1126422905
ID No : BA05/50 RECEIVED DATE : 08-Mar-24
AIR PRESSURE : 1010mbar \pm 1mbar CALIBRATION DATE : 08-Mar-24
AMBIENT TEMPERATURE : 25° C \pm 1° C RELATIVE HUMIDITY : 53 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

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

3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.

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

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

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

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0.000055 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.00	0.00000	0.00000	0.000065
0.02	0.02001	-0.00001	0.000065
0.10	0.10002	-0.00002	0.000066
0.20	0.20001	-0.00001	0.000066
0.50	0.50001	-0.00001	0.000065
1.00	1.00003	-0.00003	0.000066
2.00	2.00001	-0.00001	0.000067
5.00	5.00001	-0.00001	0.000068
10.00	9.99994	0.00006	0.000070
20.00	20.00008	-0.00008	0.000078
50.00	50.0000	0.0000	0.00013
100.00	100.0001	-0.0001	0.00019
120.00	120.0001	-0.0001	0.00022

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.0000
2	50.0000
3	50.0000
4	50.0000
5	50.0000
OFF-CENTER LOADING	0.0000

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

END OF CALIBRATION REPORT

เอกสารที่ 5-4

เอกสารสอบเทียบเครื่องมือการตรวจระดับเสียง

โดยทั่วไปและเสียงในสถานประกอบการ

(Working Area)

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

CALIBRATION CERTIFICATE

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

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

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

Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : ACO

Model : 2127

Serial No. : 130006

Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.

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

3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.

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

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

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

7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871.

Ambient Environment

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

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

Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$

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

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

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

Date of Receipt : 27 Mar. 2023

Date of Calibration : 29 Mar. 2023

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

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

FM.BLMTC.002 Rev.4

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

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

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

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

1. Sound Pressure Level

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

2. Frequency

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

3. Total distortion

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

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

Approved by :


(Mr. Prawate Kludypa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref : 2011266032701228001

Date of Calibration : 29 Mar. 2023

Date of Issue : 30 Mar. 2023

End of Certificate

2 / 2

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

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

FM.BLMTC.002 Rev.4



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอย พหลโยธิน 24 ถนนพหลโยธิน แขวงจตุจักร เขตจตุจักร กรุงเทพฯ 10900
Tel : (062) 039-4370-72 Fax : (062) 513-4321 E-mail : sales@spscs.com, www.spscs.com

Noise B_035/24

Sound Level Meter Calibration Report

Acoustic Calibrator Data

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

Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
ACO-B30	ACO	6236	00182012	23 February 2024	94.1	94.0
ACO-B33	ACO	6236	00182015	23 February 2024	94.1	94.0
ACO-B34	ACO	6236	00192025	23 February 2024	94.0	94.0
ACO-B37	ACO	6236	00192028	23 February 2024	93.9	94.0
ACO-B38	ACO	6236	00192029	23 February 2024	94.0	94.0
ACO-B40	ACO	6236	00192031	23 February 2024	94.0	94.0
ACO-B41	ACO	6236	00192032	23 February 2024	94.0	94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.94 ± 0.10 dB	



Certificate of Calibration

Certificate Number : SPR23030423-6

Page : 1 of 3

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

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

Equipment Name : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial Number : 172048

ID. Number : ACO-B18

Environmental Conditions

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

Received Date : 24 Mar 2023

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

Calibration Date : 07 Apr 2023

Location of Calibration : In-Lab

Recommend Due Date : 07 Apr 2024

Calibration Procedure : SP-CPE-04-01

Date of Issue : 08 Apr 2023

Method of Calibration

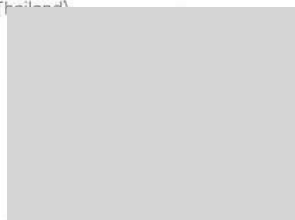
This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure. Standards used to perform this calibration are certified by to NIST or equivalent, National metrology institute, Natural physical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

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

Calibrated by : Mr.Chumpon Dokpikul

Calibration Officer

Approved by



Calibration Report

Certificate Number : SPR23030423-6

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Sound Level Calibrator	ST-120	211203773	EEL.BP. 114/0166	17 Jan 2024

Traceability

This certification is traceable to the International System of Unit maintained at :
TISTR - Thailand Institute of Scientific and Technological Research



Result of Calibration

Certificate No. : SPR23030423-6

Page : 3 of 3

Range : 94 to 114 dB

Function : @1kHz

Select A		Unit : dB			
Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.0	94.0	0.0	0.0	0.15
114	114.0	114.0	0.0	0.0	0.15

Select C		Unit : dB			
Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.1	94.1	0.1	0.1	0.15
114	114.0	114.0	0.0	0.0	0.15

Note:

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

Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor $k = 2.00$, providing a level of confidence approximately 95%.

- End of Certificate -



Certificate of Calibration

Certificate Number : SPR23030423-2

Page : 1 of 3

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

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

Equipment Name : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial Number : 182011

ID. Number : ACO-B29

Environmental Conditions

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

Received Date : 24 Mar 2023

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

Calibration Date : 28 Mar 2023

Location of Calibration : In-Lab

Recommend Due Date : 28 Mar 2024

Calibration Procedure : SP-CPE-04-01

Date of Issue : 29 Mar 2023

Method of Calibration

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

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

Calibrated by : Mr.Karoon Pengsalung

Approved by :

Calibration Officer



Calibration Report

Certificate Number : SPR23030423-2

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Sound Level Calibrator	ST-120	211203773	EEL.BP. 114/0166	17 Jan 2024

Traceability

This certification is traceable to the International System of Unit maintained at :
TISTR - Thailand Institute of Scientific and Technological Research



Result of Calibration

Certificate No. : SPR23030423-2

Page : 3 of 3

Range : 94 to 114 dB

Function : @1kHz

Select A

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.0	94.0	0.0	0.0	0.15
114	114.0	114.0	0.0	0.0	0.15

Select C

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.2	94.2	0.2	0.2	0.15
114	114.0	114.0	0.0	0.0	0.15

Note:

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

Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor $k = 2.00$, providing a level of confidence approximately 95%.

- End of Certificate -



Certificate of Calibration

Certificate Number : SPR23040335-1

Page : 1 of 3

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

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

Equipment Name : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial Number : 182015

ID. Number : ACO-B33

Environmental Conditions

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

Received Date : 28 Apr 2023

Relative Humidity : 50 % \pm 15 %

Calibration Date : 28 Apr 2023

Location of Calibration : In-Lab

Recommend Due Date : 28 Apr 2024

Calibration Procedure : SP-CPE-04-01

Date of Issue : 29 Apr 2023

Method of Calibration

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

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

Calibrated by : Mr.Karoon Pengsalung

Approved by :

Calibration Officer



Calibration Report

Certificate Number : SPR23040335-1

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Sound Level Calibrator	ST-120	211203773	EEL.BP. 114/0166	17 Jan 2024

Traceability

This certification is traceable to the International System of Unit maintained at :

TISTR - Thailand Institute of Scientific and Technological Research

Result of Calibration

Certificate No. : SPR23040335-1

Page : 3 of 3

Range : 94 to 114 dB

Function : @1kHz

Select A

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.2	94.2	0.2	0.2	0.15
114	114.1	114.1	0.1	0.1	0.15

Select C

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.2	94.2	0.2	0.2	0.15
114	114.1	114.1	0.1	0.1	0.15

Note:

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

Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor $k = 2.00$, providing a level of confidence approximately 95%.

- End of Certificate -

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

CALIBRATION CERTIFICATE

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

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

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

: Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : ACO

Model : 2127

Serial No. : 130006

Ambient Environment

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

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

Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$

Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.

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

3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.

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

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

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

7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871.

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

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

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

Date of Receipt : 27 Mar. 2023

Date of Calibration : 29 Mar. 2023

1/2

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

FM.8L.MTC.002 Rev.4

Head Office

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



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

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

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

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

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

1. Sound Pressure Level

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

2. Frequency

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

3. Total distortion

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

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

Approved by :



Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 29 Mar. 2023

Date of Issue : 30 Mar. 2023

Ref : 2011266032701228001

End of Certificate

2 / 2

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

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



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

Noise B_042/24

Sound Level Meter Calibration Report

Acoustic Calibrator Data

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

Calibration Data

Sound Level Meter Data				Calibration Data	
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]
					Before Adjustment After Adjustment
ACO-B18	ACO	6236	00172048	25 February 2024	94.0 94.0
ACO-B29	ACO	6236	00182011	25 February 2024	94.1 94.0
ACO-B33	ACO	6236	00182015	25 February 2024	94.0 94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.94 \pm 0.10 dB



Certificate of Calibration

Certificate Number : SPR23090267-6

Page : 1 of 3

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

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

Equipment Name : Sound Level Meter

Manufacturer : Cirrus

Model : N/A

Serial Number : G301151

ID. Number : CR-B06

Environmental Conditions

Ambient Temperature : $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$ Received Date : 16 Sep 2023

Relative Humidity : $50\% \pm 15\%$ Calibration Date : 18 Sep 2023

Location of Calibration : In-Lab Recommend Due Date : 18 Sep 2024

Calibration Procedure : SP-CPE-04-01 Date of Issue : 19 Sep 2023

Method of Calibration

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

The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by : Mr.Chumpon Dokpikul

Calibration Officer

Approved by



Calibration Report

Certificate Number : SPR23090267-6

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Sound Level Calibrator	ST-120	211203773	EEL.BP. 114/0166	17 Jan 2024

Traceability

This certification is traceable to the International System of Unit maintained at :
TISTR - Thailand Institute of Scientific and Technological Research



Result of Calibration

Certificate No. : SPR23090267-6

Page : 3 of 3

Range : 94 to 114 dB

Function : @1kHz

Select A Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.0	94.0	0.0	0.0	0.15
114	113.9	113.9	-0.1	-0.1	0.15

Select C Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.0	94.0	0.0	0.0	0.15
114	113.9	113.9	-0.1	-0.1	0.15

Select Z Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.0	94.0	0.0	0.0	0.15
114	113.9	113.9	-0.1	-0.1	0.15

Note:

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

Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor $k = 2.00$, providing a level of confidence approximately 95%.
- End of Certificate -



Sound level Calibration report

Instrument Calibrated

Description : Sound Level Meter
Manufacturer : Cirrus
Model : CR161B
Serial No. : G301401
Microphone No. : 216924A
Peramplifier No. : 10323F

Ambient Enviroment

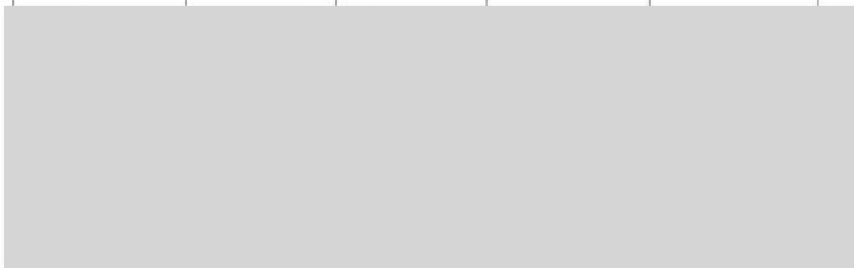
Temperature : (24±3)°C
Relative Humidity : (55±15)%
Ambient Pressure : (1008±5)hPa

Standards Used

- Sound Level Calibrator Delta ohm HD 2020 S/N : 15030521

Measurement Result

Method	Standard Reference (dB)	Reading (dB)	Error (dB)	After Adjustment ± (dB)
Sound level	94.0	95.3	1.30	93.7



CERTIFICATE OF CALIBRATION

ISSUED BY Cirrus Research plc
DATE OF ISSUE 08 June 2023 CERTIFICATE NUMBER 193308

Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Microphone

Microphone capsule

Manufacturer: Cirrus Research plc

Model: MK:224

Serial Number: 216924A

Calibration procedure

Date of calibration: 08 June 2023

Open circuit: 48.6 mV/Pa

Sensitivity at 1 kHz: -26.3 dB rel 1 V/Pa

The microphone capsule detailed above has been calibrated to the published data as described in the operating manual of the associated sound level meter (where applicable).

The frequency response was measured using an electrostatic actuator in accordance with BS EN 61094-6:2005 with the free-field response derived via standard correction data traceable to a National Measurement Institute.

The absolute sensitivity at 1 kHz was measured using an acoustic calibrator conforming to IEC 60942:2003 Class 1.

Environmental conditions

Pressure: 101.50 kPa

Temperature: 21.0 °C

Humidity: 48.0 %

CERTIFICATE OF CALIBRATION

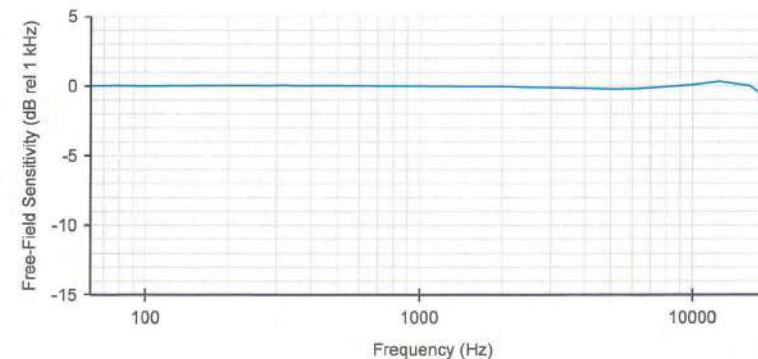
Certificate Number:
193308

Page 2 of 2

Free-Field Frequency Response : Tabular

Frequency (Hz)	Free-Field Sensitivity (dB rel 1 kHz)	Actuator Response (dB)
63	0.02	-0.15
80	0.04	-0.03
100	0.01	0.04
125	0.02	0.05
160	0.04	0.09
200	0.03	0.10
250	0.03	0.11
315	0.05	0.10
400	0.04	0.10
500	0.03	0.09
630	0.02	0.07
800	0.01	0.05
1 000	0.00	0.02
1 250	-0.01	-0.03
1 600	-0.02	-0.11
2 000	-0.03	-0.22
2 500	-0.07	-0.39
3 150	-0.11	-0.65
4 000	-0.14	-1.04
5 000	-0.20	-1.56
6 300	-0.17	-2.26
8 000	-0.04	-3.22
10 000	0.09	-4.57
12 500	0.32	-6.11
16 000	0.02	-7.79
20 000	-1.35	-10.36

Free-Field Frequency Response : Graphical



CERTIFICATE OF CALIBRATION

ISSUED BY Cirrus Research

DATE OF ISSUE 13 February 2024 CERTIFICATE NUMBER 208458

Cirrus Research
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Sound Level Meter : IEC 61672

Instrument information

Manufacturer: Cirrus Research plc
Model: CR:161B
Serial number: G301407
Class: 1
Firmware version: 5.8.3251

Notes:

Test summary

Date of calibration: 12 February 2024

The calibration was performed respecting the requirements of ISO/IEC 17025:2017.
Periodic tests were performed in accordance with procedures from IEC 61672-3:2013.

The sound level meter submitted for testing successfully completed the class 1 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 because (a) evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to determine that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Notes

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a coverage probability of approximately 95%.

CERTIFICATE OF CALIBRATION

Certificate Number:
208458

Page 2 of 2

Environmental conditions

The following conditions were recorded at the time of the test:

Before Pressure: 99.64 kPa Temperature: 22.6 °C Humidity: 39.1 %
After Pressure: 99.68 kPa Temperature: 22.9 °C Humidity: 39.6 %

Test equipment

Equipment	Manufacturer	Model	Serial number
Signal Generator	KEYSIGHT	33511B	MY58001681
Attenuator	Cirrus Research	ZE:952	64370
Environmental Monitor	Comet	T7510	16966334

Additional instrument information

Instruction manual:

Reference level range: Single range

Pattern approval: No

Source of pattern approval: -

Preamplifier

Model: MV:200F
Serial number: 9649F

Microphone

Model: MK:224
Serial number: 212389D

Test results summary

Test	Result
Toneburst response	Complies
Electrical noise-floor	Complies
Linearity	Complies
Electrical Frequency weightings	Complies
Frequency and time weightings at 1 kHz	Complies
C-weighted peak	Complies
Overload indication	Complies
High level stability	Complies
Long-term stability	Complies
Acoustic Frequency weightings	Complies

CERTIFICATE OF CALIBRATION

ISSUED BY Cirrus Research

DATE OF ISSUE 06 February 2024 CERTIFICATE NUMBER 208459

Cirrus Research
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Microphone

Microphone capsule

Manufacturer: Cirrus Research plc

Model: MK:224

Serial Number: 212389D

Calibration procedure

Date of calibration: 06 February 2024

Open circuit: 40.8 mV/Pa

Sensitivity at 1 kHz: -27.8 dB rel 1 V/Pa

The microphone capsule detailed above has been calibrated to the published data as described in the operating manual of the associated sound level meter (where applicable).

The frequency response was measured using an electrostatic actuator in accordance with BS EN 61094-6:2005 with the free-field response derived via standard correction data traceable to a National Measurement Institute.

The absolute sensitivity at 1 kHz was measured using an acoustic calibrator conforming to IEC 60942:2003 Class 1.

Environmental conditions

Pressure: 99.10 kPa

Temperature: 22.0 °C

Humidity: 40.0 %

CERTIFICATE OF CALIBRATION

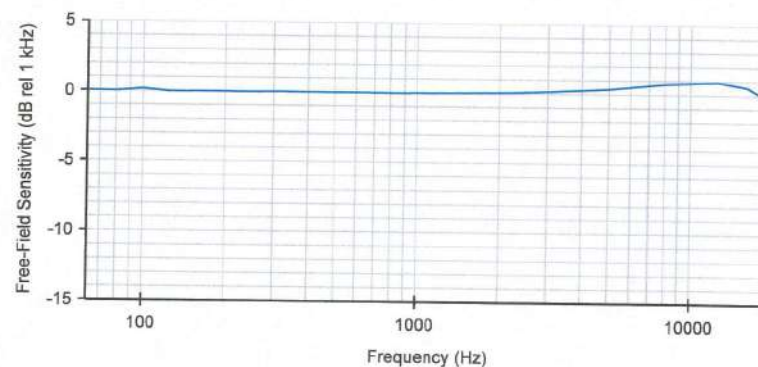
Certificate Number:
208459

Page 2 of 2

Free-Field Frequency Response : Tabular

Frequency (Hz)	Free-Field Sensitivity (dB rel 1 kHz)	Actuator Response (dB)
63	0.03	-0.14
80	0.02	-0.04
100	0.17	0.20
125	-0.00	0.03
160	0.00	0.06
200	-0.00	0.07
250	-0.02	0.06
315	0.02	0.07
400	0.00	0.07
500	0.01	0.07
630	0.01	0.06
800	-0.00	0.04
1 000	0.00	0.02
1 250	0.02	0.01
1 600	0.05	-0.04
2 000	0.08	-0.10
2 500	0.12	-0.19
3 150	0.21	-0.33
4 000	0.30	-0.60
5 000	0.41	-0.95
6 300	0.60	-1.49
8 000	0.79	-2.39
10 000	0.88	-3.78
12 500	0.96	-5.47
16 000	0.60	-7.20
20 000	-0.49	-9.50

Free-Field Frequency Response : Graphical





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจตุจักร เขตจตุจักร กรุงเทพฯ 10900
Tel : (062) 979-4379/72 Fax : (062) 513-4221 E-mail : sales@spscon.com, www.spscon.com

Noise B_138/24

Sound Level Meter Calibration Report

Acoustic Calibrator Data						
Brand		CIRRUS		Number		AC-CR01/63
Model		CR515		Serial No.		92002
Calibration Range		94 dB, 1000 Hz		Last Calibration		05 March 2024
				Due Date		05 March 2025
Calibration Data						
Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
CR-B06	Cirrus	CR161B	G301151	05 May 2024	94.0	94.0
CR-B09	Cirrus	CR161B	G301401	05 May 2024	94.1	94.0
CR-B10	Cirrus	CR161B	G301407	05 May 2024	94.0	94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					94.04 ± 0.10 dB	

เอกสารที่ 5-5

เอกสารสอบเทียบเครื่องมือการตรวจค่าความร้อน
ในสถานประกอบการ (Working Area)



Certificate of Calibration

Certificate Number : SPR23030505-1

Page : 1 of 3

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

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

Equipment Name : Area Heat Stress Monitor

Manufacturer : Quest Technologies

Model : QUESTemp 34

Serial Number : TEG040059

ID. Number : B07

Environmental Conditions

Ambient Temperature : $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$

Received Date : 30 Mar 2023

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

Calibration Date : 31 Mar 2023

Location of Calibration : In-Lab

Recommend Due Date : 31 Mar 2024

Calibration Procedure : SP-CPT-04-13

Date of Issue : 01 Apr 2023

Method of Calibration

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

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

Calibrated by : Mr. Sarawut Khitmai

Approved

Calibration Officer



Calibration Report

Certificate Number : SPR23030505-1

Page : 2 of 3

Reference Standards

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

Traceability

This certification is traceable to the International System of Unit maintained at :

SP Metrology - SP Metrology system (Thailand) Co.Ltd.

Quality Reborn Co., Ltd



Result of Calibration

Certificate No. : SPR23030505-1

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.013	30.0	-0.013	0.50
35.0	35.010	35.0	-0.010	0.50
40.0	40.015	40.0	-0.015	0.50

Temperature Accuracy in the Measurement. (DRY)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.013	30.0	-0.013	0.50
35.0	35.010	35.0	-0.010	0.50
40.0	40.015	40.0	-0.015	0.50

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.013	30.0	-0.013	0.50
35.0	35.010	35.0	-0.010	0.50
40.0	40.015	40.0	-0.015	0.50

Note:

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

Measurement Uncertainty

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

- End of Certificate -



Certificate of Calibration

Certificate Number : SPR23110155-2

Page : 1 of 3

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

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

Equipment Name : Area Heat Stress Monitor

Manufacturer : Quest Technologies

Model : QUESTemp 34

Serial Number : TEL080034

ID. Number : B11

Environmental Conditions

Ambient Temperature : $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ Received Date : 10 Nov 2023

Relative Humidity : $50\% \pm 15\%$ Calibration Date : 11 Nov 2023

Location of Calibration : In-Lab Recommend Due Date : 11 Nov 2024

Calibration Procedure : SP-CPT-04-13 Date of Issue : 12 Nov 2023

Method of Calibration

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

The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by : Mr.Navaporn Uengseng

Approved by

Calibration Officer



Calibration Report

Certificate Number : SPR23110155-2

Page : 2 of 3

Reference Standards

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

Traceability

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



Result of Calibration

Certificate No. : SPR23110155-2

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.011	30.3	0.289	0.20
35.0	35.014	35.3	0.286	0.20
40.0	40.017	40.3	0.283	0.20

Temperature Accuracy in the Measurement. (DRY)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.011	30.3	0.289	0.20
35.0	35.014	35.3	0.286	0.20
40.0	40.017	40.3	0.283	0.20

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

Humidity Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.011	30.5	0.489	0.20
35.0	35.014	35.5	0.486	0.20
40.0	40.017	40.5	0.483	0.20

Note:

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

Measurement Uncertainty

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

- End of Certificate -



Certificate of Calibration

Certificate Number : SPR23110050-1 Page : 1 of 3

Customer : S.P.S. CONSULTING SERVICE CO., LTD.
7 Soi Phaholyothin 24 Phaholyothin Road., Jompol, Chatuchak,
Bangkok 10900

Equipment Name : Area Heat Stress Monitor
Manufacturer : Quest Technologies
Model : QUESTemp 32
Serial Number : TPA100010
ID. Number : B12

Environmental Conditions

Ambient Temperature : $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ Received Date : 03 Nov 2023
Relative Humidity : $50\% \pm 15\%$ Calibration Date : 03 Nov 2023
Location of Calibration : In-Lab Recommend Due Date : 03 Nov 2024
Calibration Procedure : SP-CPT-04-13 Date of Issue : 04 Nov 2023

Method of Calibration

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

The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by : Mr. Pitak Srisutam
Calibration Officer

Approved by :

()



Calibration Report

Certificate Number : SPR23110050-1 Page : 2 of 3

Reference Standards

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

Traceability

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



Result of Calibration

Certificate No. : SPR23110050-1

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.014	30.1	0.086	0.20
35.0	35.012	35.1	0.088	0.20
40.0	40.017	40.1	0.083	0.20

Temperature Accuracy in the Measurement. (DRY)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.014	30.2	0.186	0.20
35.0	35.012	35.2	0.188	0.20
40.0	40.017	40.2	0.183	0.20

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

Humidity Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.014	30.2	0.186	0.20
35.0	35.012	35.2	0.188	0.20
40.0	40.017	40.2	0.183	0.20

Note :

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

Measurement Uncertainty

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

- End of Certificate -



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

Heat 042_1

Heat Stress WBGT Meter Verification Report			
Verification Data			
Heat Stress WBGT Meter No. :	B07	Verification Date :	25 February 2024
Brand :	3M	Ambient Temp. :	24.5 °C
Model :	QUESTemp ^o 34	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)	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	47.2	-0.1	± 0.5
Globe Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
69.3	69.2	0.1	± 0.5
UUC* = UNIT UNDER CALIBRATION			



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S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
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Heat 042_2

Heat Stress WBGT Meter Verification Report			
Verification Data			
Heat Stress WBGT Meter No.	: B11	Verification Date	: 25 February 2024
Brand	: 3M	Ambient Temp.	: 24.5 °C
Model	: QUESTemp ^o 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	47.2	-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			



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S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
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Heat 042_3

Heat Stress WBGT Meter Verification Report			
Verification Data			
Heat Stress WBGT Meter No.	: B12	Verification Date	: 25 February 2024
Brand	: 3M	Ambient Temp.	: 24.5 °C
Model	: QUESTemp ^o 32	Barometric Pressure	: 1011 mmbar
Serial No.	: TPA100010	Relative Humidity	: 49 %
Verification Module (Electronic Sensor Check) :			
Verification Module No. : 21 WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C			
Result of Verification : Without Adjustment			
Wet Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
12.5	12.6	-0.1	± 0.5
Dry Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
47.1	47.3	-0.2	± 0.5
Globe Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
69.3	69.1	0.2	± 0.5
UUC* = UNIT UNDER CALIBRATION			



Certificate of Calibration

Certificate Number : SPR23110050-2 Page : 1 of 3

Customer : S.P.S. CONSULTING SERVICE CO., LTD.
7 Soi Phaholyothin 24 Phaholyothin Road., Jompol, Chatuchak,
Bangkok 10900

Equipment Name : Area Heat Stress Monitor

Manufacturer : Quest Technologies

Model : QUESTemp 34

Serial Number : TEF050029

ID. Number : B17

Environmental Conditions

Ambient Temperature : $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$ Received Date : 03 Nov 2023

Relative Humidity : $50\% \pm 15\%$ Calibration Date : 03 Nov 2023

Location of Calibration : In-Lab Recommend Due Date : 03 Nov 2024

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

Method of Calibration

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

The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by : Mr.Pitak Srisutam

Calibration Officer

Approved by :



Calibration Report

Certificate Number : SPR23110050-2 Page : 2 of 3

Reference Standards

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

Traceability

This certification is traceable to the International System of Unit maintained at :

SP Metrology - SP Metrology system (Thailand) Co.Ltd.

Quality Reborn Co., Ltd



Page : 3 of 3

Unit : °C

Unit : °CUnit : °C

Note :

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

Measurement Uncertainty

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

- End of Certificate -



Page : 1 of 3

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

ID. Number : B21

Environmental Conditions

Ambient Temperature : 23 °C ± 2 °C Received Date : 19 Mar 2024

Relative Humidity : 50 % \pm 15 % Calibration Date : 20 Mar 2024

Location of Calibration : In-Lab Recommend Due Date : 20 Mar 2025

Calibration Procedure : SP-CPT-04-13 Date of Issue : 21 Mar 2024

Method of Calibration

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

The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by : Mr.Navaporn Uengseng

Calibration Officer

Approved by _____



ID LINE : IEC17025



Calibration Report

Certificate Number : SPR24030285-8

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Humidity Chamber	TH-80S	N/A	SPR24020149-7	23 Feb 2025
THERMO-HYGROMETER	5020A	A47046	QR24-0167	26 Jan 2025

Traceability

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

Quality Reborn Co., Ltd



ID LINE : IEC17025



Result of Calibration

Certificate No. : SPR24030285-8

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.012	29.8	-0.212	0.20
35.0	35.010	34.8	-0.210	0.20
40.0	40.015	39.9	-0.115	0.20

Temperature Accuracy in the Measurement. (DRY)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.012	29.7	-0.312	0.20
35.0	35.010	34.7	-0.310	0.20
40.0	40.015	39.8	-0.215	0.20

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

Humidity Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.012	29.7	-0.312	0.20
35.0	35.010	34.7	-0.310	0.20
40.0	40.015	39.7	-0.315	0.20

Note :

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

Measurement Uncertainty

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

- End of Certificate -



Certificate of Calibration

Certificate Number : SPR23110155-4

Page : 1 of 3

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

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

Equipment Name : Area Heat Stress Monitor

Manufacturer : Quest Technologies

Model : QUESTemp 32

Serial Number : TPK040059

ID. Number : B22

Environmental Conditions

Ambient Temperature : 23 °C ± 2 °C

Relative Humidity : 50 % ± 15 %

Location of Calibration : In-Lab

Calibration Procedure : SP-CPT-04-13

Received Date : 10 Nov 2023

Calibration Date : 11 Nov 2023

Recommend Due Date : 11 Nov 2024

Date of Issue : 12 Nov 2023

Method of Calibration

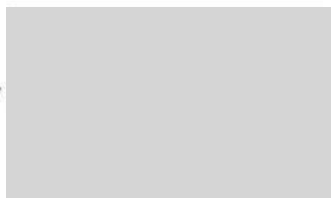
This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure. Standards used to perform this calibration are certified by to NIST or equivalent, National metrology institute, Natural physical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

The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by : Mr.Navaporn Uengseng

Calibration Officer

Approved by



Calibration Report

Certificate Number : SPR23110155-4

Page : 2 of 3

Reference Standards

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

Traceability

This certification is traceable to the International System of Unit maintained at :

SP Metrology - SP Metrology system (Thailand) Co.Ltd.

Quality Reborn Co., Ltd



Result of Calibration

Certificate No. : SPR23110155-4

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.011	30.2	0.189	0.20
35.0	35.014	35.2	0.186	0.20
40.0	40.017	40.2	0.183	0.20

Temperature Accuracy in the Measurement. (DRY)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.011	30.2	0.189	0.20
35.0	35.014	35.2	0.186	0.20
40.0	40.017	40.2	0.183	0.20

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

Humidity Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.011	30.3	0.289	0.20
35.0	35.014	35.3	0.286	0.20
40.0	40.017	40.3	0.283	0.20

Note:

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

Measurement Uncertainty

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

– End of Certificate –



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S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
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Heat B_139_1

Heat Stress WBGT Meter Verification Report			
Verification Data			
Heat Stress WBGT Meter No. :	B17	Verification Date :	05 May 2024
Brand :	Quest Technologies	Ambient Temp. :	24.5 °C
Model :	QUESTemp [®] 34	Barometric Pressure :	1011 mmbar
Serial No. :	TEF050029	Relative Humidity :	49 %
Verification Module (Electronic Sensor Check) :			
Verification Module No. : 21 WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C			
Result of Verification : Without Adjustment			
Wet Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
12.5	12.5	0.0	± 0.5
Dry Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
47.1	47.2	-0.1	± 0.5
Globe Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
69.3	69.2	0.1	± 0.5
UUC* = UNIT UNDER CALIBRATION			



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S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
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Heat B_139_2

Heat Stress WBGT Meter Verification Report			
Verification Data			
Heat Stress WBGT Meter No. :	B21	Verification Date :	05 May 2024
Brand :	METROSINCS	Ambient Temp. :	24.5 °C
Model :	hs-32	Barometric Pressure :	1011 mmbar
Serial No. :	MCE030011	Relative Humidity :	49 %
Verification Module (Electronic Sensor Check) :			
Verification Module No. : 21 WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C			
Result of Verification : Without Adjustment			
Wet Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
12.5	12.6	-0.1	± 0.5
Dry Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
47.1	47.1	0.0	± 0.5
Globe Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
69.3	69.2	0.1	± 0.5
UUC* = UNIT UNDER CALIBRATION			

Verif



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S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
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Heat B_139_3

Heat Stress WBGT Meter Verification Report			
Verification Data			
Heat Stress WBGT Meter No. :	B22	Verification Date :	05 May 2024
Brand :	Quest Technologies	Ambient Temp. :	24.5 °C
Model :	QUESTemp ³²	Barometric Pressure :	1011 mmbar
Serial No. :	TPK040059	Relative Humidity :	49 %
Verification Module (Electronic Sensor Check) :			
Verification Module No. : 21 WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C			
Result of Verification : Without Adjustment			
Wet Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
12.5	12.5	0.0	± 0.5
Dry Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
47.1	47.2	-0.1	± 0.5
Globe Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
69.3	69.1	0.2	± 0.5
UUC* = UNIT UNDER CALIBRATION			