

ภาคผนวกที่ 5

เอกสารการสอบเทียบเครื่องมือตรวจวัด

ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม

รายการตรวจวัด	เครื่องมือเก็บตัวอย่าง	เครื่องมือตรวจวิเคราะห์
	ชื่อเครื่องมือ	ชื่อเครื่องมือ
คุณภาพอากาศในบรรยากาศ	- High Volume Air Sampler No. B21, B44	- Digital Balance
	- High Volume PM-10 Air Sampler No. B32, R01	- Digital Balance
	- NO ₂	- NO ₂ Analyzer No. B14, R05
	- SO ₂	- SO ₂ Analyzer No. B06, B08
	- Particulate	- Digital Balance
คุณภาพอากาศจากปล่อง	- Console No. B02, B03	- Inductively Coupled Plasma (ICP)
	- Pitot Tube No. B35, B36	- Ion Chromatography (IC)
	- Console No. B02, B03	- Ion Chromatography (IC)
	- Pitot Tube No. B35, B36	- Spectrophotometer
	- Personal Pump No. B03, B55	-
	- Rotameter No. H-B09	- CO Analyzer No. B13
	- Personal Pump No. B03, B55	- GC-FID
	- Rotameter No. H-B09	-
	- NO _x	-
	- SO ₂	-
	- Rotameter No. H-B08, B09	-
	- CO	-
	- Personal Pump No. B70, B88	-
	- Rotameter No. H- B08, B09	-
	- Xylene	-
	- Personal Pump No. B88	-
	- Rotameter No. L-B09	-
	- Velocity, Flow Rate	-
	- Hot Wire Probe	-
	- Orsat No. B08, B11	-
คุณภาพอากาศในสถานประกอบการ	- Total Dust	- Digital Balance
	- Personal Pump No. B50, B51, B56, B58, B64, B89, B93	- Digital Balance
	- Rotameter No. H-B10	-
	- Respirable dust	- Digital Balance
	- Personal Pump No. B33, B51, B56, B64, B73, B76, R50	-
	- Rotameter No. H-B10	-
	- Al Fume	- Inductively Coupled Plasma (ICP)
	- Personal Pump No. B73, B81, B96, R47	- Ion Chromatography (IC)
	- Rotameter No. H-B10	-
	- HCl	-
	- Personal Pump No. B33, B77, B96, R48	-
	- Rotameter No. L-B10	-
	- Oil Mist	- Infra-red Spectrophotometer (IR)
	- Personal Pump No. B48, B77, B96, R48, R49, R51	-
	- Rotameter No. H-B10	-
	- HF	- Ion Chromatography (IC)
	- Personal Pump No. B77, B93, R47, R51	-
	- Rotameter No. H-B10	-

IMA001/ATAC/2025/JAN-JUN/CAL.DOCX

ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม (ต่อ)

รายการตรวจวัด	เครื่องมือเก็บตัวอย่าง	เครื่องมือตรวจวิเคราะห์
	ชื่อเครื่องมือ	ชื่อเครื่องมือ
ระดับเสียงในบรรยากาศ	- L _{eq} 24 hr, L ₉₀ , L _{max} , ระดับเสียงรบกวน	- Acoustic Calibrator
	- Integrated Sound Level Meter No. ACO-B03, B04, B41	-
ระดับเสียงในสถานประกอบการ	- L _{eq} 8 hr, L _{max} , TWA	- Acoustic Calibrator
	- Integrated Sound Level Meter No. ACO-B29, B36, B41, B43, R40, R41	-
Noise Dose	- Acoustic Calibrator	-
	- Integrated Sound Level Meter	-
ระดับความร้อนในสถานประกอบการ	- No. NMD-B01, B02, B03, B04, B05, B06	-
	- WGBT	- Heat Stress WGBT Meter No. B05, B21, B26, B28, B30, B31, B32, B33
ระดับความเข้มของแสงสว่าง	- Light Intensity	- Digital Light Meter No. B09
	-	-
คุณภาพน้ำ	- pH	- pH Meter
	- SS	- Digital Balance
	- TDS	- Digital Balance
	- BOD ₅	- DO Meter
	- COD	- COD Reactor
	- TKN	- Block Digestion
	- Grease & Oil	- Digital Balance
	-	-
	-	-
	-	-

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เอกสารการสอบเทียบเครื่องมือการตรวจวัด
คุณภาพอากาศในบรรยากาศ



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

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

7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจตุจักร เขตจตุจักร กรุงเทพฯ 10000

7 Soi Phayathai 24, Phayathai Rd., Jangsi, Chatuchak, Bangkok 10000

Tel. (662) 539-6279 (Automate 5 Lines Fax (662) 513-6271 E-mail: salsp@spscs.com

การรับความถูกต้องเครื่องมือ High Volume Air Sampler

ข้อมูลการ Calibrate			
High Volume Air Sampler เบอร์	: B21	วันที่ทำการ Calibrate	: 22/05/2025
Shower Meter เบอร์	: B21	อุณหภูมิ	: 31 °C
Flow Recorder ชื่อ/รุ่น	: TESCH, Model TE-5009	ความชื้นบรรยากาศ	: 1011 mmHg
	(Accuracy ± 2% Full Scale)	ความชื้นสัมพัทธ์	: 48 %
หมายเลขประจำเครื่องมือ	: 5627		

โดยคำนวณปริมาณอากาศที่เก็บได้จากการมาตรฐาน คือ ที่อุณหภูมิ 25 องศาเซลเซียส และที่ความดันบรรยากาศ 760 มิลลิเมตรปรอท

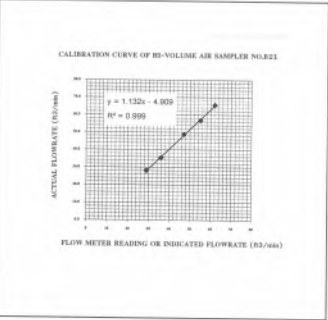
จากสูตร $V_m(Std.) = V_m \times \frac{P}{1.333224 \times 760} \times \frac{298}{(T+273)}$ โดยที่ $V_m(Std.)$ = ปริมาณอากาศที่เก็บการมาตรฐาน

V_m = ปริมาณอากาศที่ P และ T ตาม Calibrate

P = ความดันบรรยากาศตาม Calibrate (mmHg)

T = อุณหภูมิขณะ Calibrate (°C)

Calibration Method : Multipoint Orifice Flow Transfer Standard			Model : TE 5025A	S/N : 3611
Plate	Indicated Flowrate (ft ³ /min)	True Static Pressure (in. H ₂ O)	Actual Flowrate ที่ T และ P ของ Calibrate (ft ³ /min)	Actual Flowrate ที่ T และ P ที่ มาตรฐาน (ft ³ /min)
18	82	11.6	87.1	65.6
13	55	9.5	58.0	56.8
10	47	7.6	49.9	48.6
7	36	4.4	36.1	36.4
5	29	2.7	28.8	28.2



เบสที่คำนวณ : ค่า R² จาก Calibration Curve 0.995 / Flow Meter Reading = 48.5

ค่าได้มาน : Flow Rate (มาตรฐาน) = 50 ft³/min ดังนั้น คำนวณได้ค่า Flow Meter Reading =



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CALIBRATION REPORT					
CHEMILUMINESCENT NO / NO ₂ / NO _x ANALYZER					
DATE :	22 May 2025	BRAND :	API	MODEL :	200E
NO.	NOX-R05	SERIAL NO.	4413		
Calibrator (Dilution System)					
Brand :	API		Model :	700	
Last Cal. Date :	05 August 2024		Serial No. :	911	
Reference Standard Gas					
Standard Gas :	Nitric Oxide (NO)		Cylinder No. :	A007265V	
Certified Date :	05 January 2023		Expired Date :	05 January 2026	
Cylinder Conc. :	48.8 ppm				
CALIBRATING CONDITION					
Pressure :	1011	mmbar	Temp. :	24.6	°C
% RH :	50				
CALIBRATION SETTING					
Span	Initial Reading (Before Adj.) PPB			Final Reading (After Adj.) PPB	
Set Point	Expected Concentration	Analyzer Response	%Diff	Analyzer Response	Slope
Zero	0	0.10	-	0	-
NO Span	400	399.6	-0.100	400.0	1.005
NO ₂ Span	400	399.9	-0.025	400.0	1.008
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	509	cc/min	500 ± 50		
OZONE FLOW	79	cc/min	80 ± 15		
PMT	103.4	mV	-20 - 150		
AZERO	94.1	mV	-20 - 150		
HVPS	673	V	420 - 900 constant		
RCCELL TEMP	50.4	°C	50 ± 1		
BOX TEMP	29.2	°C	8 - 48		
PMT TEMP	7.5	°C	7 ± 2		
MOLY TEMP	315.4	°C	315 ± 5		
RCCELL PRESS	8.2	IN-Hg-A	2 - 10 constant		
SAMPLE PRESS	28.5	IN-Hg-A	25 - 30 constant		
NO Span Conc	400	PPB	20 - 20,000		
NO ₂ Span Conc	400	PPB	20 - 20,000		
NO Slope	1.005	-	1.0 ± 0.3		
NO ₂ Slope	1.008	-	1.0 ± 0.3		
NO Offset	1.2	mV	-20 to +150		
NO ₂ Offset	0.8	mV	-20 to 150		
Stability at Zero	0.1	PPB	< 0.2		
Stability at Span	0.2	PPB	< 2 ppb @ 400 ppb span gas		



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CALIBRATION REPORT					
SO ₂ FLUORESCENT ANALYZER					
DATE :	22 May 2025	BRAND :	API	MODEL :	100E
NO.	SO ₂ -806	SERIAL NO.	3430		
Calibrator (Dilution System)					
Brand :	API		Model :	700	
Last Cal. Date :	05 August 2024		Serial No. :	911	
Reference Standard Gas					
Standard Gas :	Sulphur Dioxide (SO ₂)		Cylinder No. :	A008145K	
Certified Date :	21 June 2021		Expired Date :	21 June 2029	
Cylinder Conc. :	49.8 ppm				
CALIBRATING CONDITION					
Pressure :	1011	mmbar	Temp. :	24.6	°C
% RH :	50				
CALIBRATION SETTING					
Span	Initial Reading (Before Adj.) PPB			Final Reading (After Adj.) PPB	
Set Point	Expected Concentration	Analyzer Response	%Diff	Analyzer Response	Slope
Zero	0	-0.10	-	0	-
SO ₂ Span	400.0	399.7	-0.075	400.0	1.008
API Model 100E SO ₂ Analyzer Check List					
Test Values	Observed Value	Units	Nominal Range		
RANGE	500	PPB	0-500		
SAMPLE PRESS	28.7	in-Hg	25-35		
SAMPLE FLOW	660	cc/min	650 ± 10%		
PMT	103.2	mV	-20-150 with Zero Air		
UV LAMP	3027.6	mV	1000-4900		
STR. LGT	61.8	PPB	<100		
DRK PMT	63.3	mV	-50 - 200		
DRK LMP	58.1	mV	-50 - 200		
HVPS	673	V	550-900 constant		
DCPS	2526	mV	2500 ± 200		
RCCELL TEMP	50.5	°C	50 ± 1		
BOX TEMP	29.4	°C	5-40		
PMT TEMP	7.2	°C	7 ± 2.0		
SO ₂ Span Conc	400	PPB	20-20,000		
SO ₂ Slope	1.008	-	1.0 ± 0.3		
SO ₂ Offset	21.9	mV	<250		
Stability at Zero	0.1	PPB	<0.2		
Stability at Span	0.2	PPB	0.5% of reading (above 50 ppb)		



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CALIBRATION REPORT					
SO ₂ FLUORESCENT ANALYZER					
DATE :	22 May 2025	BRAND :	API	MODEL :	100A
NO.	SO ₂ -808	SERIAL NO.	1003		
Calibrator (Dilution System)					
Brand :	API		Model :	700	
Last Cal. Date :	05 August 2024		Serial No. :	911	
Reference Standard Gas					
Standard Gas :	Sulphur Dioxide (SO ₂)		Cylinder No. :	A008145K	
Certified Date :	21 June 2021		Expired Date :	21 June 2029	
Cylinder Conc. :	49.8 ppm				
CALIBRATING CONDITION					
Pressure :	1011	mmbar	Temp. :	24.6	°C
% RH :	50				
CALIBRATION SETTING					
Span	Initial Reading (Before Adj.) PPB			Final Reading (After Adj.) PPB	
Set Point	Expected Concentration	Analyzer Response	%Diff	Analyzer Response	Slope
Zero	0	0.10	-	0	-
SO ₂ Span	400.0	399.8	-0.050	400.0	1.009
API Model 100A SO ₂ Analyzer Check List					
Test Values	Observed Value	Units	Nominal Range		
RANGE	500	PPB	0-500		
SAMPLE PRESS	28.5	in-Hg	25-35		
SAMPLE FLOW	659	cc/min	650 ± 10%		
PMT	103.3	mV	-20-150 with Zero Air		
UV LAMP	3034.8	mV	1000-4900		
STR. LGT	61.6	PPB	<100		
DRK PMT	63.0	mV	-50 - 200		
DRK LMP	57.9	mV	-50 - 200		
HVPS	671	V	550-900 constant		
DCPS	2523	mV	2500 ± 200		
RCCELL TEMP	50.2	°C	50 ± 1		
BOX TEMP	29.1	°C	5-40		
PMT TEMP	7.4	°C	7 ± 2.0		
SO ₂ Span Conc	400	PPB	20-20,000		
SO ₂ Slope	1.009	-	1.0 ± 0.3		
SO ₂ Offset	22.1	mV	<250		
Stability at Zero	0.1	PPB	<0.2		
Stability at Span	0.2	PPB	0.5% of reading (above 50 ppb)		



QUALITY CALIBRATION CO., LTD.

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

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www.qcalibration.com



CERTIFICATE No : 25M2254
REFERENCE No : 76365-1

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 : 07-Mar-25

APPROVED BY : [Signature]

ISSUED DATE : 13-Mar-25

RECEIVED DATE : 07-Mar-25

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



F-G010 REV 03



CERTIFICATE No : 25M2254

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : METTLER TOLEDO
ID No : BA05/50
AIR PRESSURE : 1009mbar \pm 1mbar
AMBIENT TEMPERATURE : 24°C \pm 1°C
MODEL : XS105DU
S/N : 1126422905
RECEIVED DATE : 07-Mar-25
CALIBRATION DATE : 07-Mar-25
RELATIVE HUMIDITY : 54 % RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

1) STANDARD WEIGHT SET
2) STANDARD WEIGHT
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)

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL
2. TARE FUNCTION : NORMAL
3. REPEATABILITY OF READING AT 120 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	0.01999	0.00001	0.000065
0.10	0.10001	-0.00001	0.000066
0.20	0.20001	-0.00001	0.000066
0.50	0.50002	-0.00002	0.000065
1.00	1.00003	-0.00003	0.000066
2.00	2.00001	-0.00001	0.000067
5.00	5.00002	-0.00002	0.000068
10.00	10.00000	0.00000	0.000070
20.00	20.00004	-0.00004	0.000078
50.00	50.00000	0.00000	0.00013
100.00	100.00001	-0.00001	0.00019
120.00	120.00002	-0.00002	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
COVERAGE FACTOR $k=2$, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%
END OF CALIBRATION REPORT



เอกสารการสอบเทียบเครื่องมือการตรวจวัด
คุณภาพอากาศจากปล่องระบายน



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CONSOLE CALIBRATE DATA

CONSOLE NO. : B02
SERIAL NUMBER :
OF DRY GAS METER : 8002514
CALIBRATE DATE : 27-05-2025
CALIBRATE BY : SPS
ROOM TEMP. : 24.5 °C
PRESSURE : 758.31 mm.Hg

ORIFICE Value	VB 40	VB 48	VB 55	VB 63	VB 73
k Of Orifice	0.1765	0.3090	0.2922	0.4276	0.5310
Cal. Time (min.)	20	14	10	8	6
Vm. Cal. (Liters)	158.8	192.4	129.5	153.6	143.3
Temp. Meter (°C)	24.3	24.5	24.7	25.0	25.2
ΔH (mm.H ₂ O)	7.0	20.0	19.8	40.8	64.7
Vm. Cal. (std.) (Liters)	159.0	192.7	129.6	153.9	143.8
Vm. Orifice (Liters)	157.8	193.4	130.7	153.0	142.5
Vm. Orifice (std.) (Liters)	157.8	193.3	130.6	152.9	142.4
Y	0.992	1.003	1.008	0.994	0.990
Y Average	0.997				
ΔH_{90}	49.98	46.31	51.42	49.49	51.14
ΔH_{90} Average	49.67				

Remark : For Calibration Factor Y, acceptable tolerance of individual values from the average is ± 0.02
For DH_{90} , at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 5.1 mmH₂O
Accept Value of Y (Average) is $0.97 < y < 1.03$
Accept Value of DH_{90} (Average) is 46.7 ± 6.4 (mmH₂O)



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7 ซอยพหลโยธิน 24 ซอยพหลโยธิน แขวงจตุจักร เขตจตุจักร กรุงเทพฯ 10000
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Tel : (662) 839-4379-72 Fax : (662) 513-4221 E-mail : ssp@spscon.com, www.spscon.com

CONSOLE CALIBRATE DATA

CONSOLE NO. : B03
CONSOLE :
SERIAL NUMBER : 1503016
CALIBRATE DATE : 27-05-2025
CALIBRATE BY : SPS
ROOM TEMP. : 24.5 °C
PRESSURE : 758.31 mm.Hg

ORIFICE Value	VB 40	VB 48	VB 55	VB 63	VB 73
k Of Orifice	0.1765	0.3090	0.2922	0.4276	0.5310
Cal. Time (min.)	20	14	10	8	6
Vm. Cal. (Liters)	157.8	191.0	131.0	152.0	140.2
Temp. Meter (°C)	24.2	24.4	24.6	24.9	25.2
ΔH (mm.H ₂ O)	7.0	20.2	19.9	42.0	63.5
Vm. Cal. (std.) (Liters)	158.0	191.4	131.1	152.3	140.7
Vm. Orifice (Liters)	157.8	193.4	130.7	153.0	142.5
Vm. Orifice (std.) (Liters)	157.8	193.3	130.6	152.9	142.4
Y	0.999	1.010	0.996	1.004	1.012
Y Average	1.004				
ΔH_{90}	49.81	46.83	51.54	51.04	50.20
ΔH_{90} Average	49.88				

Remark : For Calibration Factor Y, acceptable tolerance of individual values from the average is ± 0.02
For DH_{90} , at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 5.1 mmH₂O
Accept Value of Y (Average) is $0.97 < y < 1.03$
Accept Value of DH_{90} (Average) is 46.7 ± 6.4 (mmH₂O)



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : HI-LIGHT
MODEL / TYPE : N/A
SERIAL NO. : N/A[64-220066-2]
CLID. NO. : 212201113
JOB CONTROL NO. : 240730078440
CALIBRATION SERVICE : ☒ IN-LABORATORY ☐ ON-SITE

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

DATE OF RECEIVED : 30 July 2024

DATE OF ISSUED : 02 August 2024

The report of calibration shall not be reproduced except in full without approval of the Calibration Laboratory Co., Ltd.

Calibrated By : Sittipong Pimdee
Calibration Engineer

Approved By : 
Authorized Signatory
02 August 2024

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. Q24078440

F3-011-05/12-23

page 1 of 3



idccalibration



REPORT OF CALIBRATION

FOR

NOMENCLATURE : VACUUM GAUGE
MANUFACTURER : HI-LIGHT
MODEL / TYPE : N/A
SERIAL NO. : N/A[64-220066-2]
DATE OF CALIBRATION : 31 July 2024
DUE DATE OF CALIBRATION : 31 July 2025

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-0040-24, Due Date 08 February 2025.

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. Q24078440

F3-011-05/12-23

page 2 of 3



idccalibration



CONDITION OF CALIBRATION ITEM : RECEIVED IN GOOD OPERATIONAL CONDITION

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	0.000	0.000	0.0	0.0	0.0	0.0
-5	-16.591	-16.930	-4.9	-5.0	+0.1	0.0
-10	-33.521	-33.521	-9.9	-9.9	+0.1	+0.1
-15	-50.113	-50.113	-14.8	-14.8	+0.2	+0.2
-20	-66.704	-67.043	-19.7	-19.8	+0.3	+0.2
-25	-83.634	-83.973	-24.7	-24.8	+0.3	+0.2
-30	-100.564	-100.564	-29.7	-29.7	+0.3	+0.3

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 012 Page 43 of 67

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

End of Certificate

Certificate No. Q24078440

F3-011-05/12-23

page 3 of 3



idccalibration



ISOCAL TECHNOLOGY CO.,LTD.

Industrial Instrument Calibration Center

170/405 Moo 3 Serithai Rd., Kannayao Kannayao Bangkok 10230

Tel. 0-2906-3040-1 Fax. 0-2919-9948

Certificate of Calibration

Certificate Number : E24/0225B

Page : 1 of 3

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

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

Equipment Name : Anemometer

Model : 425

Serial No. : 03053644

ID No. : NO.B03

Manufacture : Testo

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

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

Location of Calibration : In-Lab

Date of Received : 18-Jun-2024

Date of Calibration : 19-Jun-2024

Date of Issued : 22-Jun-2024

Condition as Received : Normal

Calibration Method : Calibration Procedure Number WE-119

This certificate is traceable to national standards, which realize the units of measurement according to the International System of Units (SI).

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

This certificate shall not be reproduced other than in full except without the prior written approval of the Head of Calibration Laboratory of Isocal Technology Co.,Ltd.

Calibrated by : Mr. Sittichai Intisak
Technical



ISOCAL TECHNOLOGY CO.,LTD.

Calibration Report

Certificate Number : E24/0225B

Page : 2 of 3

Equipment Standards Used

Description	Serial No.	Certificate No.	Cal. Due Date
Anemometer	Q431637	L202404117-001	21-Apr-25

Traceability :-

The calibration within the certificate are traceable to the International System of Units (SI).

FM-15-3:00



ISOCAL TECHNOLOGY CO.,LTD.

Calibration Report

Certificate Number : E24/0225B

Page : 3 of 3

Result of Calibration : Adjustment (No)

Function : Air Velocity Measurement

Resolution : 0.01 m/s

Standard Setting (m/s)	UUC Reading (m/s)	Error (m/s)	Uncertainty (m/s)
0.00	0.00	0.00	0.036
2.05	2.14	0.09	0.17
4.07	4.15	0.08	0.23
6.12	6.23	0.11	0.23
8.14	8.20	0.06	0.23
10.10	10.20	0.10	0.23

... END ...

FM-15-3:00



QUALITY CALIBRATION CO.,LTD.

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

www.qcalibration.com



CERTIFICATE No : 25M2254
REFERENCE No : 76365-1

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 : 07-Mar-25

APPROVED BY :

ISSUED DATE : 13-Mar-25

RECEIVED DATE : 07-Mar-25

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

F-0010 REV 03



QUALITY CALIBRATION CO.,LTD.

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

www.qcalibration.com

CERTIFICATE No : 25M2254

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : METTLER TOLEDO
ID No : BA05/50
AIR PRESSURE : 1009mbar ± 1mbar
AMBIENT TEMPERATURE : 24°C ± 1°C
MODEL : XS105DU
S/N : 1126422905
RECEIVED DATE : 07-Mar-25
CALIBRATION DATE : 07-Mar-25
RELATIVE HUMIDITY : 54 %RH ± 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-1-151	C02250116	28-Jan-27
2) STANDARD WEIGHT	E2	15843	C02250117	29-Jan-27

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)

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL
2. TARE FUNCTION : NORMAL
3. REPEATABILITY OF READING AT 120 g WAS 0.000055 g
4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (± g)
0.00	0.00000	0.00000	0.000065
0.02	0.01999	0.00001	0.000065
0.10	0.10001	-0.00001	0.000066
0.20	0.20001	-0.00001	0.000066
0.50	0.50002	-0.00002	0.000065
1.00	1.00003	-0.00003	0.000066
2.00	2.00001	-0.00001	0.000067
5.00	5.00002	-0.00002	0.000068
10.00	10.00000	0.00000	0.000070
20.00	20.00004	-0.00004	0.000078
50.00	50.00000	0.00000	0.00013
100.00	100.00001	-0.00001	0.00019
120.00	120.00002	-0.00002	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
COVERAGE FACTOR k=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



WO-02612424/2024

MAINTENANCE AND TEST CERTIFICATE MODEL OPTIMA 5300DV

Customer : S.P.S.Consulting Service Co.,Ltd **Date Tested:** January 6, 2025
Address : 7 Soi Phaholyothin 24 **Period** 6 Months
Paholyothin Road **Recertification Due:** July 6, 2025
Jompol Chatuchak, Bangkok 1090 **Date Last Certified:** July 4, 2024
User Name: K.Phenpha Viphashtawat **Visit Number:** 2 of 2
Phone: 083-9269252 **PerkinElmer Phone:** 02-719-6420 ext 206
Fax: 02-513-4221 **PerkinElmer Fax:** 02-318-5597

CONFIGURATION TESTED

MODEL	SERIAL NUMBER
OPTIMA 5300DV	077C7042401

TESTED EQUIPMENT	CALIBRATION NUMBER	EXPIRATION
IPV Methods		

TEST STANDARD USED	PART NUMBER	EXPIRATION DATE
Multielement Standard	N069-1579	December 30, 2025
Wavecal Solution	N058-2152	April 30, 2025
VIS Wavecal solution	N930-2946	December 30, 2025
Instrument Cal. STD4	N930-0221	August 30, 2025

CUSTOMER SUPPLIED	COMMENTS	CUSTOMER INITIALS
2 % HNO3		
10 % HNO3		

Page 1 of 4

PerkinElmer Scientific (Thailand) Co., Ltd.
290 Soi Soonvijai 4, Bangkapi, Huay Kwang, Bangkok 10310 Head Office



WO-02612424/2024

MAINTENANCE AND TEST CERTIFICATE MODEL OPTIMA 5300DV

SERIAL NUMBER 077C7042401 **DATE TESTED** January 6, 2025

1. MECHANICAL CHECKS

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

2. OPTICAL CHECKS

- A. Inspect and clean all optical components. ☐ OK
B. As required, check and replace all purgefilters. ☐ OK
C. Recheck optical alignment. ☐ OK

3. COOLING SYSTEM CHECKS

- A. Perform preventive maintenance on chiller. ☐ OK
B. Flush out the chiller every year. ☐ N/A

4. PERFORMANCE CHECKS

- A. Torch View Alignment. ☐ OK
B. Wavelength Calibration. ☐ OK

Page 2 of 4

PerkinElmer Scientific (Thailand) Co., Ltd.
290 Soi Soonvijai 4, Bangkapi, Huay Kwang, Bangkok 10310 Head Office



WO-02612424/2024

MAINTENANCE AND TEST CERTIFICATE MODEL OPTIMA 5300DV

SERIAL NUMBER :	077C7042401	DATE TESTED :	January 6, 2025
PARAMETER	SPECIFICATION	FINAL VALUE	
Spectral Resolution : UV	As 193.696 nm	≤ 0.007	0.00519
	Ni 231.604 nm	≤ 0.008	0.00667
	Ni 341.476 nm	≤ 0.012	0.00757
Spectral Resolution : VIS	La 408.672 nm	≤ 0.020	0.01621
	Ba 455.403 nm	≤ 0.025	0.02183
Precision	As 193.656 nm	% RSD < 1.0	0.51 %
	Zn 213.856 nm	% RSD < 1.0	0.48 %
	Mn 257.610 nm	% RSD < 1.0	0.03 %
	La 379.478 nm	% RSD < 1.0	0.05 %
	Ba 455.403 nm	% RSD < 1.0	0.07 %
	Ba 493.408 nm	% RSD < 1.0	0.04 %
Detection Limits : Axial	Ti 190.080 nm	3(sd)	10.65 ppb
	As 193.696 nm	3(sd)	2.48 ppb
	Pb 220.353 nm	3(sd)	3.09 ppb
Detection Limits : Radial	As 193.696 nm	3(sd)	12.41 ppb
	Zn 213.856 nm	3(sd)	0.91 ppb
	Mn 257.610 nm	3(sd)	0.13 ppb
	La 379.478 nm	3(sd)	4.74 ppb
	Ba 455.403 nm	3(sd)	0.10 ppb
	Ba 493.408 nm	3(sd)	0.18 ppb
BEC : Axial (IB X 500)(IS-IB)	Cd 226.502 nm	≤ 150 ppb	14.22
BEC : Radial (IB X 1000)(IS-IB)	Mn 257.610 nm	≤ 45 ppb	6.14

Page 3 of 4

PerkinElmer Scientific (Thailand) Co., Ltd.
290 Soi Soonvijai 4, Bangkapi, Huay Kwang, Bangkok 10310 Head Office



WO-02612424/2024

MAINTENANCE AND TEST CERTIFICATE MODEL OPTIMA 5300DV

SERIAL NUMBER 077C7042401 **DATE TESTED** January 6, 2025

Remarks :

Commissioning follow as commissioning performance sheets.

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



meets



does not meet

the PerkinElmer Specifications listed on this certificate.

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

Service Department PerkinElmer Ltd.

Authorized Representative:

Page 4 of 4

PerkinElmer Scientific (Thailand) Co., Ltd.
290 Soi Soonvijai 4, Bangkapi, Huay Kwang, Bangkok 10310 Head Office



Certificate of Calibration

Aquion: Anion (ID#894)

This certificate is to verify that instrument below are calibrated

by Archemica Lab Co.,Ltd.

AQUION S/N : 190840059

AS-DV S/N : 190915235

for

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

SITHIPORN ASSOCIATES CO., LTD. CALIBRATION LABORATORY

451-451/1 Sirinthorn Road, Bangbunru, Bangplud, Bangkok, 10700 Thailand
Tel. +66 2433 8331 Email : calibration@sithiporn.com



Cert. No. : SP24020
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 : WET CHEMISTRY LABORATORY IV

Ambient Temperature : (28.1 ± 5) °C
Relative Humidity : (47.2 ± 25) %

Received Date : 27 AUGUST 2024
Calibration Date : 27 AUGUST 2024
Date of Issue : 27 AUGUST 2024

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 CO., LTD. CALIBRATION LABORATORY

451-451/1 Sirinthorn Road, Bangbunru, Bangplud, Bangkok, 10700 Thailand
Tel. +66 2433 8331 Email : calibration@sithiporn.com



Cert. No. : SP24020
Job No. : VC67SP0013
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-0185-24	14/05/2026

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

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

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

Result of calibration : Wavelength Accuracy

(Without adjustment)

Material	Certified Values of Reference Material (nm)	UUC* Reading (nm)	Error (nm)	Uncertainty ± (nm)	k Factor
RM-HL	278.13	278.3	0.17	0.16	2.00
	361.25	361.4	0.15	0.16	2.00
	467.82	467.7	-0.12	0.16	2.00
	536.56	536.5	-0.06	0.16	2.00
	640.50	640.4	-0.10	0.16	2.00
RM-DL	740.09	739.9	-0.19	0.16	2.00
	864.94	865.2	0.26	0.16	2.00

UUC* = Unit Under Calibration

SITHIPORN ASSOCIATES CO., LTD. CALIBRATION LABORATORY

451-451/1 Sirinthorn Road, Bangbunru, Bangplud, Bangkok, 10700 Thailand
Tel. +66 2433 8331 Email : calibration@sithiporn.com



Cert. No. : SP24020
Job No. : VC67SP0013
Pages : 3 of 3

Result of calibration : Photometric Accuracy

(Without adjustment)

Material	Wavelength (nm)	Filter S/N	Nominal Absorbance	Certified Absorbance (A)	UUC* Reading Absorbance (A)	Error (A)	Uncertainty ± (A)	k Factor
Neutral Density glass filter	440.0	29360	1.0	1.0517	1.0550	0.0033	0.0029	2.00
		29914	0.7	0.7445	0.7460	0.0015	0.0029	2.00
		29381	0.5	0.5416	0.5431	0.0015	0.0030	2.00
	546.1	29360	1.0	0.9821	0.9820	-0.0001	0.0028	2.00
		29914	0.7	0.6961	0.6958	-0.0003	0.0028	2.00
		29381	0.5	0.5073	0.5080	0.0007	0.0029	2.00
	590.0	29360	1.0	1.0222	1.0210	-0.0012	0.0028	2.00
		29914	0.7	0.7237	0.7221	-0.0016	0.0029	2.00
		29381	0.5	0.5361	0.5361	0.0000	0.0031	2.00
	635.0	29360	1.0	0.9753	0.9745	-0.0008	0.0028	2.00
		29914	0.7	0.6910	0.6900	-0.0010	0.0029	2.00
		29381	0.5	0.5211	0.5210	-0.0001	0.0032	2.00
RM-0204060810	235.0	20	0.2422	0.2418	0.2418	-0.0004	0.0101	2.00
		40	0.4866	0.4852	0.4852	-0.0014	0.0115	2.00
		60	0.7414	0.7389	0.7389	-0.0025	0.0067	2.00
		80	0.9858	0.9842	0.9842	-0.0016	0.0093	2.00
	100	1.2442	1.2414	1.2414	1.2414	-0.0028	0.0086	2.00

UUC* = Unit Under Calibration

Condition of this result of calibration : Spectrophotometer PERKINELMER Model Lambda 25 S/N 501S14123010

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)
0.0117	3.8659

**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

Calibration Report
Non-Dispersive Infrared CO Analyzer

Date : 05 May 2023 Brand : API Model : 300E
No. CO-813 Serial No. 176

Calibrator (Dilution System)
Brand : Teldyne Model : 700E
Last Cal. Date : 28 October 2024 Serial No. : 201-5

Reference Standard Gas
Standard Gas : Carbon Monoxide (CO) Cylinder No. : D71359
Certified Date : 14 March 2028 Expiry Date : 14 March 2032 Cylinder Conc. : 4.580 ppm

Calibrating Condition
Pressure : 1011 mmbar Temp : 24.6 °C % RH : 50

Calibration Setting
Span : Initial Reading (Before Adj.), PPM Final Reading (After Adj.), PPM
Set Point : Expected Concentration Analyzer Response %DIF Analyzer Response
Zero : g 0.00 - 0.125 0
CO Span : 40.00 39.59 40.00

API Model 300E CO Analyzer Check List

Parameter	Observed Value	Units	Nominal Range
Range	50	PPM	0-1000 ppm
Stability	0.00	PPM	± 1 ppm With Zero Air
CO Measure	4016.6	mV	2500-4000 mV
CO Reference	3948.5	mV	2500-4000 mV
Measure/Reference Ratio	1.180	-	1.1-1.3 W/Zero Air
Sample Pressure	28.6	in-Hg/A	±2"± Ambient Absolute Pressure
Sample Flow	812	CC/Min	800 ± 10%
Sample Temperature	48.3	°C	48 ± 4
Bench Temperature	48.0	°C	48 ± 2
Wheel Temperature	48.6	°C	48 ± 2
Box Temperature	30.8	°C	Ambient Temp ± 7 ± 10
Photo-Drive	3036.1	mV	250 mV to 4750 mV
Slope	1.017	-	1.0 ± 0.3
Offset	0.2	-	0 ± 0.3



GAS CHROMATOGRAPH TEST CERTIFICATION

Certificate No. : SV0824/22063

Instrument Type : Gas Chromatography

Model : CP-3800

Serial Number : 00734

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

Address : 7 Phahonyothin Soi 24 Phahonyothin Rd. Ladyao Chatuchak Bangkok 10900

Date : 05/08/2024

ELECTRONIC TEST

CPU	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
LCD TEST	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
VENT TEST	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
KEY ECHO TEST	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL
DESTRUCTION RAM TEST	<input checked="" type="checkbox"/> PASS	<input type="checkbox"/> FAIL

RUN CHROMATOGRAM TEST

DETECTOR : Flame Ionization Detector (FID Channel Front)

INJECTOR : Capillary Injector Model 1079

GC CONDITION:

Column	80 °C hold 1 min., rate 20 °C/min. to 200 °C hold 1min.
Injector	220 °C
Detector	300 °C
Column flow	5 mL/min
Makeup flow	25 mL/min
Air flow	300 mL/min
Hydrogen flow	30 mL/min

Column:Capillary Column CP sil 5 CB 0.25 ID x 15 M

Sample: 1 µL Injection FID Test Sample 0.218 g/L C14,C15,C16 in hexane

SENSITIVITY TEST: C15. (Area count) = 156,955 Counts.



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SERVICE DEPARTMENT
FR-SV-029 Rev. 04



Detector Sensitivity (FID)

Detector Response	Result	Specification
Baseline Noise (µV)	2.85	≤ 50
Baseline Drift (%)	0.09	≤ 1
Sensitivity (S/N for C15)	16,400	≥ 1,024

Temperature Specification

Temperature	Set	Result	Specification
Column Oven (° C)	80	80	± 5
Injector (° C)	220	220	± 5
Detector (° C)	300	300	± 5
Incubator (° C)	60	N/A	± 5

Relative Standard Deviation % (% RSD)

Checkout Procedure	Result	Specification
Area C15 (%)	1.71	≤ 5
Retention Time C15(%)	0	≤ 0.5



Results Integrated System Testing

Checkout Procedure	FID
Detector Position	Front
Inlet Type	1079 Injector
C15 Area 1	157,309
C15 Area 2	159,359
C15 Area 3	157,349
C15 Area 4	152,379
C15 Area 5	158,379
C15 Area Average	156,955
* % RSD (< 5 %)	1.71

* The precision specification should be less than 2.0 % RSD ** (Relative Standard Deviation) for an Auto sampler injection and less than 5 % for Manual injections. To calculate the %RSD, select the C15 peak area for each of the five (5) samples.

** (Relative Standard Deviation is determined by dividing the standard deviation by the average and multiplying by 100.)

$$\% \text{ RSD} = (\text{std.dev} / \text{avg}) * 100$$



1/1

SERVICE DEPARTMENT



2/2

SERVICE DEPARTMENT
FR-SV-029 Rev. 04



บริษัท ไทยยูนิค จำกัด THAI UNIQUE CO., LTD.

80-82 ถนนประชาธิปไตย แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200

80-82 Prachathipatai Rd., Bangkokunphrom, Pranakorn, Bangkok 10200

Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thuwat@thaiunique.com, Website : www.thaiunique.com

Results Integrated System Testing

Checkout Procedure	FID
Detector Position	Front
Inlet Type	1079 Injector
C15 RT 1	4.128
C15 RT 2	4.128
C15 RT 3	4.128
C15 RT 4	4.128
C15 RT 5	4.128
C15 RT Average	4.128
* % RSD (< 0.5 %)	0

* The precision specification should be less than 0.5 % RSD ** (Relative Standard Deviation) for an Auto sampler injection and less than 0.5 % for Manual injections. To calculate the %RSD, select the RT C15 peak for each of the five (5) samples.

** (Relative Standard Deviation is determined by dividing the standard deviation by the average and multiplying by 100.)

$$\% \text{ RSD} = (\text{std.dev} / \text{avg}) * 100$$

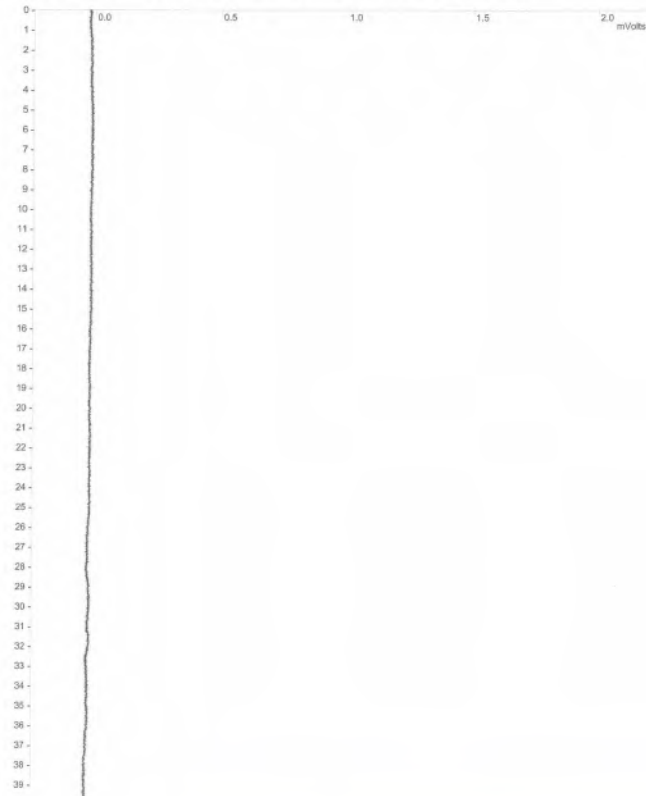
Title :
Run File : f:\sps2024\cal2024\baseline2024002.run
Method File : D:\Method-GC\star C\Star\TU\cal0203\baseline FID.mth
Sample ID : Baseline2024

Injection Date: 5/8/2567 14:01 Calculation Date: 5/8/2567 14:41

Operator : watsamon Detector Type: 3800 (10 Volts)
Workstation: Local Disk Bus Address : 44
Instrument : Sample Rate : 10.00 Hz
Channel : Front = FID Run Time : 39.960 min

** LC Workstation Version 6.20 ** 02511-7390-ae7-0265 **

Chart Speed = 0.56 cm/min Attenuation = 1 Zero Offset = 10%
Start Time = 0.000 min End Time = 39.960 min Min / Tick = 1.00



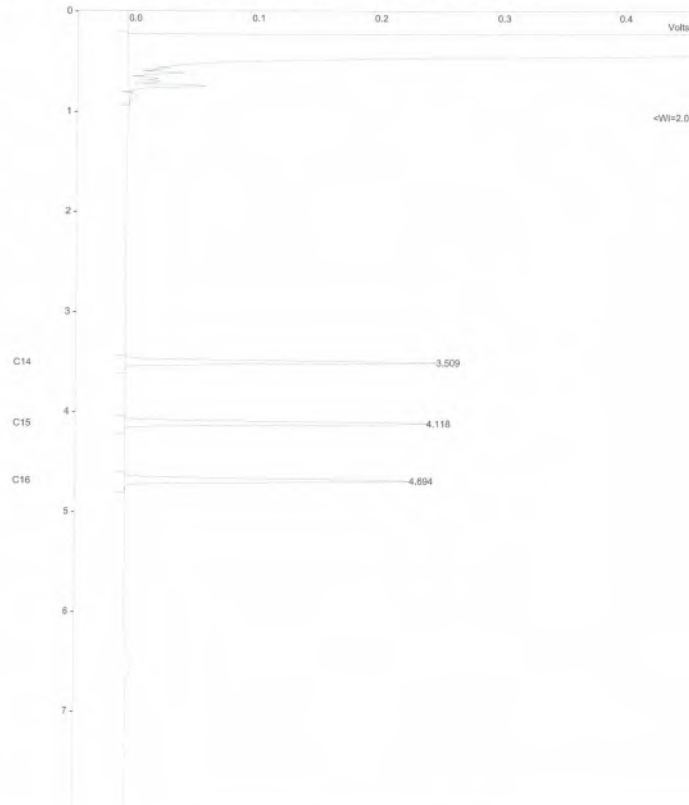
Title :
Run File : f:\sps2024\cal2024\fid2024003.run
Method File : d:\caf2024003-front.mth
Sample ID : FID2024

Injection Date: 5/8/2567 9:16 Calculation Date: 5/8/2567 9:26

Operator : suwarot Detector Type: 3800 (10 Volts)
Workstation: GC-LAB Bus Address : 44
Instrument : Sample Rate : 10.00 Hz
Channel : Front = FID Run Time : 7.993 min

** LC Workstation Version 6.20 ** 02511-7390-ae7-0265 **

Chart Speed = 2.83 cm/min Attenuation = 205 Zero Offset = 8%
Start Time = 0.000 min End Time = 7.993 min Min / Tick = 1.00



Print Date: Sat Jan 01 19:06:02 2005 Page 1 of 1

Title :
Run File : f:\sps2024\cal2024\baseline2024002.run
Method File : D:\Method-GC\star C\Star\TU\cal0203\baseline FID.mth
Sample ID : Baseline2024

Injection Date: 5/8/2567 14:01 Calculation Date: 5/8/2567 14:41

Operator : suwarot Detector Type: 3800 (10 Volts)
Workstation: Local Disk Bus Address : 44
Instrument : Sample Rate : 10.00 Hz
Channel : Front = FID Run Time : 39.960 min

** LC Workstation Version 6.20 ** 02511-7390-ae7-0265 **

Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard

Peak No.	Peak Name	Result ()	Ret. Time (min)	Time Offset (min)	Area (counts)	Sep. Code	Width 1/2 (sec)	Status Codes
-----	-----	-----	-----	-----	-----	-----	-----	-----
Totals:		0.0000		0.000	0			

Total Unidentified Counts : 0 counts

Detected Peaks: 0 Rejected Peaks: 0 Identified Peaks: 0

Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0

Baseline Offset: -16 microVolts LSB: 1 microVolts

Noise (used): 22 microVolts - monitored before this run

Manual injection

Data Handling: No peaks

Print Date: Sat Jan 01 19:35:30 2005 Page 1 of 1
Title :
Run File : f:\apps2024\cal2024\fid2024003.run
Method File : d:\fid2024003-front.mth
Sample ID : FID2024
Injection Date: 5/8/2567 9:16 Calculation Date: 5/8/2567 9:26
Operator : suwarot Detector Type: 3800 (10 Volts)
Workstation: GC-LAB Bus Address : 44
Instrument : Sample Rate : 10.00 Hz
Channel : Front = FID Run Time : 7.993 min
** LC Workstation Version 6.20 ** 02511-7390-ae7-0265 **
Run Mode : Analysis
Peak Measurement: Peak Area
Calculation Type: External Standard
Peak No. Peak Name Result (f) Ret. Time (min) Time Offset (min) Area (counts) Sep. 1/2 Code Status
1 C14 54.1202 3.509 -0.005 163563 BB 2.1 C
2 C15 53.5241 4.128 -0.005 157309 BB 2.2 C
3 C16 52.2361 4.694 0.001 146804 BB 2.3 C
Totals: 159.8804 -0.009 1704289
Status Codes:
C - Out of calibration range
Total Unidentified Counts : 69332200 counts
Detected Peaks: 11 Rejected Peaks: 0 Identified Peaks: 3
Multiplier: 1 Divisor: 1 Unidentified Peak Factor: 0
Baseline Offset: -29 microVolts LSB: 1 microVolts
Noise (used): 28 microVolts - monitored before this run
Manual injection
Calib. out of range; No Recovery Action Specified

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

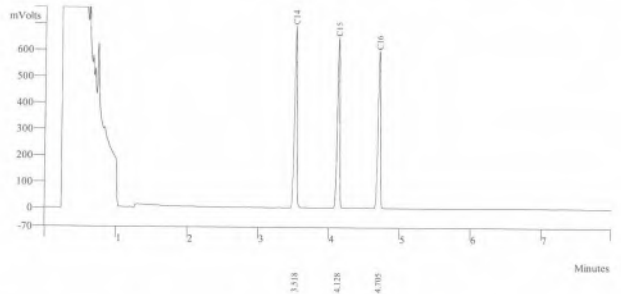
Sample ID: fid std

Operator (Inj): suwarot
Injection Date: 05/08/2024
Calc Date: 05/08/2024
Run Time (min): 7.993
Workstation: GC-LAB
Instrument (Inj):



c:\star\data\tu\cal2024\fid2024001.run

A = FID 10 V RESULTS



Peak No	Peak Name	Result (f)	Ret Time (min)	Peak Area (counts)	Sep. Code	Width 1/2 (sec)
1	C14	152.6865	3.518	163565	BB	2.2
2	C15	147.1889	4.128	157309	BB	2.3
3	C16	138.7997	4.705	146804	BB	2.3
Totals		438.6751		467678		



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1 Of 1

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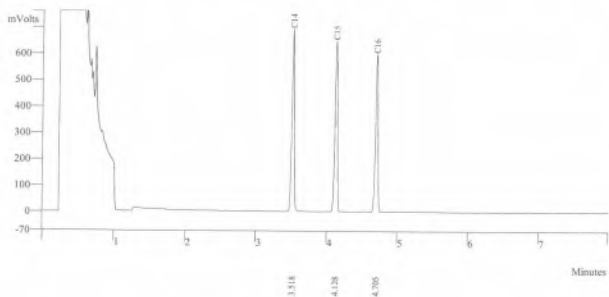
Sample ID: fid std

Operator (Inj): suwarot
Injection Date: 05/08/2024
Calc Date: 05/08/2024
Run Time (min): 7.993
Workstation: GC-LAB
Instrument (Inj):



c:\star\data\tu\cal2024\fid2024002.run

A = FID 10 V RESULTS



Peak No	Peak Name	Result (f)	Ret Time (min)	Peak Area (counts)	Sep. Code	Width 1/2 (sec)
1	C14	152.6865	3.518	168565	BB	2.2
2	C15	137.1189	4.128	159359	BB	2.3
3	C16	128.7997	4.705	147834	BB	2.3
Totals		418.6042		475758		

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

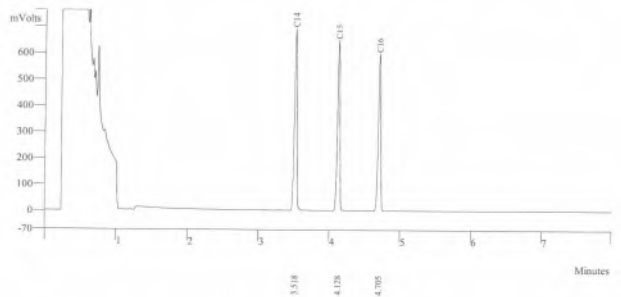
Sample ID: fid std

Operator (Inj): suwarot
Injection Date: 05/08/2024
Calc Date: 05/08/2024
Run Time (min): 7.993
Workstation: GC-LAB
Instrument (Inj):



c:\star\data\tu\cal2024\fid2024003.run

A = FID 10 V RESULTS



Peak No	Peak Name	Result (f)	Ret Time (min)	Peak Area (counts)	Sep. Code	Width 1/2 (sec)
1	C14	152.7865	3.518	169535	BB	2.2
2	C15	197.1159	4.128	157349	BB	2.3
3	C16	128.5997	4.705	149834	BB	2.3
Totals		478.5021		476718		



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1 Of 1



THAI UNIQUE CO.,LTD.

1 Of 1

Sample ID: fid std

Operator (Inj): suwarot
Injection Date: 05/08/2024
Calc Date: 05/08/2024
Run Time (min): 7.993
Workstation: GC-LAB
Instrument (Inj):

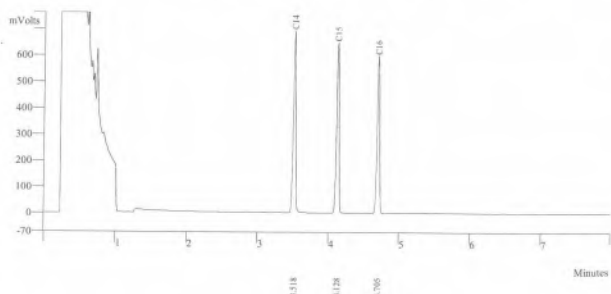


VARIAN

Run Mode: Analysis
Peak Measurement: Peak Area
Calculation Type: External Std.

c:\star\data\tu\cal2024\fid2024004.run

A = FID 10 V RESULTS



Peak No	Peak Name	Result ()	Ret Time (min)	Peak Area (counts)	Sep. Code	Width 1/2 (sec)
1	C14	162.7865	3.518	165521	BB	2.2
2	C15	157.1159	4.128	152379	BB	2.3
3	C16	138.5997	4.705	146834	BB	2.3
Totals		458.5021		464734		



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1 OF 1

Sample ID: fid std

Operator (Inj): suwarot
Injection Date: 05/08/2024
Calc Date: 05/08/2024
Run Time (min): 7.993
Workstation: GC-LAB
Instrument (Inj):

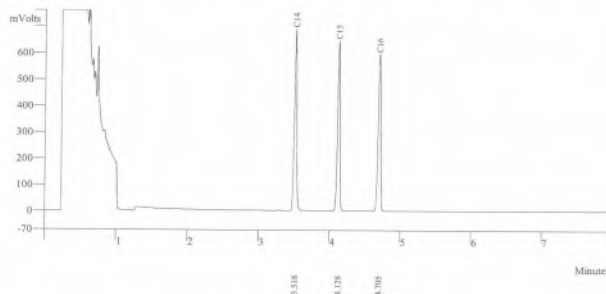


VARIAN

Run Mode: Analysis
Peak Measurement: Peak Area
Calculation Type: External Std.

c:\star\data\tu\cal2024\fid2024005.run

A = FID 10 V RESULTS



Peak No	Peak Name	Result ()	Ret Time (min)	Peak Area (counts)	Sep. Code	Width 1/2 (sec)
1	C14	162.7965	3.518	164521	BB	2.2
2	C15	137.1159	4.128	158379	BB	2.3
3	C16	128.1947	4.705	149834	BB	2.3
Totals		428.1071		472734		



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1 OF 1



Agilent Technologies

Certificate of Analysis

FID-TCD Performance Evaluation Sample Kit

Agilent Part Number: 5080-8842, 18710-60170

Sample Lot Number: 0006750304

This analytical reference material was manufactured and verified in accordance with an ISO 9001 registered quality system, and the analyte concentrations were verified by an ISO 17025 accredited laboratory. The certified value for each analyte was determined gravimetrically.

Concentrations:		
n-tetradecane	0.218 g/L ($\pm 0.5\%$)	0.033 w/w %
n-pentadecane	0.218 g/L ($\pm 0.5\%$)	0.033 w/w %
n-hexadecane	0.218 g/L ($\pm 0.5\%$)	0.033 w/w %

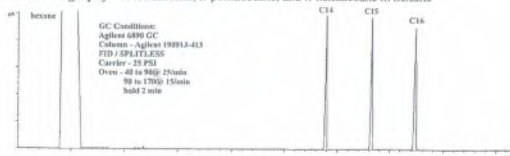
Solvent: hexane

Calibrated Class A glassware and clean bottles were used in the manufacture of this standard. Balances used in the manufacture of this standard are calibrated with weights traceable to NIST in compliance with ANSI/NCSL Z-540-1 and ISO 9001.

Purities:	
n-tetradecane	99.6%
n-pentadecane	99%
n-hexadecane	99.5%
hexane	99%

Typical Analytical Spectrum or Chromatography

GC Chromatography - n-tetradecane, n-pentadecane, and n-hexadecane in hexane



Date of release: 30 June 2023
Date of expiration: 31 July 2025



WK Electric Co.,Ltd.



68/242 Moo 5, Sawalpracharaj Rd., Tumbol Ladsawai, Amphur Lamluaka, Pathumthani 12150
Tel. +66 2993 4773, +66 2153 7132-3 Fax. +66 2994 5509 E-mail : wk.calibrations@gmail.com www.wk-etc.com

Certificate of Calibration

Certificate No.: WK2312-031-1

Page 1 of 2

Customer : THAI UNIQUE CO., LTD.
80-82 PRACHATHIPATAI RD., BANGKHUNPHROM,
PRANAKORN, BANGKOK 10200

Instrument	: AMD Flow Meter	Ambient Temperature	: (23 \pm 2) °C
Manufacturer	: Agilent Technologies	Humidity	: (50 \pm 15) %RH
Model	: G6691A	Received Date	: 6-Dec-23
Serial No.	: MY16470347	Calibrated Date	: 7-Dec-23
Identity No.	: SV-DF-001	Issued Date	: 12-Dec-23
Range	: 0 ml/min to 750 ml/min	Calibrated Location	: In Lab
Resolution	: See to data		
Calibration Method	: CP-WK-M10		

Reference standard instruments :

Instrument	Serial No.	Certificate No.	Due Date	Traceability to
Flow Calibrator	140215-134	L202304114-001	18-Apr-25	MIT
Primary Flow Calibrator	1107-S	WK2305-049-5	22-May-24	WK Electric Co.,Ltd.

MIT : Miracle International Technology Co.,Ltd.

This result calibrate was found accurate as shown on date place of calibrate only
This certificate is traceability to the International System of Unit (SI)

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%

Calibrated by : Mr.Taywanat Hansuwankul Appr

This certificate may not be reproduced except in full unless permission is given in writing from the laboratory.

Calibration Results

Certificate No. : WK2312-031-1

Page 2 of 2

Calibration Result of the Accuracy

Function : Flow Measurement
Range : 0 ml/min to 750 ml/min
Resolution : 0.01 / 0.1 / 1 ml/min

UUC Setting		STD Reading	Error	Uncertainty (±)	Tolerance Limit Values (ml/min)
Scale	ml/min				
0	0.00	0.00	0.00	3.3	-0.20 ~ 0.20
50	50.7	51.15	-0.45	3.3	45.80 ~ 51.20
300	300	300.4	-0.4	3.3	293.8 ~ 306.2
450	450	450.7	-0.7	3.3	440.8 ~ 459.2
550	550	549.5	0.5	3.3	533.5 ~ 566.5
650	650	649.3	0.7	3.3	630.5 ~ 669.5
700	700	699.2	0.8	3.3	679.0 ~ 721.0

(X) Without Adjustment () After Adjustment

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**** End of Certificate****

F5100

REV.00 27 Oct 16

Certificate of Calibration

Certificate Number : LF24-0278
Equipment : Thermometer
Manufacturer : Fluke
Model : 51
Serial Number : 5910857
Asset Number : 5910857
Customer : Thai Unique Co., Ltd.
80-82 Prachathipatai Road,
Bangkhunphrom, Pranakorn,
Bangkok 10200
Date of Calibrate : 26-Jun-2024
Date of Issue : 27-Jun-2024

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

This calibration certificate applies only to the item identified and shall not be reproduced other than in full, without specific written approval by Measuretronix Cal-Lab. Calibration certificates without signature are not valid.

The measurements marked with an asterisk (*) in this certificate are outside our range of accreditation. They have been included for completeness.

The Calibration interval (Cal.Due) is the responsibility of the end user.

Certificate No. : LF24-0278 Model : 51 Serial No. : 5910857 Page 1 of 3
Form 421 Rev.07 Date : 06-Jun-2024 Measuretronix Cal-Lab

Measuretronix Limited
Calibration Report

UUC : Fluke 51 Thermometer

Serial No. : 5910857
Asset No. : 5910857
Procedure : CP-LF-04/Rev.02
Note : Refer to Fluke 51,52 Operator's Manual Rev 1 3/86, Oct 1985

Customer : Thai Unique Co., Ltd.
Address : 80-82 Prachathipatai Road,
Bangkhunphrom, Pranakorn,
Bangkok 10200

Certificate No. : LF24-0278

Report data type : As-Found
Date of Calibrate : 26-Jun-2024
Date of Receive : 17-Jun-2024

Environment condition

Temperature : 23 °C ± 3 °C
Humidity : 50 %RH ± 20 %RH

Measuretronix Cal-Lab certifies that the above listed instrument meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). The measurements are traceable to national or international measurement standards or accept fundamental or natural physical constants or have been derived by approved ratio techniques as state in the Standard Used below. The policies and procedures used comply with ISO/IEC 17025:2017.

This report applies only to the item identified and shall not be reproduced other than in full, without specific written approval by Measuretronix Cal-Lab.

The uncertainties shown are the expanded uncertainties, which calculated from the standard uncertainties multiplied by a coverage factor of $k = 2$, providing a measurement confidence level of approximately 95%.

No statement of compliance with specifications is made or implied on this certificate.

Remark : The units of uncertainty values in this report are referred to the below details :

"Volt" or "V" for voltage, "Ampere" or "A" for current, "Ohm" or "Ω" for resistance, "Farad" or "F" for capacitance, "Hertz" or "Hz" for frequency, "deg C" or "°C" for degree Celsius, "deg F" or "°F" for degree Fahrenheit, etc.

Standard Used

Serial/Asset	Description	Traceable	Cert.No.	Cal.Date	Due Date
6400011	Fluke 5500A Calibrator	NIMT	EE-0017-24	7-Mar-2024	6-Mar-2025

Certificate No. : LF24-0278 Model : 51 Serial No. : 5910857 Page 2 of 3

Test Data						
TEST	RANGE	Nominal Value	UUC Tol. (+/-)	Test Result	Error	Uncertainty (+/-)
THERMOCOUPLE MEASUREMENT CALIBRATION						
TYPE K THERMOCOUPLE						
1		-195.0 °C*	0.9 °C	-195.4 °C	-0.4 °C	0.27 °C
2		-100.0 °C	0.8 °C	-100.5 °C	-0.5 °C	0.21 °C
3		-50.0 °C	0.8 °C	-50.2 °C	-0.2 °C	0.21 °C
4		0.0 °C	0.7 °C	0.0 °C	0.0 °C	0.21 °C
5		100.0 °C	0.8 °C	100.1 °C	0.1 °C	0.21 °C
6		300.0 °C	1.0 °C	300.2 °C	0.2 °C	0.21 °C
7		500.0 °C	1.2 °C	500.1 °C	0.1 °C	0.21 °C
8		1365.0 °C	2.1 °C	1365.2 °C	0.2 °C	0.32 °C
TYPE J THERMOCOUPLE						
9		-195.0 °C*	1.0 °C	-194.4 °C	0.6 °C	0.22 °C
10		-100.0 °C	0.9 °C	-99.3 °C	0.7 °C	0.18 °C
11		-50.0 °C	0.9 °C	-49.4 °C	0.6 °C	0.18 °C
12		0.0 °C	0.8 °C	0.5 °C	0.5 °C	0.18 °C
13		100.0 °C	0.9 °C	100.4 °C	0.4 °C	0.18 °C
14		300.0 °C	1.1 °C	300.8 °C	0.8 °C	0.18 °C
15		755.0 °C	1.6 °C	755.3 °C	0.3 °C	0.18 °C

End of Calibration Report

Certificate No. : LF24-0278 Model : 51 Serial No. : 5910857 Page 3 of 3

Certificate

It is hereby certified that

Suwarot Trikainut

Has successfully completed the Application Training for

Basic Gas Chromatography and Sampler

Training Contents were:

Hardware Operation, Software Operation, Data analysis and

Troubleshooting : Model

CP-3800, 3900, 450-GC, 430-GC, 456-GC, 436-GC

At Thai Unique Co., Ltd, Bangkok, Thailand

On 15th March, 2019

Service Manager

เอกสารสอบเทียบเครื่องมือการตรวจวัด
คุณภาพอากาศในสถานประกอบการ

บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
1 ซอยพหลโยธิน 24 แขวงพหลโยธิน เขตพหลโยธิน กรุงเทพมหานคร 10600
Tel : (082) 039-6279-79 Fax : (082) 033-4271 E-mail : ssp@spsservice.com, ssp@spsservice.com

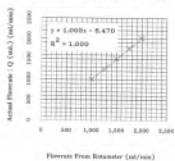
ข้อมูลการปรับเทียบอุปกรณ์ Air Sampling Pump โดยใช้ Dry Cal Primary Flowmeter

ข้อมูลการปรับเทียบ		ข้อมูลการปรับเทียบ	
Air Sampling Pump used	833	วันที่ทำการปรับเทียบ	03/06/2023
ผู้ปรับเทียบ	S.K.C Model 224-PC008	อุณหภูมิขณะปรับเทียบ	24.8 °C
เลขประจำตัวเครื่อง	091756	ความดันบรรยากาศ	1011 mmbar
	(Accuracy = 3% of Full Scale)	ความชื้นสัมพัทธ์	50 %
Environmental Conditions			
Temperature	25 ± 3 °C		
Pressure	1005 ± 15 mmbar		
Relative Humidity	55 ± 15 %		
Calibration Method	Dry Cal Primary Flowmeter	Model	Dry Cal DCL-ML
		S/N	136164
เลขตัวเครื่อง			
$Q_{std}(l) = Q \times \frac{P}{(1.33324 \times T_{std})} \times \frac{T}{(T+273)}$ Q = อัตราการไหลที่วัดโดยมาตรวัดปริมาตร (l/min) Q _{std} = อัตราการไหลที่วัดโดยมาตรวัดปริมาตรมาตรฐาน (l/min) P = ความดันบรรยากาศขณะปรับเทียบ (mmHg) T = อุณหภูมิอากาศขณะปรับเทียบ (โดยเฉลี่ย) (°C)			

ตารางแสดงค่าการปรับเทียบจาก Rotameter 834 Air Sampling Pump ด้วย High Flow และอัตราการไหลที่วัดโดยมาตรวัด

Flowrate (l/min) ที่อ่านได้จาก Rotameter	Actual Flowrate (l/min)					ที่อ่านได้จากมาตรวัด มาตรฐาน (l/min)
	ครั้งที่ 1	ครั้งที่ 2	ครั้งที่ 3	ครั้งที่ 4	ครั้งที่ 5	
1,000	1006.4	1003.1	1003.2	1002.9	1006.9	1000.7
1,250	1246.3	1248.8	1247.9	1245.7	1245.1	1246.4
1,500	1505.1	1502.9	1506.4	1504.4	1507.2	1505.2
1,750	1751.5	1750.4	1752.8	1757.3	1744.6	1754.3
2,000	2002.8	2004.2	2008.7	2010.1	2004.4	2004.4

CALIBRATION CURVE OF SKC NO.833



ผู้ทำการปรับเทียบ

ผู้ตรวจสอบ

ผู้รับรอง

หมายเหตุการสอบเทียบ : อ้างอิงตาม Standard Method ที่ใช้ในการปรับเทียบอย่างสม่ำเสมอและใช้ค่า R² จาก Calibration Curve > 0.999

บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
1 ซอยพหลโยธิน 24 แขวงพหลโยธิน เขตพหลโยธิน กรุงเทพมหานคร 10600
Tel : (082) 039-6279-79 Fax : (082) 033-4271 E-mail : ssp@spsservice.com, ssp@spsservice.com

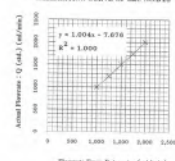
ข้อมูลการปรับเทียบอุปกรณ์ Air Sampling Pump โดยใช้ Dry Cal Primary Flowmeter

ข้อมูลการปรับเทียบ		ข้อมูลการปรับเทียบ	
Air Sampling Pump used	848	วันที่ทำการปรับเทียบ	03/06/2023
ผู้ปรับเทียบ	S.K.C Model 224-PC008	อุณหภูมิขณะปรับเทียบ	24.8 °C
เลขประจำตัวเครื่อง	566753	ความดันบรรยากาศ	1011 mmbar
	(Accuracy = 3% of Full Scale)	ความชื้นสัมพัทธ์	50 %
Environmental Conditions			
Temperature	25 ± 3 °C		
Pressure	1005 ± 15 mmbar		
Relative Humidity	55 ± 15 %		
Calibration Method	Dry Cal Primary Flowmeter	Model	Dry Cal DCL-ML
		S/N	136164
เลขตัวเครื่อง			
$Q_{std}(l) = Q \times \frac{P}{(1.33324 \times T_{std})} \times \frac{T}{(T+273)}$ Q = อัตราการไหลที่วัดโดยมาตรวัดปริมาตร (l/min) Q _{std} = อัตราการไหลที่วัดโดยมาตรวัดปริมาตรมาตรฐาน (l/min) P = ความดันบรรยากาศขณะปรับเทียบ (mmHg) T = อุณหภูมิอากาศขณะปรับเทียบ (โดยเฉลี่ย) (°C)			

ตารางแสดงค่าการปรับเทียบจาก Rotameter 834 Air Sampling Pump ด้วย High Flow และอัตราการไหลที่วัดโดยมาตรวัด

Flowrate (l/min) ที่อ่านได้จาก Rotameter	Actual Flowrate (l/min)					ที่อ่านได้จากมาตรวัด มาตรฐาน (l/min)
	ครั้งที่ 1	ครั้งที่ 2	ครั้งที่ 3	ครั้งที่ 4	ครั้งที่ 5	
1,000	1001.3	1005.4	1003.4	995.2	998.7	1000.0
1,250	1245.9	1245.7	1241.5	1239.8	1242.4	1242.7
1,500	1508.8	1505.3	1507.9	1510.6	1506.9	1507.8
1,750	1744.5	1742.3	1745.8	1741.9	1743.6	1743.6
2,000	2009.1	2004.9	2004.3	2004.5	2007.2	2006.0

CALIBRATION CURVE OF SKC NO.848



ผู้ทำการปรับเทียบ

ผู้ตรวจสอบ

ผู้รับรอง

หมายเหตุการสอบเทียบ : อ้างอิงตาม Standard Method ที่ใช้ในการปรับเทียบอย่างสม่ำเสมอและใช้ค่า R² จาก Calibration Curve > 0.999



CERTIFICATE No : 25M2254

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : XST05DU
MANUFACTURER : METTLER TOLEDO S/N : 11264229005
ID No : BA05/50 RECEIVED DATE : 07-Mar-25
AIR PRESSURE : 1009mbar ± 1mbar CALIBRATION DATE : 07-Mar-25
AMBIENT TEMPERATURE : 24° C ± 1° C RELATIVE HUMIDITY : 54 % RH ± 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

1) STANDARD WEIGHT SET E2 QK-1-151 C02250116 28-Jan-27
2) STANDARD WEIGHT E2 15843 C02250117 29-Jan-27
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)

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

- ZERO SETTING FUNCTION : NORMAL
- TARE FUNCTION : NORMAL
- REPEATABILITY OF READING AT 120 g WAS 0.000055 g
- DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (±g)
0.00	0.00000	0.00000	0.000065
0.02	0.01999	0.00001	0.000065
0.10	0.10001	-0.00001	0.000066
0.20	0.20001	-0.00001	0.000066
0.50	0.50002	-0.00002	0.000065
1.00	1.00003	-0.00003	0.000066
2.00	2.00001	-0.00001	0.000067
5.00	5.00002	-0.00002	0.000068
10.00	10.00000	0.00000	0.000070
20.00	20.00004	-0.00004	0.000078
50.00	50.00000	0.00000	0.00013
100.00	100.0001	-0.0001	0.00019
120.00	120.0002	-0.0002	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



WO-02612424/2024



MAINTENANCE AND TEST CERTIFICATE MODEL OPTIMA 5300DV

SERIAL NUMBER 077C7042401 DATE TESTED January 6, 2025

1. MECHANICAL CHECKS

- Inspect and clean all fans and filters. ☐
- Inspect and replace as necessary, all torch components including the RF coil. ☐
- Inspect all tubing for sign of clacking or leaking. ☐
- Adjust water and gas pressure regulator settings. ☐
- Inspect and leak check pneumatics drawers. ☐
- Clean the exterior of the instrument. ☐

2. OPTICAL CHECKS

- Inspect and clean all optical components. ☐
- As required, check and replace all purgefilters. ☐
- Recheck optical alignment. ☐

3. COOLING SYSTEM CHECKS

- Perform preventive maintenance on chiller. ☐
- Flush out the chiller every year. ☐

4. PERFORMANCE CHECKS

- Torch View Alignment. ☐
- Wavelength Calibration. ☐

Page 2 of 4



MAINTENANCE AND TEST CERTIFICATE MODEL OPTIMA 5300DV

Customer : S.P.S.Consulting Service Co.,Ltd Date Tested: January 6, 2025
Address : 7 Soi Phaholyothin 24 Recommendation Recertification
Paholyothin Road Period 6 Months
Jompol Chatuchak, Bangkok 1090 Recertification Due: July 6, 2025
Date Last Certified: July 4, 2024
User Name: K.Phenpha Vipphasthawat Visit Number: 2 of 2
Phone: 083-9269252 PerkinElmer Phone: 02-719-6420 ext 206
Fax: 02-513-4221 PerkinElmer Fax: 02-318-5597

CONFIGURATION TESTED

MODEL SERIAL NUMBER
OPTIMA 5300DV 077C7042401

TESTED EQUIPMENT CALIBRATION NUMBER EXPIRATION

IPV Methods

TEST STANDARD USED PART NUMBER EXPIRATION DATE
Multielement Standard N069-1579 December 30, 2025
Wavecal Solution N058-2152 April 30, 2025
VIS Wavecal solution N930-2946 December 30, 2025
Instrument Cal. STD4 N930-0221 August 30, 2025

CUSTOMER SUPPLIED COMMENTS CUSTOMER INITIALS

2 % HNO3

10 % HNO3

Page 1 of 4

PerkinElmer Scientific (Thailand) Co., Ltd.
290 Soi Soonvijai 4, Bangkok, Huay Kwang, Bangkok 10310 Head Office

WO-02612424/2024



MAINTENANCE AND TEST CERTIFICATE MODEL OPTIMA 5300DV

SERIAL NUMBER : 077C7042401 DATE TESTED : January 6, 2025

PARAMETER	SPECIFICATION	FINAL VALUE
Spectral Resolution : UV	As 193.696 nm	≤ 0.007 0.00519
	Ni 231.604 nm	≤ 0.008 0.00667
	Ni 341.476 nm	≤ 0.012 0.00757
Spectral Resolution : VIS	La 408.672 nm	≤ 0.020 0.01621
	Ba 455.403 nm	≤ 0.025 0.02183
Precision	As 193.656 nm	% RSD < 1.0 0.51 %
	Zn 213.856 nm	% RSD < 1.0 0.48 %
	Mn 257.610 nm	% RSD < 1.0 0.03 %
	La 379.478 nm	% RSD < 1.0 0.05 %
	Ba 455.403 nm	% RSD < 1.0 0.07 %
	Ba 493.408 nm	% RSD < 1.0 0.04 %
Detection Limits : Axial	Ti 190.080 nm	3(sd) 10.65 ppb
	As 193.696 nm	3(sd) 2.48 ppb
	Pb 220.353 nm	3(sd) 3.09 ppb
Detection Limits : Radial	As 193.696 nm	3(sd) 12.41 ppb
	Zn 213.856 nm	3(sd) 0.91 ppb
	Mn 257.610 nm	3(sd) 0.13 ppb
	La 379.478 nm	3(sd) 4.74 ppb
	Ba 455.403 nm	3(sd) 0.10 ppb
	Ba 493.408 nm	3(sd) 0.18 ppb
BEC : Axial (IB X 500)(IS-IB)		Cd 226.502 nm ≤ 150 ppb 14.22
BEC : Radial (IB X 1000)(IS-IB)		Mn 257.610 nm ≤ 45 ppb 6.14

Page 3 of 4



MAINTENANCE AND TEST CERTIFICATE MODEL OPTIMA 5300DV

SERIAL NUMBER 077C7042401 DATE TESTED January 6, 2025

Remarks :

Commissioning follow as commissioning performance sheets.

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

☒

meets

☐

does not meet

the PerkinElmer Specifications listed on this certificate.

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

Authorized Represent

(Wiphan Promlunda)
Service Engineer

Page 4 of 4

PerkinElmer Scientific (Thailand) Co., Ltd.
290 Soi Soonvijai 4, Bangkok, Huay Kwang, Bangkok 10310 Head Office



Certificate of Calibration

Aquion: Anion (ID#894)

This certificate is to verify that instrument below are calibrated

by Archemica Lab Co.,Ltd.

AQUION S/N : 190840059

AS-DV S/N : 190915235

for

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

(Mr. Ponwut Kornthongnimit)

Test Engineer



Spectrum BX Preventive Maintenance (PM)

Company Name:	S.P.S. Consulting Service Co.,Ltd.		
Address:	7 Soi Phaholyothin 24 ,Phaholyothin Rd.,Jompol, Chatuchak,Bangkok 10900		
User Name:	K.Waraphon Phoowat	WO Number :	WO-02860803
Telephone No.:	083-033-6758	Certificate Number:	IR1164-2024
Customer Support Engineer:	Tanongsak	PM Number :	1 of 1
Date PM Performed: (DD-MMM-YYYY)	14-Aug-2024	Next PM Due Date: (DD-MMM-YYYY)	14-Aug-2025

Scope

The purpose of this PM is to ensure the continued functionality of the Spectrum FTIR Spectrophotometer by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer.

The document can be used for spectrum One, Spectrum One, NTS, Spectrum 100, Spectrum 100N, Spectrum Optica, Spectrum 4000F and the Frontier Series of FTIR Spectrophotometers.

The customer should save their method before the PM begins.

General Instructions:

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

General Instructions:

The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM. Always check with the customer before making any changes that may affect the customer's analysis or calibration, including a current back-up of system software and/or data files. The completed document should be signed by an authorized PerkinElmer and customer representative and left with the customer. Update the PM sticker and instrument logbook as required.

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Component List

Component / Specific Model	Serial #	Software Version	Configuration Notes
Spectrum BX	70366	5.3.1 Std	KBr B/S

Parts Lists

Parts Included with the PM				
Part Number (if applicable)	Description	Quantity	Batch/Lot/SN #	Expiration Date (MM/YY)
N0171159	Desiccant	2	NA	NA



Procedure Checklist

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

1. General:

- ☒ Source and Source Mirror
- ☒ Beam splitter
- ☒ Optical Unit Windows
- ☒ Mirror

2. Mechanical:

- ☒ Motors including Electronics unit fan
- ☒ Purge seals
- ☒ Change Desiccant

3. Electronics Check:

- ☒ Laser Output

1000, Paragon, RX or BX Laser Output	Specification	Value	Laser Gain
	16 +/- 1	15.85	2.61

- ☒ EndStop

End Stop	Specification	Value
	+/- 50	3.00

- ☒ Zero Path

Zero Path	Specification	Value
	+/- 20	4.00

- ☒ Energy

Energy	Specification	Value
	NA	14454.00



- ☒ Gain

Gain	Specification	Value
	Less than +/- 9.5	6.85 / -8.26

- ☒ Match

Match	Specification	Value
	NA	3.22

3. Performance Test:

- ☒ Signal to Noise Ratio (SNR) – (Record typical SNR Value).

	Detector Type	Typical SNR
Signal to Noise Ratio	DTGS (MIR)	2858.78

4. Wavenumber Calibrate:

- ☒ Wavenumber Calibrate

Certified Value (cm-1)	Value	Specification	Difference (cm-1)
3082.22	3082.06	+/- 0.5	0.16
3060.14	3060.00	+/- 0.5	0.14
1601.38	1601.40	+/- 0.5	-0.02
1583.04	1583.27	+/- 0.5	-0.23
1028.42	1028.51	+/- 0.5	-0.09



6. Review:

- ☒ Review with the customer PM work performed.
- ☒ Reset desiccant and service intervals on maintenance dialog.
- ☒ Review with the customer routine maintenance procedures.
- ☒ Discuss recommended customer-supplied materials to have on hand
- ☒ Attach PM sticker.
- ☐ Update Logbook.

Additional Comments

Additional Comments Regarding the PM

Review

The preventive maintenance checks and if applicable performance tests for FTIR have been completed.	
Passes <input checked="" type="checkbox"/> Fails <input type="checkbox"/> the preventive maintenance.	
Review of Preventive Maintenance:	
Authorized Customer Representative:	Date: 14-Aug-2024 (DD-MMM-YYYY)
	Date: 14-Aug-2024 (DD-MMM-YYYY)

เอกสารการสอบเทียบเครื่องมือการตรวจวัด
ระดับเสียงในบรรยากาศ



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0220 MTC No. EEL. BP. 44/0268

CALIBRATION CERTIFICATE

Submitted by : S.P.S.Consulting Service Co.,Ltd.
Address : 7 Soi Phaholyothin 24, Phaholyothin Road, Jompol, Chatuchak, Bangkok 10900.
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.
Instrument Calibrated :
Description : Sound Calibrator
Manufacturer : ACO
Model : 2127
Serial No. : 130006
Ambient Environment
Temperature : (23 ± 3) °C
Relative Humidity : (50 ± 15) %
Ambient Pressure : (101.325 ± 1.500) kPa
Standards used :
1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier 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 Panasonic VP-7722A S/N 041477D122.
7. Condenser Microphone B&K 4180 S/N 2889871.

Calibration Procedure: CP-102-04 based on IEC 60942:2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 19 Feb. 2025
Date of Calibration : 21 Feb. 2025

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.BLMTC.002 Rev.5

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Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
(66) 08 5219 9440
E-mail : mtc@tistr.or.th Website : www.tistr.or.th
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(66) 08 1889 6827



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0220 MTC No. EEL. BP. 44/0268

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

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

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	93.81	-0.19	± 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	±1.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	0.95	± 0.50	±3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Approved

Date of Calibration : 21 Feb. 2025
Date of Issue : 24 Feb. 2025

Industrial Metrology and Testing Service Centre
Ref : 2011268021900739001

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.5

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Tel. (66) 0 2323 1672-80 ext. 115, 116
(66) 08 5219 9440
E-mail : mtc@tistr.or.th Website : www.tistr.or.th
Office
196 Phaholyothin Road, Ladyao, Chatuchak,
Bangkok 10900, Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
(66) 08 1889 6827



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 แขวงคลองจั่น เขตจตุจักร กรุงเทพฯ 10200
Tel. (66) 020-4339-72 Fax. (66) 020-433-423 E-mail : ssp@spscs.com, www.spscs.com

Noise B_207/25

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	21 February 2025
		Due Date	21 February 2026

Calibration Data

Sound Level Meter Data				Calibration Data	
SLM No.	Brand	Model	Serial No.	Date	Actual Reading (dB)
					Before Adjustment After Adjustment
ACO-B03	ACO	6236	00222297	22 May 2025	93.7 93.9
ACO-B04	ACO	6236	00222298	22 May 2025	93.9 93.9
ACO-B41	ACO	6236	00192032	22 May 2025	93.7 93.9
ACO-C1-B02	ACO	6236	00223039	22 May 2025	93.9 93.9

Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) 93.81 ± 0.10 dB

เอกสารการสอบเทียบเครื่องมือการตรวจวัด
ระดับเสียงในสถานประกอบการ



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0220 MTC No. EEL. BP. 44/0268

CALIBRATION CERTIFICATE

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

Instrument Calibrated :
Description : Sound Calibrator
Manufacturer : ACO
Model : 2127
Serial No. : 130006
Ambient Environment
Temperature : (23 ± 3) °C
Relative Humidity : (50 ± 15) %
Ambient Pressure : (101.325 ± 1.500) kPa

- Standards used :
1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
 2. Measuring Amplifier 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 Panasonic VP-7722A S/N 041477D122.
 7. Condenser Microphone B&K 4180 S/N 2889871.

Calibration Procedure: CP-102-04 based on IEC 60942:2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 19 Feb. 2025
Date of Calibration : 21 Feb. 2025

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.

Head Office 35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang, Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9036
Fax. (66) 0 2577 9009
Office/Laboratory 668 Mu 2 Tambon Bangpoo, Amphoe Muang Samutprakan, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
(66) 08 3219 9440
E-mail : mtc@tistr.or.th Website : www.tistr.or.th
Office 196 Phahonyothin Road, Ladyao, Chatuchak, Bangkok 10900, Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
(66) 08 1889 6827
E-mail : mtc@tistr.or.th Website : www.tistr.or.th

FM.BLMTC.002 Rev.5



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0220 MTC No. EEL. BP. 44/0268

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

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

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	93.81	-0.19	± 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	±1.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	0.95	± 0.50	±3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The instrument has been corrected to reference conditions.

Calibrated by :

Electrical and Electronic Standards Laboratory

Date of Calibration : 21 Feb. 2025
Date of Issue : 24 Feb. 2025
Ref: 2011268021900739001

End of Certificate

2/2

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

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

Head Office 35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang, Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9036
Fax. (66) 0 2577 9009
Office/Laboratory 668 Mu 2 Tambon Bangpoo, Amphoe Muang Samutprakan, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
(66) 08 3219 9440
E-mail : mtc@tistr.or.th Website : www.tistr.or.th
Office 196 Phahonyothin Road, Ladyao, Chatuchak, Bangkok 10900, Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
(66) 08 1889 6827
E-mail : mtc@tistr.or.th Website : www.tistr.or.th

FM.BLMTC.002 Rev.5



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 แขวงคลองจั่น เขตจตุจักร กรุงเทพฯ 10700
Tel. (66) 0 2577 9036 Fax. (66) 0 2577 9009 E-mail : sales@spsc.com www.spsc.com

Note B.220/25

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 : 21 February 2025
Due Date : 21 February 2026

Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
ACO-B29	ACO	6236	00182011	03 June 2025	93.8	93.9
ACO-B36	ACO	6236	00192027	03 June 2025	93.7	93.9
ACO-B41	ACO	6236	00192032	03 June 2025	93.8	93.9
ACO-B43	ACO	6236	00192034	03 June 2025	93.9	93.9
ACO-R40	ACO	6236	00192052	03 June 2025	93.9	93.9
ACO-R41	ACO	6236	00192053	03 June 2025	93.9	93.9

Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR) 93.81 ± 0.10 dB



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0562 MTC No. EEL. BP. 72/0767

CALIBRATION CERTIFICATE

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

Instrument Calibrated :
Description : Sound Calibrator
Manufacturer : SVANTEK
Model : SV34
Serial No. : 83820
Ambient Environment
Temperature : (23 ± 3) °C
Relative Humidity : (50 ± 15) %
Ambient Pressure : (101.325 ± 1.500) kPa
Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier 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 Panasonic VP-7722A S/N 041477D122.
7. Condenser Microphone B&K 4180 S/N 2633526.

Calibration Procedure: CP-102-04 based on IEC 60942:2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 31 Jul. 2024
Date of Calibration : 6 Aug. 2024

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.

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 : rumpat@tistr.or.th Website: www.tistr.or.th
Office/Laboratory 196 Phahonyothin Road, Chatuchak, Bangkok 10900, Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
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 : suralee@tistr.or.th

FM.BLMTC.002 Rev.4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0562 MTC No. EEL. BP. 72/0767

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

Nominal Output of Unit Under Test = 114 dB re 20 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 2
1/2 inch Bruel&Kjaer 4180	114.03	0.03	± 0.10	± 0.75 dB

2. Frequency

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

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	0.27	± 0.50	$\pm 4.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 6 Aug. 2024

Date of Issue : 7 Aug. 2024

Ref : 2011267073102836003

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

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
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Tel. (66) 0 2577 9000
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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 Phaholyothin 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



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel. (002) 659-4350-72 Fax. (002) 513-4231 E-mail : info@sps.com, www.sps.com

Note Due B. 220.1/25

Noise Dose Meter Calibration Report

Acoustic Calibrator Data

Brand	SVANTEK	Number	SV 03/60
Model	SV34	Serial No.	83820
Calibration Range	114 dB, 1000 Hz	Last Calibration	06 August 2024
		Due Date	06 August 2025

Calibration Data

SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
NMD-B01	SVANTEK	SV-104IS	80840	03 June 2025	114.0	114.0
NMD-B02	SVANTEK	SV-104IS	80842	03 June 2025	114.0	114.0
NMD-B03	SVANTEK	SV-104IS	80852	03 June 2025	113.9	114.0
NMD-B04	SVANTEK	SV-104IS	80854	03 June 2025	114.1	114.0
NMD-B05	SVANTEK	SV-104IS	80856	03 June 2025	114.1	114.0
NMD-B06	SVANTEK	SV-104IS	80816	03 June 2025	114.0	114.0

Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)

114.03 \pm 0.10 dB

เอกสารการสอบเทียบเครื่องมือการตรวจวัด
ระดับความร้อนในสถานประกอบการ



METROLOGY SYSTEM (THAILAND) CO.,LTD.



ID LINE : BC17035



Certificate of Calibration

Certificate Number : SPR24100363-5

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 : TEH060047

ID. Number : B05

Environmental Conditions

Ambient Temperature : 23 °C \pm 2 °C

Received Date : 21 Oct 2024

Relative Humidity : 50 % \pm 15 %

Calibration Date : 21 Oct 2024

Location of Calibration : In-Lab

Recommend Due Date : 21 Oct 2025

Calibration Procedure : SP-CPT-04-13

Date of Issue : 22 Oct 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 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.Surasak Ritthikaew

Calibration Officer

Authorized Signature



Calibration Report

Certificate Number : SPR24100363-5

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

SP-FM-04-15 rev.0
rev.01

Result of Calibration

Certificate Number : SPR24100363-5

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	30.1	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. (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 -

SP-FM-04-15 REV.0
rev.01

Heat B_120_1

Heat Stress WBGT Meter Verification Report

Verification Data

Heat Stress WBGT Meter No. :	B05	Verification Date :	21 April 2025
Brand :	Quest Technologies	Ambient Temp. :	24.5 °C
Model :	QUESTemp 34	Barometric Pressure :	1011 mmbar
Serial No. :	TEH060047	Relative Humidity :	49 %

Verification Module (Electronic Sensor Check) :

Verification Module No. : 21 WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C

Result of Verification : Without Adjustment

Wet Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
12.5	12.6	-0.1	± 0.5
Dry Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
47.1	46.9	0.2	± 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

A Trescal company



Certificate of Calibration

Certificate Number : SPR25030358-6

Page : 1 of 3

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

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

Equipment Name : Area Heat Stress Monitor

Manufacturer : Metrosonics

Model : hs-32

Serial Number : MCE030011

ID. Number : B21

Environmental Conditions

Ambient Temperature : 23 °C ± 2 °C Received Date : 19 Mar 2025

Relative Humidity : 50 % ± 15 % Calibration Date : 27 Mar 2025

Location of Calibration : In-Lab Recommend Due Date : 27 Mar 2026

Calibration Procedure : SP-CPT-04-13 Date of Issue : 28 Mar 2025

Method of Calibration

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

Calibrated by : Mr.Surasak Ritthikaew

Calibration Officer

Approved by



ID LINE : IEC17025



Calibration Report

Certificate Number : SPR25030358-6

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Humidity Chamber	TH-80S	N/A	SPR25010173-14	30 Jan 2026
THERMO-HYGROMETER	5020A	A47046	TMU2500342	29 Jan 2026

Traceability

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

NA - NA Caltechnologies Co., Ltd.

SP-FM-04-15 rev.0



ID LINE : IEC17025



Result of Calibration

Certificate Number : SPR25030358-6

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	29.985	29.8	-0.185	0.20
35.0	34.988	34.8	-0.188	0.20
40.0	39.990	39.9	-0.090	0.20

Temperature Accuracy in the Measurement. (DRY)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	29.985	29.7	-0.285	0.20
35.0	34.988	34.7	-0.288	0.20
40.0	39.990	39.8	-0.190	0.20

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

Humidity Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	29.985	29.7	-0.285	0.20
35.0	34.988	34.7	-0.288	0.20
40.0	39.990	39.7	-0.290	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 -

SP-FM-04-15 REV.0



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด
S.P.S. CONSULTING SERVICE CO., LTD.
7 ซอยพหลโยธิน 24 ซอยพหลโยธิน แขวงจตุจักร 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 B_120_2

Heat Stress WBGT Meter Verification Report							
Verification Data							
Heat Stress WBGT Meter No.	:	B21	Verification Date	:	21 April 2025		
Brand	:	METROSINICS	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		12.5		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							



ID LINE : IEC17025



Certificate of Calibration

Certificate Number : SPR24080586-4

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 34

Serial Number : TPH050041

ID. Number : B26

Environmental Conditions

Ambient Temperature : 23 °C ± 2 °C Received Date : 30 Aug 2024

Relative Humidity : 50 % ± 15 % Calibration Date : 30 Aug 2024

Location of Calibration : In-Lab Recommend Due Date : 30 Aug 2025

Calibration Procedure : SP-CPT-04-13 Date of Issue : 31 Aug 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 : Ms. Apinya Pinyo

Calibration Officer



69/29 Moo 1 Klongsi Klongluang Pathumthani 12120 (Thailand) Tel: (662) 193-2220 5 ผู้ขาย www.spsystem.co.th



Calibration Report

Certificate Number : SPR24080586-4

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

SP-FM-04-15 rev.0



69/29 Moo 1 Klongsi Klongluang Pathumthani 12120 (Thailand) Tel: (662) 193-2220 5 ผู้ขาย www.spsystem.co.th



Result of Calibration

Certificate No. : SPR24080586-4

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.011	29.9	-0.111	0.20
35.0	35.016	34.9	-0.116	0.20
40.0	40.018	39.9	-0.118	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	35.016	35.2	0.184	0.20
40.0	40.018	40.2	0.182	0.20

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.011	30.3	0.289	0.20
35.0	35.016	35.3	0.284	0.20
40.0	40.018	40.3	0.282	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 -

SP-FM-04-15 REV.0

Heat B_120_3

Heat Stress WBGT Meter Verification Report				
Verification Data				
Heat Stress WBGT Meter No.	: B26	Verification Date	: 21 April 2025	
Brand	: Quest Technologies	Ambient Temp.	: 24.5	°C
Model	: QUESTemp 32	Barometric Pressure	: 1011	mmbar
Serial No.	: TPH050041	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	69.3	0.0	± 0.5	
UUC* = UNIT UNDER CALIBRATION				



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Certificate of Calibration

Certificate Number : SPR24090395-6

Page : 1 of 3

Customer

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

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

Equipment Name : Area Heat Stress Monitor

Manufacturer : Quest Technologies

Model : QUESTemp 32

Serial Number : TPH050046

ID. Number : B28-TPH050046

Environmental Conditions

Ambient Temperature : 23 °C ± 2 °C

Received Date : 20 Sep 2024

Relative Humidity : 50 % ± 15 %

Calibration Date : 23 Sep 2024

Location of Calibration : In-Lab

Recommend Due Date : 23 Sep 2025

Calibration Procedure : SP-CPT-04-13

Date of Issue : 24 Sep 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).

SP-FM-04-15 rev.0



ID LINE : IEC17025



Calibration Report

Certificate Number : SPR24090395-6

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

SP-FM-04-15 rev.0



ID LINE : IEC17025



Result of Calibration

Certificate Number : SPR24090395-6

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.014	30.2	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. (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

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

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 -

SP-FM-04-15 REV.0



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

Heat B_120_4

Heat Stress WBGT Meter Verification Report					
Verification Data					
Heat Stress WBGT Meter No.	:	828	Verification Date	:	21 April 2025
Brand	:	Quest Technologies	Ambient Temp.	:	24.5 °C
Model	:	QUESTemp 32	Barometric Pressure	:	1011 mmbar
Serial No.	:	TPH050046	Relative Humidity	:	49 %
Verification Module (Electronic Sensor Check) :					
Verification Module No.:	21	WB = 12.5 °C,	DB = 47.1 °C,	G = 69.3 °C	
Result of Verification : Without Adjustment					
Wet Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)		Correction (°C)	Tolerance Limit (°C)	
12.5	12.5		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	69.5		-0.2	± 0.5	
UUC* = UNIT UNDER CALIBRATION					



ID LINE : IEC17025



Certificate of Calibration

Certificate Number : SPR24090395-7

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 : TPH050057

ID. Number : B30-TPH050057

Environmental Conditions

Ambient Temperature : 23 °C ± 2 °C Received Date : 20 Sep 2024

Relative Humidity : 50 % ± 15 % Calibration Date : 23 Sep 2024

Location of Calibration : In-Lab Recommend Due Date : 23 Sep 2025

Calibration Procedure : SP-CPT-04-13 Date of Issue : 24 Sep 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

SP-FM-04-15 rev.0



ID LINE : IEC17025



Calibration Report

Certificate Number : SPR24090395-7

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.

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ID LINE : IEC17025



Result of Calibration

Certificate Number : SPR24090395-7

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.014	30.3	0.286	0.20
35.0	35.012	35.3	0.288	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	30.014	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

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

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 -

SP-FM-04-15 REV.0

Heat B_120_5

Heat Stress WBGT Meter Verification Report				
Verification Data				
Heat Stress WBGT Meter No.	: B30	Verification Date	: 21 April 2025	
Brand	: Quest Technologies	Ambient Temp.	: 24.5 °C	
Model	: QUESTemp 32	Barometric Pressure	: 1011 mmbar	
Serial No.	: TPH050057	Relative Humidity	: 49 %	
Verification Module (Electronic Sensor Check) :				
Verification Module No. : 21 WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C				
Result of Verification : Without Adjustment				
Wet Probe Temperature Measurement				
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)	
12.5	12.6	-0.1	± 0.5	
Dry Probe Temperature Measurement				
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)	
47.1	47.0	0.1	± 0.5	
Globe Probe Temperature Measurement				
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)	
69.3	69.3	0.0	± 0.5	
UUC* = UNIT UNDER CALIBRATION				



ID LINE : IEC17025



Certificate of Calibration

Certificate Number : SPR24090395-5

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 : TPH050047
ID. Number : B31-TPH050047

Environmental Conditions

Ambient Temperature : 23 °C ± 2 °C Received Date : 20 Sep 2024
Relative Humidity : 50 % ± 15 % Calibration Date : 23 Sep 2024
Location of Calibration : In-Lab Recommend Due Date : 23 Sep 2025
Calibration Procedure : SP-CPT-04-13 Date of Issue : 24 Sep 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).

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ID LINE : IEC17025



Calibration Report

Certificate Number : SPR24090395-5

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.

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SP-FM-04-15 rev.0



ID LINE : IEC17025



Result of Calibration

Certificate Number : SPR24090395-5

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	30.3	0.286	0.20
35.0	35.012	35.3	0.288	0.20
40.0	40.017	40.3	0.283	0.20

Temperature Accuracy in the Measurement. (GLOBE)

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

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 -

SP-FM-04-15 REV.0



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7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900
Tel : (662) 939-4370-72, Fax : (662) 513-4321, E-mail : sales@spsc.com, www.spsc.com

Heat B_120_6

Heat Stress WBGT Meter Verification Report				
Verification Data				
Heat Stress WBGT Meter No.	: B31	Verification Date	: 21 April 2025	
Brand	: Quest Technologies	Ambient Temp.	: 24.5 °C	
Model	: QUESTemp 32	Barometric Pressure	: 1011 mmbar	
Serial No.	: TPH050047	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				



A Trespac company



ID LINE : IEC17025



Certificate of Calibration

Certificate Number : SPR25030358-2

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 32

Serial Number : TPH050015

ID. Number : B32

Environmental Conditions

Ambient Temperature : 23 °C ± 2 °C

Received Date : 19 Mar 2025

Relative Humidity : 50 % ± 15 %

Calibration Date : 22 Mar 2025

Location of Calibration : In-Lab

Recommend Due Date : 22 Mar 2026

Calibration Procedure : SP-CPT-04-13

Date of Issue : 23 Mar 2025

Method of Calibration

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

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

Authorized Signatory

SP-FM-04-15 rev.0



ID LINE : IEC17925



Calibration Report

Certificate Number : SPR25030358-2

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Humidity Chamber	TH-80S	N/A	SPR25010173-14	30 Jan 2026
THERMO-HYGROMETER	5020A	A47046	TMU2500342	29 Jan 2026

Traceability

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

NA - NA Caltechnologies Co., Ltd.

SP-FM-04-15 rev.0



ID LINE : IEC17925



Result of Calibration

Certificate Number : SPR25030358-2

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.015	29.9	-0.115	0.20
35.0	35.012	34.9	-0.112	0.20
40.0	40.016	39.9	-0.116	0.20

Temperature Accuracy in the Measurement. (DRY)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.015	30.0	-0.015	0.20
35.0	35.012	35.0	-0.012	0.20
40.0	40.016	40.0	-0.016	0.20

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.015	30.2	0.185	0.20
35.0	35.012	35.2	0.188	0.20
40.0	40.016	40.2	0.184	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 -

SP-FM-04-15 REV.0

Heat 8_120_7

Heat Stress WBGT Meter Verification Report

Verification Data

Heat Stress WBGT Meter No.	: B32	Verification Date	: 21 April 2025
Brand	: Quest Technologies	Ambient Temp.	: 24.5 °C
Model	: QUESTemp 32	Barometric Pressure	: 1011 mmbar
Serial No.	: TPH050015	Relative Humidity	: 49 %

Verification Module (Electronic Sensor Check) :

Verification Module No. : 21 WB = 12.5 °C, DB = 41.1 °C, G = 69.3 °C

Result of Verification : Without Adjustment

Wet Probe Temperature Measurement

Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
12.5	12.3	0.2	± 0.5

Dry Probe Temperature Measurement

Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
47.1	47.2	-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



ID LINE : IEC17925



Certificate of Calibration

Certificate Number : SPR24100363-2

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 32

Serial Number : TPK120034

ID. Number : B33

Environmental Conditions

Ambient Temperature : 23 °C ± 2 °C Received Date : 21 Oct 2024

Relative Humidity : 50 % ± 15 % Calibration Date : 21 Oct 2024


Location of Calibration : In-Lab Recommend Due Date : 21 Oct 2025

Calibration Procedure : SP-CPT-04-13 Date of Issue : 22 Oct 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).



SP-FM-04-15 rev.0



METROLOGY SYSTEM (THAILAND) CO.,LTD.



ID LINE : IEC17025



Calibration Report

Certificate Number : SPR24100363-2

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

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SP-FM-04-15 rev.0



METROLOGY SYSTEM (THAILAND) CO.,LTD.



ID LINE : IEC17025



Result of Calibration

Certificate Number : SPR24100363-2

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.018	30.3	0.282	0.20
35.0	35.016	35.3	0.284	0.20
40.0	40.020	40.3	0.280	0.20

Temperature Accuracy in the Measurement. (DRY)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.018	30.3	0.282	0.20
35.0	35.016	35.3	0.284	0.20
40.0	40.020	40.3	0.280	0.20

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty (±)
30.0	30.018	30.3	0.282	0.20
35.0	35.016	35.3	0.284	0.20
40.0	40.020	40.3	0.280	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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SP-FM-04-15 REV.0

Heat B_120_8

Heat Stress WBGT Meter Verification Report			
Verification Data			
Heat Stress WBGT Meter No. :	B33	Verification Date :	21 April, 2025
Brand :	Quest Technologies	Ambient Temp. :	24.5 °C
Model :	QUESTemp 32	Barometric Pressure :	1011 mmbar
Serial No. :	TPK120034	Relative Humidity :	49 %
Verification Module (Electronic Sensor Check) :			
Verification Module No. : 21 WB = 12.5 °C, DB = 47.1 °C, G = 69.3 °C			
Result of Verification : Without Adjustment			
Wet Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
12.5	12.7	-0.2	± 0.5
Dry Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
47.1	47.2	-0.1	± 0.5
Globe Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
69.3	69.2	0.1	± 0.5
UUC* = UNIT UNDER CALIBRATION			



เอกสารการสอบเทียบเครื่องมือการตรวจวัด
ระดับความเข้มของแสงสว่าง



QUALITY CALIBRATION CO., LTD.

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

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



CERTIFICATE No : 24E6416

REFERENCE No : 73694-1

PAGE : 1 OF 3

Certificate of Calibration

EQUIPMENT : pH METER

MANUFACTURER : HANNA

MODEL : HI 3512

SERIAL No : TH118035


ID No : pH 04/56

CONDITION AS RECEIVED : USED ITEM

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

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 27-Jun-24


APPROVED BY : 

ISSUED DATE : 27-Jun-24

RECEIVED DATE : 24-Jun-24

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



F-G010 REV 03



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CERTIFICATE No : 24E6416

PAGE : 2 OF 3

Calibration Report

EQUIPMENT : pH METER

MANUFACTURER : HANNA

ID No : pH 04/56

RECEIVED DATE : 24-Jun-24

AMBIENT TEMPERATURE : 23 ° C ± 3 ° C

MODEL : HI 3512

SERIAL NUMBER : TH118035

CALIBRATION DATE : 27-Jun-24

RELATIVE HUMIDITY : 50 % RH ± 10% RH

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No/ LOT No	CERTIFICATE No	DUE DATE
1) pH STANDARD SOLUTION	00651-06	CC784945	4880-14413915	24-Aug-25
2) pH STANDARD SOLUTION	00651-08	CC785578	4881-14430833	31-Aug-25
3) pH STANDARD SOLUTION	00651-10	CC787086	4882-14483317	21-Sep-25
4) PROCESS CALIBRATOR	CA150	9186079	24E1251	09-Apr-25
5) BATH	260014	1247 48074	23T9014	11-Sep-24
6) THERMOMETER WITH PROBE	421504	55000379	23T9623	13-Sep-24

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 SI UNIT MAINTAINED AT -
- NATIONAL INSTITUTE OF STANDARD AND TECHNOLOGY, USA.
- NATIONAL INSTITUTE OF METROLOGY (THAILAND)


RESULT OF CALIBRATION : ADJUSTMENT

1. DISPLAY UNIT ONLY

SLOPE FACTOR k = 2.303 RT/F = 59 mV/pH

mV APPLIED	UUC READING (mV)	CORRECTION (mV)	UUC READING (pH)	UNCERTAINTY OF MEASUREMENT (± mV)	COVERAGE FACTOR k
414.11	414.8	-0.69	-0.115	0.15	2.00
354.95	355.5	-0.55	0.884	0.15	2.00
295.80	296.4	-0.60	1.885	0.15	2.00
236.64	237.1	-0.46	2.886	0.15	2.00
177.48	178.0	-0.52	3.887	0.15	2.00
118.32	118.8	-0.48	4.887	0.15	2.00
59.16	59.6	-0.44	5.887	0.15	2.00
0.00	0.4	-0.40	6.888	0.15	2.00
-59.16	-58.7	-0.46	8.101	0.15	2.00
-118.32	-117.9	-0.42	9.345	0.15	2.00
-177.48	-177.4	-0.08	10.589	0.15	2.00
-236.64	-236.4	-0.24	11.834	0.15	2.00
-295.80	-294.5	-1.30	13.077	0.15	2.00
-354.95	-354.7	-0.25	14.322	0.15	2.00
-414.11	-413.9	-0.21	15.565	0.15	2.00



END OF CALIBRATION REPORT PAGE 2 OF 3



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CERTIFICATE No : 24E6416

PAGE : 3 OF 3

Calibration Report

RESULT OF CALIBRATION (CONTINUE)1:

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

STANDARD pH BUFFER SOLUTION (pH)	UUC READING (pH)	CORRECTION (pH)	VALUE BEFORE ADJUSTMENT	UNCERTAINTY OF MEASUREMENT (± pH)	COVERAGE FACTOR k
4.015	4.011	0.004	3.905	0.012	2.00
7.003	7.003	0.000	6.972	0.012	2.00
10.009	10.014	-0.005	9.570	0.014	2.00

3. DISPLAY UNIT WITH TEMPERATURE

STANDARD READING (°C)	UUC READING (°C)	CORRECTION (°C)	VALUE BEFORE ADJUSTMENT	UNCERTAINTY OF MEASUREMENT (± °C)	COVERAGE FACTOR k
25.004	25.0	0.004	---	0.0085	2.00

4. PERCENT SLOPE 100%

UUC: UNIT UNDER CALIBRATION

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

END OF CALIBRATION REPORT

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F-G010 REV 03



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www.qcalibration.com



CERTIFICATE No : 24M2229

REFERENCE No : 72448-3

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : SARTORIUS

MODEL : BSA224S-CW

SERIAL No : 36591843

ID No : BA 09/61

CONDITION AS RECEIVED : USED ITEM

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

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 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.

F-G010 REV 03



CERT No.: HS-W015C

Calibration Date : 18 Mar 25

Submitted by : S.P.S CONSULTING SERVICE CO.,LTD

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

Avg Room Temp : 20 °C

Avg Water Temp : 20 °C

Air Pressure : 760.00 mmHg

Salinity : 0 ppt

Model : YSI 5000

S/N : 15B100751

Probe : YSI 5010

S/N : 22D100097

ID NO. : -

Air Temp ref : S/N. F8065C26

Barometric ref : S/N. F8065C26

Water Temp ref : -

ID NO. HS001

Technician : Kittipong M.

Harikul Science Co.,Ltd.

694 Soi Ratchadaniwet 24, Pracharatbamphen,

Samsaenok, Huaihwang, Bangkok 10310

Tel: 0-2274-2456 Fax: 0-2274-2443

Email: info@harikul.com www.harikul.com

Certificate of Calibration

Calibration Details

Calibration Point	100% air sat. (@20 °C, DO = 9.09 mg/l)	(status)	(status)
Measurement 1 (mg/l)	9.08	(PASS)	-
Measurement 2 (mg/l)	9.08	(PASS)	-
Measurement 3 (mg/l)	9.08	(PASS)	-
Measurement 4 (mg/l)	9.07	(PASS)	-
Measurement 5 (mg/l)	9.07	(PASS)	-
Measurement 6 (mg/l)	9.07	(PASS)	-
Measurement 7 (mg/l)	9.07	(PASS)	-
Measurement 8 (mg/l)	9.07	(PASS)	-
Measurement 9 (mg/l)	9.07	(PASS)	-
Measurement 10 (mg/l)	9.07	(PASS)	-

Mean Measurement 9.07 mg/l -

Inaccuracy 0.02 mg/l -

Overall Status (PASS)

Manufacturer Specification

Accuracy = +/- 0.02 mg/l

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

Technician Signature

(Kittipong Maekwong)

Laboratory Manager

(Natanapha Pisatkunchon)



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www.qcalibration.com

CERTIFICATE No : 24T0774

REFERENCE No : 71986-2

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : COD REACTOR

MANUFACTURER : HACH

MODEL : DRB 200

SERIAL No : 15110C0235

ID No : CRB 05/59

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

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 5-Feb-24

APPROVED BY :

ISSUED DATE : 5-Feb-24

RECEIVED DATE : 5-Feb-24

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
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F-G010 REV : 02



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CERTIFICATE No : 24T0774

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : COD REACTOR
MANUFACTURER : HACH
ID NUMBER : CRB 05/59
RECEIVED DATE : 5-Feb-24
AMBIENT TEMPERATURE : 23°C ± 1°C

MODEL : DRB 200
SERIAL NUMBER : 15110C0235
CALIBRATION DATE : 5-Feb-24
RELATIVE HUMIDITY : 52 %RH ± 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY DIRECT MEASUREMENT TEMPERATURE RECORDER WITH THERMOCOUPLE TYPE K UNDER NO LOAD CONDITION. THE THERMOCOUPLES WERE PLACED ON 15 POINTS AND LOCATED ONE THERMOCOUPLE IN EACH OF THE FOUR CORNERS OF THE REACTOR AND PLACED THE EIGHTH THERMOCOUPLE AT THE CENTER OF THE REACTOR.

2. REFERENCE STANDARD INSTRUMENTS :-

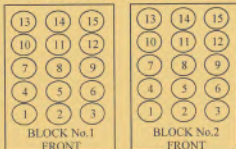
INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH TC TYPE K	HYDRA 2635A	8009008	2316640	14-Jul-24

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

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

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



TEMPERATURE MEASUREMENT ACCURACY TEST

Block No.	1	2
Controller temperature (°C)	145	145
Indicating Temperature	145	145
Measured Temperature (°C) at Spread Locations		
1	150.2	150.1
2	150.2	150.1
3	150.2	149.8
4	149.9	150.3
5	150.1	149.8
6	150.7	149.6
7	149.9	150.2
8	149.9	149.6
9	150.8	150.4
10	149.5	150.1
11	150.2	150.6
12	150.0	150.1
13	149.5	149.6
14	149.5	149.4
15	149.6	149.5
Uncertainty of Measurement (± °C)	0.86	0.86

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER

NOTE 2 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MU

COVERAGE FACTOR K=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%

END OF CALIBRATION REPORT

F-G



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www.qcalibration.com

CERTIFICATE No : 25T0520

REFERENCE No : 75853-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : COD REACTOR

MANUFACTURER : HACH

MODEL : DRB 200

SERIAL No : 15110C0497

ID No : DRB 05/59

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 : CHAICHARN CH.

CALIBRATION DATE : 27-Jan-25

APPROVED BY :

ISSUED DATE : 27-Jan-25

RECEIVED DATE : 15-Jan-25

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
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F-G010 REV : 03



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CERTIFICATE No : 25T0520

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : COD REACTOR
MANUFACTURER : HACH
ID NUMBER : DRB 05/59
RECEIVED DATE : 15-Jan-25
AMBIENT TEMPERATURE : 23° C ± 1° C

MODEL : DRB 200
SERIAL NUMBER : 15110C0497
CALIBRATION DATE : 27-Jan-25
RELATIVE HUMIDITY : 53 %RH ± 10 % RH

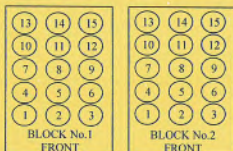
CONDITION OF THIS RESULTS OF CALIBRATION

- THIS INSTRUMENT WAS CALIBRATED BY DIRECT MEASUREMENT METHOD WITH CALIBRATED THERMOCOUPLE TYPE K UNDER NO LOAD CONDITION. THE THERMOCOUPLES WERE PLACED ON POINTS AND LOCATED AS THE PICTURE.
- REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT MODEL SERIAL No. CERTIFICATE No. DUE DATE
1) DATA LOGGER WITH TC TYPE K HYDRA 2635A 6635300 24T6468 26-Jun-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 QUALITY CALIBRATION CO., LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



Block No.	1	2
Calibration Point (°C)	150	150
Controller temperature (°C)	144	144
Indicating Temperature	144	144
Measured Temperature (°C) at Spread Locations		
1	150.01	149.57
2	150.69	150.44
3	150.40	149.46
4	150.22	149.89
5	150.27	149.75
6	150.51	150.45
7	150.24	150.03
8	150.20	150.08
9	150.14	150.14
10	149.70	149.83
11	149.58	149.89
12	149.46	149.79
13	148.77	149.03
14	148.99	149.14
15	149.02	149.62
Uncertainty of Measurement (± °C)	0.87	0

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : LOCATION 10 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.
THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY COVERAGE FACTOR k = 2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



MIRACLE INTERNATIONAL TECHNOLOGY CO., LTD.
214 Bangwak Rd. Bangpai, Bangkai, Bangkok 10160
Tel.: 0-2865-4647-8 Fax: 0-2865-4649 http://www.mit.in.th



CALIBRATION CERTIFICATE

Certificate No. : L202407024-0001

Date Issued : 31-Jul-24

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

Equipment : Block Digestion (Gerhardt, TR)

Manufacturer : Gerhardt

Model : -

Serial No. : 4061832

ID No./Tag No. : KJ 01/43

Date Received : 18-Jul-24

Date Calibrated : 30-Jul-24

Calibrated by : Surat Aumarb

Calibration Method or Calibration Procedure Used

In-house method : CP-49 base on TLAS G-20 by comparing against Standard Thermometer.

This certificate is traceable to national standards, which realize the units of measurement according to the International System of Units (SI).

Result of Calibration

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor k = 2, providing a level confidence approximately 95 percent.

This certificate may not be reproduced other than in full except with the prior written approval of the Miracle International Technology Company Limited.

Page 1 of 2

Certificate No. : L202407024-0001

Environment : Ambient Temperature : Start record 26.8 °C, Stop record 26.9 °C

Relative Humidity : Start record 54.4 %RH, Stop record 57.1 %RH

Calibration Temperature	Setting Temperature	Indicating Temperature	Measured Stability ¹	Measured Uniformity ²	Overall Variation ³
(°C)	(°C)	(°C)	(°C)	(°C)	(°C)
380	380	380	1.34	2.28	3.27

Calibration Temperature (°C)	Standard Reading (°C), Probe No. 20 is Reference Probe					Uncertainty ⁴ (±°C)
380	No. 1	No. 2	No. 3	No. 4	No. 5	2.2
	380.07	379.54	380.96	379.66	379.31	
	No. 6	No. 7	No. 8	No. 9	No. 10	
	380.63	380.22	379.71	380.41	380.72	
	No. 11	No. 12	No. 13	No. 14	No. 15	
	380.40	380.28	380.03	379.69	380.47	
	No. 16	No. 17	No. 18	No. 19	No. 20	
	380.11	379.97	379.93	379.81	379.58	

Decision Rule with Guard Band

Calibration		Pass / Fail					MPE
Temperature (°C)	No. 1	No. 2	No. 3	No. 4	No. 5		(±°C)
380	Pass	Pass	Pass	Pass	Pass		5
	No. 6	No. 7	No. 8	No. 9	No. 10		
	Pass	Pass	Pass	Pass	Pass		
	No. 11	No. 12	No. 13	No. 14	No. 15		
	Pass	Pass	Pass	Pass	Pass		
	No. 16	No. 17	No. 18	No. 19	No. 20		
	Pass	Pass	Pass	Pass	Pass		

Pass = [error] ≤ |MPE|

Fail = [error] > |MPE|

Without adjustment

No.1	No.2	No.3	No.4
No.5	No.6	No.7	No.8
No.9	No.10	No.11	No.12
No.13	No.14	No.15	No.16
No.17	No.18	No.19	No.20

Top view position

Condition As-Received : Used Item

The measurement results and statements of conformity with specification only relate to the item calibrated.

Measurement Standards Used & Traceability :

The International System of Units (SI) through

MIT Certificate No. L202403007-0003 for Digital Thermometer with Probe (Agilent) Module 2 (172) Type K Serial No. US37011204, Due 10-Sep-24

Notes : 1. The temperature stability is the one-half of greatest maximum difference of measured temperatures at any one probe.

2. The temperature uniformity is the maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time.

3. Overall variation is the difference of maximum and minimum measured temperatures throughout observation time.

4. The uncertainty of measurement is included temperature stability.

End of Certificate