

## เอกสารแนบที่ 4

เอกสารสอบเทียบเครื่องมือ

**ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง  
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม**

รายการตรวจวัด	เครื่องมือเก็บตัวอย่าง	เครื่องมือตรวจวิเคราะห์
	ชื่อเครื่องมือ	ชื่อเครื่องมือ
<b>คุณภาพอากาศจากปล่อง</b> Total Suspended Particulate (TSP) Oxides of Nitrogen (NO <sub>x</sub> ) Sulfur Dioxide (SO <sub>2</sub> ) Carbon Monoxide (CO) PM2.5 Mercury	Console No. B05 , R04 Pitot Tube No. B4 , B21 Vacuum Gauge Personal Pump SKC No. B6 , B26 Rotameter No. H-B06 , H-B09 Personal Pump SKC No. B17 , B37 Rotameter No. H-B06 , H-B09 – Console No. B05 , R04 Pitot Tube No. B4 , B21	Digital Balance Spectrophotometer – CO Analyzer NO. B07 , B11 Digital Balance AAS
<b>คุณภาพอากาศในบรรยากาศ</b> PM2.5 Mercury	High Volume PM2.5 Air Sampler Rec. No. B09 Blower No. B09 High Volume Air Sampler Rec No. B38 Blower No. B38	Digital Balance AAS
<b>ระดับเสียงในบรรยากาศ</b> ระดับเสียงเฉลี่ย 1 ชั่วโมง (L <sub>eq</sub> 1 hr) ระดับเสียงเฉลี่ย 24 ชั่วโมง (L <sub>eq</sub> 24 hr) ระดับเสียงสูงสุด (L <sub>max</sub> ) ระดับเสียงเฉลี่ยกลางวัน-กลางคืน (L <sub>dn</sub> ) ระดับเสียงเปอร์เซ็นต์ไทล์ที่ 90 (L <sub>90</sub> )	Sound Level Calibrator Sound Level Meter No. ACO-B40, B41, B42 ACO-B17, B21, B30	–
<b>คุณภาพน้ำ</b> ความเป็นกรดและด่าง ความนำไฟฟ้า อุณหภูมิ ความขุ่น สารที่ละลายได้ทั้งหมด สารแขวนลอย ปริมาณสารทั้งหมด ซีโอดี บีโอดี น้ำมันและไขมัน ฟอสเฟต ฟลูออไรด์ ไนเตรท ไนเตรท-ไนโตรเจน ไซยาไนด์คิดเทียบเป็นไฮโดรเจนไซยาไนด์ ซัลเฟต แคลเซียม แมกนีเซียม	– – – – – – – – – – – – – – – – – –	pH Meter Conductivity Meter Thermometer Turbidity Meter Digital Balance Digital Balance Digital Balance COD Reactor BOD Analyzer Digital Balance Spectrophotometer Spectrophotometer Spectrophotometer Spectrophotometer Spectrophotometer Spectrophotometer ICP ICP

**ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง  
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม (ต่อ)**

รายการตรวจวัด	เครื่องมือเก็บตัวอย่าง	เครื่องมือตรวจวิเคราะห์
	ชื่อเครื่องมือ	ชื่อเครื่องมือ
<b>คุณภาพน้ำ (ต่อ)</b> แบคทีเรียกลุ่มโคลิฟอร์มทั้งหมด แบคทีเรียกลุ่มฟิคอลโคลิฟอร์ม พรอท แคดเมียม ตะกั่ว สังกะสี ทองแดง นิกเกิล แบริยม เหล็ก อาร์เซนิก เซเลเนียม แมงกานีส โครเมียมชนิดเฮกซะวาเลนต์ เชื้อลิสทีเรีย	– – – – – – – – – – – – – – –	Incubator Incubator AAS AAS AAS/ICP AAS/ICP AAS/ICP ICP ICP ICP AAS AAS ICP Spectrophotometer Incubator
<b>ระดับความร้อนในสถานประกอบการ</b> WBGT	Digital Thermometer Heat Stress WBGT Meter NO. B28, B30, B31, B32, B33	–
<b>ระดับเสียงในสถานประกอบการ</b> ระดับเสียงเฉลี่ย 8 ชั่วโมง ( $L_{eq} 8 \text{ hr}$ ) ระดับเสียงสูงสุด ( $L_{max}$ )	Acoustic Calibrator Sound Level Meter No. ACO-B18, B29, B33, B36, B41, B43, R40, R41, R50, R52 Sound Level Meter No. CR-B03, B05, B06, B09, B10 Noise Dose Meter No. NMD-B08, B09, B10, B16, B17, B18, B19, B20, R05, R06	–
<b>ปริมาณเสียงสะสมแบบติดตัวบุคคล</b> Noise Dose	Noise Dose Meter No. NMD-B08, B09, B10, B16, B17, B18, B19, B20, R05, R06	–
<b>ระดับความเข้มของแสงสว่างในสถานประกอบการ</b> Light Intensity	Light Meter No. B07, B08, B09	–
<b>คุณภาพอากาศในสถานประกอบการ</b> Total Dust Sulfuric Acid Sodium Hydroxide Hydrogen Chloride Ammonia Chlorine	Personal Pump SKC No. B54, B57, B68, B81, B89, B92 Rotameter No. H-B01 Personal Pump SKC No. B64, B68, B76, B81, B86, B89 Rotameter No. L-B01 Personal Pump SKC No. B76, B89, B92 Rotameter No. H-B01 Personal Pump SKC No. B54, B81, B86 Rotameter No. L-B01 Personal Pump SKC No. B54, B64, B76, B81 Rotameter No. L-B01 Personal Pump SKC No. B54, B64, B81 Rotameter No. H-B01	Digital Balance IC – IC IC Spectrophotometer

### Console Calibration Report

Calibration Method

Critical Orifices

Console Data		Calibration Data	
No.	Serial No.	Date	y
B01	1563	01/12/2022	1.007
B02	8002514	02/12/2022	1.002
B03	1503016	05/12/2022	1.004
B04	00006659	01/12/2022	1.007
B05	00007428	01/12/2022	0.998
R01	1561	01/12/2022	1.004
R02	8002513	01/12/2022	1.003
R03	1570	05/12/2022	1.008
R04	8002519	05/12/2022	0.997
R05	1503015	01/12/2022	1.003

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

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

Calibrated by :

Abdul Dangkrom  
(Mr. Abdul Dangkrom)

Approved by :

Peera Detudom  
(Mr. Peera Detudom)

### Pitot Tube Calibration Report

Calibration Method

Standard Pitot Tube

Calibration Data			
Pitot Tube Data		Calibration Data	
No.	Type of Pitot	Coefficiency of Standard Pitot	Date
B03	S	0.99	02/11/2022
B04	S	0.99	04/11/2022
B05	S	0.99	04/11/2022
B07	S	0.99	02/11/2022
B08	S	0.99	03/11/2022
B09	S	0.99	02/11/2022
B11	S	0.99	04/11/2022
B16	S	0.99	02/11/2022
B18	S	0.99	02/11/2022
B19	S	0.99	04/11/2022
B21	S	0.99	02/11/2022
B24	S	0.99	04/11/2022
B27	S	0.99	03/11/2022
B30	S	0.99	03/11/2022
B31	S	0.99	03/11/2022
B33	S	0.99	01/11/2022
B35	S	0.99	01/11/2022

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

Calibrated by :

Abdul Dangkrom  
(Mr. Abdul Dangkrom)

Approved by :

Peera Detudom  
(Mr. Peera Detudom)





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด  
S.P.S. CONSULTING SERVICE CO., LTD.  
7 ถนนพหลโยธิน 24 แขวงจตุจักร เขตจตุจักร กรุงเทพฯ 10000  
7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900  
Tel : (662) 339-2702 Fax : (662) 333-4221 E-mail : sales@spscc.com, www.spscc.com

### Pitot Tube Calibration Report

Calibration Method

Standard Pitot Tube

#### Calibration Data

No.	Pitot Tube Data		Date	Calibration Data	
	Type of Pitot	Coefficient of Standard Pitot		Side A	Side B
B36	S	0.99	02/11/2022	0.83	0.84
B37	S	0.99	01/11/2022	0.84	0.83
B38	S	0.99	02/11/2022	0.84	0.85
B39	S	0.99	04/11/2022	0.84	0.84
B40	S	0.99	02/11/2022	0.85	0.84
B41	S	0.99	02/11/2022	0.84	0.85
B44	S	0.99	02/11/2022	0.84	0.83
B45	S	0.99	01/11/2022	0.84	0.83
B46	S	0.99	01/11/2022	0.84	0.85
B47	S	0.99	03/11/2022	0.84	0.84
B48	S	0.99	03/11/2022	0.83	0.84
B49	S	0.99	04/11/2022	0.85	0.84
B54	S	0.99	01/11/2022	0.83	0.84
B56	S	0.99	01/11/2022	0.84	0.85
B57	S	0.99	04/11/2022	0.85	0.84
B58	S	0.99	04/11/2022	0.84	0.84

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

Calibrated by :

Abul Dangklom  
(Mr. Abul Dangklom)

Approved by :

Peera Detudom  
(Mr. Peera Detudom)



Accredited  
ISO/IEC 17025

CALIBRATION LABORATORY CO., LTD.

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



## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : VACUUM GAUGE  
MANUFACTURER : HI-LIGHT  
MODEL / TYPE : N/A  
SERIAL NO. : N/A[64-220066-1]  
CLID. NO. : 212201112  
JOB CONTROL NO. : 220720073201

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

DATE OF RECEIVED : 20 July 2022

DATE OF ISSUED : 22 July 2022

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

Calibrated By :

Sitipong Pimdee  
Calibration Engineer



Approved By :

Mongkol Yotsoontorn  
Authorized Signatory

22 July 2022

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

Certificate No. Q22073201

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## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : VACUUM GAUGE  
MANUFACTURER : HI-LIGHT  
MODEL / TYPE : N/A  
SERIAL NO. : N/A[64-220066-1]  
DATE OF CALIBRATION : 21 July 2022

#### ENVIRONMENT CONDITIONS :

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

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

#### PROCEDURE USED :

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

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

#### REFERENCE STANDARD USED :

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

#### TRACEABILITY :

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

#### UNCERTAINTY :

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

Certificate No. Q22073201

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#### CONDITION OF CALIBRATION ITEM : GOOD

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

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

#### CALIBRATION DATA

##### CORRECTION OF PRESSURE

DUC Test point ( inHg )	STD Reading ( inHg )		Correction ( inHg )	
	Up	Down	Up	Down
0	0.0	0.0	0.0	0.0
-5	-4.6	-4.7	+0.4	+0.3
-10	-9.5	-9.6	+0.5	+0.4
-15	-14.4	-14.5	+0.6	+0.5
-20	-19.4	-19.5	+0.6	+0.5
-25	-24.5	-24.5	+0.5	+0.5
-30	-29.5	-29.5	+0.5	+0.5

Uncertainty of measurement  $\pm 0.2$  inHg

Transmitting fluid : Air.

Technical Note. k factor 1 kPa = 0.2952998 inHg

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

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

### End of Certificate ###

Certificate No. Q22073201

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



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CERTIFICATE No : 23M2441  
REFERENCE No : 68471-1

## Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS105DU

SERIAL No : 1126422905

ID No : BA 05/50

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 :

10-Mar-23

APPROVED BY :

PONGSAK J.

ISSUED DATE :

16-Mar-23

RECEIVED DATE :

10-Mar-23

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

F-G010 REV 02

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

### Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

#### Environmental Conditions

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

Personal Pump Data			Calibration Data									
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)			Value From Calibration Curve				
					Settling			Actual (Q std.)				
					1	2	3	1	2	3	R <sup>2</sup>	
B01	SKC	224-PCXR4	262101	03/01/2023	1,000	1,500	2,000	993	1,497	1,998	1.003x - 5.584	1.000
B02	SKC	224-PCXR4	826166	03/01/2023	1,000	1,500	2,000	2,000	1,003	1,505	2,001	1.009x - 19.667
B03	SKC	224-PCXR4	612968	03/01/2023	1,000	1,500	2,000	996	1,494	2,000	1.006x - 12.109	1.000
B04	SKC	224-PCXR4	602804	04/01/2023	1,000	1,400	2,000	1,000	1,502	1,995	1.000x - 0.893	1.000
B05	SKC	224-PCXR4	612693	04/01/2023	1,000	1,500	2,000	1,003	1,500	2,003	1.012x - 22.254	0.999
B06	SKC	224-PCXR4	262188	03/01/2023	1,000	1,500	2,000	995	1,508	2,005	1.011x - 20.273	1.000
B07	SKC	224-PCXR4	826292	03/01/2023	1,000	1,500	2,000	998	1,492	1,995	0.993x + 6.066	1.000
B08	SKC	224-PCXR4	826100	03/01/2023	1,000	1,500	2,000	1,003	1,500	2,003	1.012x - 23.308	0.999
B09	SKC	224-PCXR4	836479	03/01/2023	1,000	1,400	2,000	996	1,490	1,994	0.995x + 1.117	1.000
B10	SKC	224-PCXR4	901950	03/01/2023	1,000	1,500	2,000	992	1,503	2,001	1.016x - 36.582	0.999
B11	SKC	224-PCXR8	564315	06/01/2023	1,000	1,500	2,000	996	1,490	1,999	1.003x - 8.256	1.000
B12	SKC	224-PCXR4	934656	05/01/2023	1,000	1,500	2,000	1,003	1,503	2,003	1.010x - 19.324	0.999
B13	SKC	224-PCXR4	602073	05/01/2023	1,000	1,500	2,000	995	1,500	1,998	1.001x - 3.474	1.000
B14	SKC	224-PCXR4	628933	04/01/2023	1,000	1,500	2,000	999	1,491	1,988	0.992x + 6.844	1.000
B15	SKC	224-PCXR4	626474	04/01/2023	1,000	1,500	2,000	1,001	1,502	2,005	1.014x - 25.558	0.999
B16	SKC	224-PCXR4	626477	04/01/2023	1,000	1,500	2,000	994	1,504	2,001	1.015x - 31.345	0.999
B17	SKC	224-PCXR4	626860	04/01/2023	1,000	1,500	2,000	997	1,494	1,991	0.997x + 0.359	1.000
B18	SKC	224-PCXR4	691484	04/01/2023	1,000	1,500	2,000	1,003	1,500	2,001	1.006x - 17.589	0.999
B19	SKC	224-PCXR4	691599	03/01/2023	1,000	1,500	2,000	993	1,503	1,999	1.007x - 11.574	1.000
B20	SKC	224-PCXR4	691687	03/01/2023	1,000	1,500	2,000	992	1,504	1,999	1.015x - 32.235	0.999
B21	SKC	224-PCXR4	691631	03/01/2023	1,000	1,500	2,000	993	1,499	1,994	1.001x - 7.107	1.000
B22	SKC	224-PCXR4	691654	06/01/2023	1,000	1,500	2,000	1,003	1,501	2,003	1.011x - 21.107	0.999
B23	SKC	224-PCXR4	768393	05/01/2023	1,000	1,500	2,000	992	1,507	2,002	1.018x - 34.883	0.999
B24	SKC	224-PCXR4	626363	05/01/2023	1,000	1,500	2,000	1,000	1,502	2,000	1.011x - 22.387	0.999
B25	SKC	224-PCXR4	798489	05/01/2023	1,000	1,500	2,000	1,001	1,492	2,001	0.998x + 1.101	1.000
B26	SKC	224-PCXR4	798479	05/01/2023	1,000	1,500	2,000	999	1,500	1,993	0.996x + 4.008	1.000
B27	SKC	224-PCXR4	691673	04/01/2023	1,000	1,500	2,000	994	1,503	2,002	1.016x - 32.071	0.999
B28	SKC	224-PCXR4	691570	04/01/2023	1,000	1,500	2,000	1,000	1,500	2,002	1.012x - 22.515	0.999
B29	SKC	224-PCXR4	626472	04/01/2023	1,000	1,500	2,000	1,000	1,496	1,998	1.001x - 4.942	1.000
B30	SKC	224-PCXR4	691489	03/01/2023	1,000	1,500	2,000	1,004	1,510	2,004	1.008x - 12.460	0.999
B31	SKC	224-PCXR4	691509	03/01/2023	1,000	1,500	2,000	992	1,497	1,998	1.006x - 12.711	1.000
B32	SKC	224-PCXR4	691567	03/01/2023	1,000	1,500	2,000	991	1,504	2,001	1.016x - 32.322	0.999
B33	SKC	224-PCXR4	691756	05/01/2023	1,000	1,500	2,000	993	1,497	1,991	0.997x + 0.004	1.000
B34	SKC	224-PCXR4	612962	05/01/2023	1,000	1,500	2,000	1,002	1,501	2,002	1.007x - 14.195	1.000
B35	SKC	224-PCXR4	602682	05/01/2023	1,000	1,500	2,000	993	1,498	1,995	1.002x - 8.448	1.000
B36	SKC	224-PCXR4	626164	03/01/2023	1,000	1,500	2,000	999	1,496	1,999	1.001x - 5.424	1.000
B37	SKC	224-PCXR4	626256	03/01/2023	1,000	1,500	2,000	994	1,506	1,999	1.013x - 27.815	0.999
B38	SKC	224-PCXR4	626167	03/01/2023	1,000	1,500	2,000	997	1,496	1,996	0.999x + 0.997	1.000
B39	SKC	224-PCXR4	934637	03/01/2023	1,000	1,500	2,000	1,005	1,501	2,001	1.010x - 18.618	0.999
B40	SKC	224-PCXR4	798349	05/01/2023	1,000	1,500	2,000	994	1,506	1,999	1.014x - 29.602	0.999

Calibrated by :

Abul Daulah  
(Mr. Abul Daulah)

Approved by :

Pongsak J.  
(Mr. Pong Sak J.)





CERTIFICATE No : 23M2441

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL BALANCE : MODEL : XS103DU  
MANUFACTURER : METTLER TOLEDO : S/N : 1126422905  
ID No : BA 05/50 : RECEIVED DATE : 10-Mar-23  
AIR PRESSURE : 1010mbar  $\pm$  1mbar : CALIBRATION DATE : 10-Mar-23  
AMBIENT TEMPERATURE : 23°C  $\pm$  1°C : RELATIVE HUMIDITY : 49%RH  $\pm$  10% RH

## CONDITION OF THIS RESULTS OF CALIBRATION

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

## 2. REFERENCE STANDARD INSTRUMENTS :-

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

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

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

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

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

## RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

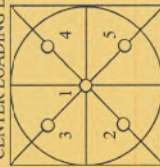
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY ( $\pm$ g)
0.00	0.00000	0.00000	0.000039
0.02	0.02000	0.00000	0.000039
0.10	0.10000	0.00000	0.000039
0.20	0.20001	-0.00001	0.000040
0.50	0.50001	-0.00001	0.000040
1.00	1.00000	0.00000	0.000041
2.00	2.00003	-0.00003	0.000042
5.00	5.00001	-0.00001	0.000046
10.00	10.00003	-0.00003	0.000053
20.00	20.00005	-0.00005	0.000067
50.00	50.00001	-0.00001	0.00011
100.00	100.00001	-0.00001	0.00019
200.00	200.00001	-0.00001	0.00032

## 5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.0000
2	50.0001
3	50.0000
4	50.0000
5	49.9999
OFF-CENTER LOADING	0.0001

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

END OF CALIBRATION REPORT

SITHIPORN ASSOCIATES CO.,LTD.  
CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd, Bangbunmu, Bangplud Bangkok 10700 THAILAND.

Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiphorn.com http://www.sithiphorn.com

NSC-TISI-TIS 17025  
CALIBRATION 0394

Cert. No. : SP22018

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,  
CHOMPON, CHATUCHAK,  
BANGKOK 10900, THAILAND.

Location : ORGANIC LABORATORY IV

Ambient Temperature : ( 24.4  $\pm$  5 ) °CRelative Humidity : ( 60.1  $\pm$  25 ) %

Received Date : 30 AUGUST 2022

Calibration Date : 30 AUGUST 2022

Date of Issue : 31 AUGUST 2022

Calibrated by :

Nathakorn Pisutpaisan

Approved by :

  
( Thanakul Petchurai )

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

Continuation of Calibration Certificate

Cert. No. : SP22018  
Job No. : VC65SP0008  
Pages : 2 of 3

**Calibration Method :**

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

**Condition of this result of calibration :**

1. Certified reference materials  

Material	Ref. type	Cell serial No.	Cert. No.	Due Date
Holmium liquid	RM-HL	29706	87569	13/10/2022
Didymium liquid	RM-DL	28912	87588	15/10/2022
Neutral density filter	RM-IN2N3N	13877	87600	15/10/2022
Potassium dichromate solutions	RM-0204060810	14204	87614	16/10/2022
Potassium Iodide solution	-	KI-0701-001	CJ-0090-22	08/04/2024
2. This result of calibration was found accurate as shown on date and place of calibration only.
3. This certificate is traceable to the international system of unit maintained at :  
3.1 The UK National Physical Laboratory (NPL)  
3.2 The National Institute of Standards and Technology, NIST.

**Result of calibration : Wavelength Accuracy**

(Without adjustment)

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

UUC\* = Unit Under Calibration

Continuation of Calibration Certificate

Cert. No. : SP22018  
Job No. : VC65SP0008  
Pages : 3 of 3

**Result of calibration : Photometric Accuracy**

(Without adjustment)

Material	Wavelength (nm)	Filter S/N	Nominal Absorbance	Certified Absorbance (A)	UUC* Reading Absorbance (A)	Error (A)	Uncertainty ± (A)	k Factor
Neutral Density glass filter	440.0	29360	1.0	1.0524	1.0539	0.0015	0.0028	2.00
		29914	0.7	0.7454	0.7459	0.0005	0.0029	2.00
		29381	0.5	0.5426	0.5426	0.0000	0.0028	2.00
	546.1	29360	1.0	0.9822	0.9810	-0.0012	0.0028	2.00
		29914	0.7	0.6962	0.6960	-0.0002	0.0028	2.00
		29381	0.5	0.5076	0.5070	-0.0006	0.0029	2.00
	590.0	29360	1.0	1.0221	1.0202	-0.0019	0.0028	2.00
		29914	0.7	0.7238	0.7230	-0.0008	0.0029	2.00
		29381	0.5	0.5364	0.5360	-0.0004	0.0031	2.00
	635.0	29360	1.0	0.9751	0.9732	-0.0019	0.0028	2.00
29914		0.7	0.6912	0.6902	-0.0010	0.0029	2.00	
29381		0.5	0.5214	0.5210	-0.0004	0.0032	2.00	
Material	Wavelength (nm)	Solution (mg/l)	Certified Absorbance (A)	UUC* Reading Absorbance (A)	Error (A)	Uncertainty ± (A)	k Factor	
RM-0204060810		20	0.2436	0.2419	-0.0017	0.0101	2.00	
		40	0.4905	0.4855	-0.0050	0.0115	2.00	
		60	0.7453	0.7388	-0.0065	0.0067	2.00	
	235.0	80	0.9920	0.9839	-0.0081	0.0071	2.00	
		100	1.2487	1.2414	-0.0073	0.0073	2.00	

UUC\* = Unit Under Calibration

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

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

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

\*\*Specific Acceptance :

Transmission  $\leq$  1.0 T(%) Absorbance  $\geq$  2.0 A

\*\*Stray light not TISI Accredited

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

End of Calibration Certificate

*T. Petcha*

*T. Petcha*



Calibration Report	
Non-Dispersive Infrared CO Analyzer	
Date : 02 February 2023	Brand : Thermo Model : 48C
No. CO-B11	Serial No. 401304262
Calibrator (Dilution System)	
Brand : API	Model : 700
Last Cal. Date : 06 September 2022	Serial No. : 421
Reference Standard Gas	
Standard Gas : Carbon Monoxide (CO)	Cylinder No. : D196045
Certified Date : 16 April 2022	Expired Date : 15 April 2024 Cylinder Conc. : 4,570 ppm
Calibrating Condition	
Pressure 1011 mmbar	Temp. 24.5 °C % RH 49
Calibration Setting	
Span Set Point	Initial Reading (Before Adj.),PPM Analyzer Response %Diff Final Reading (After Adj.),PPM Analyzer Response
Zero	Expected Concentration 0 0.11 - 0
CO Span	40.00 40.08 0.200 40.00
Instrument Status	
Chamber Temp 47.5 °C	Flow 1.5 LPM
Pressure 730.8 mm Hg	Motor Speed 100.00%

Calibrated by :

Adul Dangklom  
(Mr. Adul Dangklom)

Approved by :

(Mr. Peera Deudom)

Calibration Report	
Non-Dispersive Infrared CO Analyzer	
Date : 05 January 2023	Brand : Thermo Model : 48C
No. CO-B07	Serial No. 0335503746
Calibrator (Dilution System)	
Brand : API	Model : 700
Last Cal. Date : 06 September 2022	Serial No. : 421
Reference Standard Gas	
Standard Gas : Carbon Monoxide (CO)	Cylinder No. : D196045
Certified Date : 16 April 2022	Expired Date : 15 April 2024 Cylinder Conc. : 4,570 ppm
Calibrating Condition	
Pressure 1011 mmbar	Temp. 24.5 °C % RH 50
Calibration Setting	
Span Set Point	Initial Reading (Before Adj.),PPM Analyzer Response %Diff Final Reading (After Adj.),PPM Analyzer Response
Zero	Expected Concentration 0 -0.10 - 0
CO Span	40.00 39.92 -0.200 40.00
Instrument Status	
Chamber Temp 47.2 °C	Flow 1.5 LPM
Pressure 730.8 mm Hg	Motor Speed 100.00%

Calibrated by :


Adul Dangklom  
(Mr. Adul Dangklom)

Approved by :

(Mr. Peera Deudom)

PinAAcle 900T Preventive Maintenance (PM)				
Company Name:	SPS CONSULTING SERVICE CO.,LTD.			
Address (Instrument Location):	7 SOI PHAHOLYOTHIN 24,PHAHOLYOTHIN RD. JOMPOL,CHATUCHAK, BANGKOK 10110			
Serial Number:	PTCS14111103	PM Number:	1-2	
Customer Name (if applicable):	K. PHENPHA	Telephone Number:	083-926-9252	
Customer Support Engineer Name:	K. DUANG	Service Order Number:	WO-02044564	
Date PM Performed: (DD-MMM-YYYY)	06-Jan-2023	Next PM Due Date: (DD-MMM-YYYY)	06-Jul-2023	
Standard Labor Hours to Complete PM :			5 hours	

Part Number	Release	Publication Date
09370143 Rev.9	A	January 2018



**Scope**  
The purpose of this PM is to ensure the continued functionality of the PinAAcle 900T by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer.  
The customer should save their method before the PM begins.

**General Instructions:**  
The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM. Always check with the customer before making any changes that may affect the customer's analysis 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 #	Configuration Notes
AS900	AS9S14B1002	WINLAB 32

Parts Lists

Parts included with the PM		
Part Number (if applicable)	Description	Quantity
B0501696	Fan Filters	2
B3002013	THGA Contact Cylinders	1
B3141064	Glycerol for THGA Cooling	N/A
N3160156	O-Ring Kits for Sampling Introduction ( Stainless Steels Nebulizer)	N/A
N3160157	O-Ring Kits for Sampling Introduction ( Plastic Nebulizer)	2
N9301714	Replacement Acetylene Filter Cartridge	1
TH001022	Replacement Air Filter Cartridge	2

Additional Reagents and Standards Required for PM				
Part Number (if applicable)	Description	Quality	Batch/Lot #	Expired Date (MM/YY)
N9300183	1000 mg/L Copper Standard	AR	26-87CUY1	30-Jan-2024
N9300244	GFAAS Mixed Standard	AR	56-021CRY1	30-Jun-2023

Additional Reagents and Standards Required for PM (Customer Support Solution)				
Part Number (if applicable)	Description	Quantity	Batch/Lot #	Expiration Date (MM/YY)
N/A	DI Water	250 ml.	AR	AR
N/A	0.5% HNO <sub>3</sub>	250 ml.	AR	AR

Additional Tools Required for PM			
Part Number (if applicable)	Description	Quantity	Serial #
N1013000	0.2A Neutral density filter	1	MGO-252
N1013002	1.0A Neutral density filter	1	MG2-358
B3100652 Or N9307029	Electronic Flow Meter	1	NA
B0505495	Test Jig	1	NA
03030997	System 2 EDL Driver	1	03030997
N3050605	As System 2 EDL	1	16148
N3050121	Cu Lumina HCL	1	092216-010130
N3050109	Ba Lumina HCL	1	102416-040160
N3050139	K Lumina HCL	1	110716-010060
N3050152	Ni Lumina HCL	1	100516-030190
N3050119	Cr Lumina HCL	1	091911-020150

## Procedure Checklist

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

### 1. General:

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

### 2. PC Instrument Software:

- ☒ Instrument Software user files/databases archived, packed, and/or deleted as needed.

### 3. Mechanical:

- ☒ Inspect and clean all fans and filters. Replace filters if necessary
- ☒ Inspect all gas and water lines for leaks and/or wear. Replace if needed. Thoroughly inspect all quick connects. Replace the Y connector, P/N 09921079, if needed.
- ☒ Clean exterior of the instrument.

#### 3.1 Flame Technique

- ☒ Inspect the burner head, burner chamber, and nebulizer. Clean if needed as stated in the Hardware Guide.
- ☒ Check burner head dimensions with the feeler gauge as stated in the Hardware Guide in the Maintenance chapter section on cleaning the burner head and checking sloth width. Replace if out of specification
- ☒ Check the condition of the end cap, burner head, and nebulizer O-rings. Replace if necessary.
- ☒ Check the drain system for signs of wear. Replace worn or damaged parts.
- ☒ Visually check for proper flame conditions when igniting the Air-C2H2 and N2O-C2H2 flames (if applicable).

#### 3.2 THGA Technique

- ☒ Inspect the pole pieces and clean where the pole pieces contact the furnace. Replace the pole piece p-rings as needed, P/N's B0501018 & B0501250. Grease the O-rings as needed with Apiezon L grease, P/N 09905148
- ☒ Inspect the four insulation pads on the front contact housing of the THGA in furnace. If the pads are missing replace the THGA furnace or replace the insulator pads on the furnace.
- ☒ Inspect the graphite tube and clean the contact cylinders. Replace if necessary.
- ☒ Check internal and external gas flows with the Electronic Gas Flow Meter and the Gas Flow Test Probe as described in the Service Manual. Correct if necessary.
- ☒ Check furnace open/close function.
- ☒ Verify the operation of the GFTV Camera for proper operation and viewing alignment in the furnace camera Tube View window. Align if needed.
- ☒ Check the operation of the Halogen Light ASSY for the GFTV Camera. Replace if needed.
- ☒ Check the water level/quality in the recirculation (if applicable). Add distilled water if necessary.
- ☒ Check the cooling system fluid flow rate with the FCS In-Line Flow Meter for proper levels if needed. Refer to SDB# COSY008.STN



8. After PIM Performance tests [Flame]:

8.1 Detector Linearity with Barium

Description: Ensures that the detector is linear in the Visible Range.

Parameter	Specification	Certificate Value at 553.6 nm (Abs.)	Test Results	Pass/Fail
1.0 A ND Filter	± 5% from Cert.	0.9798	0.1982	Passed
0.2 A ND Filter	± 5% from Cert.	0.2042	0.9942	Passed

8.2 Baseline Noise at 1.0 Absorbance with Barium

Description: Ensures that a high absorbance will not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0014	Passed

8.3 AA Baseline Noise with Copper

Description: Check baseline noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.001	0.0001	Passed

8.4 D<sub>2</sub> Background Compensation with Copper

Description: Verifies the instruments ability to compensate for Background absorption.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0083	Passed

8.5 AA-BG Baseline Noise with Copper

Description: Ensures that background correction does not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0002	Passed
8. After PIM Performance tests [Flame]:

8.1 Detector Linearity with Barium

Description: Ensures that the detector is linear in the Visible Range.

Parameter	Specification	Certificate Value at 553.6 nm (Abs.)	Test Results	Pass/Fail
1.0 A ND Filter	± 5% from Cert.	0.9798	0.1982	Passed
0.2 A ND Filter	± 5% from Cert.	0.2042	0.9942	Passed

8.2 Baseline Noise at 1.0 Absorbance with Barium

Description: Ensures that a high absorbance will not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0014	Passed

8.3 AA Baseline Noise with Copper

Description: Check baseline noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.001	0.0001	Passed

8.4 D<sub>2</sub> Background Compensation with Copper

Description: Verifies the instruments ability to compensate for Background absorption.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0083	Passed

8.5 AA-BG Baseline Noise with Copper

Description: Ensures that background correction does not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0002	Passed
4. Electrical:

Inspect PC boards. Clean if necessary.

Carefully check all internal and external cable connections.

Check instrument firmware revisions upgrade to current levels (if necessary)

Run Diagnostics Test within the Advanced function of the Spectrometer page. Check the results in the service log folder in the Spectrometer BM Log Viewer.

5. Optics:

Inspect and clean the sample compartment windows, if needed.

Inspect and clean the furnace windows, if needed.

Inspect and clean the GFTV camera lens, if needed.

Inspect optics. Clean or replace if necessary.

6. Gasses:

Verify that the Gasses supplied to the instrument are within the pressure and purity specifications found in the PinAAcle 900 Series Pre-Installation Checklist SDB.

Verify that the air filter element is dry. Replace if necessary.

7. Flame Interlock Check:

Description: Check to ensure that all safety interlocks are closed.

Parameter	Specification	Test Results	Pass/Fail
Flame Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Drain Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Nebulizer Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
C <sub>2</sub> H <sub>2</sub> Pressure Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Air Pressure Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Burner Head Sensor	Choosing Nitrous Oxide as the oxidant should trigger an interlock shuts down	Active	Passed
- PinAAcle 900T Preventive Maintenance (PM)
- Page 5 of 9
- PinAAcle 900T Preventive Maintenance (PM)
- Page 6 of 9

8.6 AA-BG Baseline Noise with Arsenic

Description: Ensures that background correction does not produce excessive noise at a low wavelength.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0021	Passed

8.7 Flame Sensitivity

Description: Instrument Sensitivity checked against Copper standard.

Standard Copper Sensitivity		Specification	Results (Abs.)	Pass/Fail
5 mg/L Sensitivity SS Neb (if applicable)	> 0.250 Abs.	> 0.250 Abs.	NA	Not Applicable
2 mg/L Sensitivity HS Neb (if applicable)	> 0.250 Abs.	> 0.250 Abs.	0.3281	Passed

9. After PM Performance tests [THGA]:

9.1 Furnace Gas Flows

Description: Ensures the flow rates are within specification.

Parameter	Specification	Test Results	Pass/Fail
Internal Flow Rate	250 mL/min ± 25 mL/min	255	Passed
External Flow Rate	100 mL/min ± 10 mL/min	105	Passed

9.2 Chromium Baseline Noise

Description: Signal to noise check.

Parameter	Specification	Results	Pass/Fail
Baseline Noise	≤ 0.005 Abs.	0.0000	Passed
Standard Deviation	≤ 0.005	0.0002	Passed

9.3 Chromium Characteristic Mass and Precision

Description: Calculate the characteristic mass using the characteristic mass tool and precision from the integrated absorbance values.

Parameter	Specification	Results	Pass/Fail
Cr m <sub>0</sub> Results	≤ 7.0 pg/0.0044 A-s	5.7	Passed
Precision	≤ 2.0 %	0.74	Passed

9.4 Copper Characteristic Mass and Zeeman Ratio

Description: Calculate the characteristic mass using the characteristic mass tool and check the Zeeman Ratio.

Parameter	Specification	Results	Pass/Fail
Cu m <sub>0</sub> Result	≤ 16.5 pg/0.0044 A-s	12.3	Passed
Zeeman Ratio	0.52 ± 0.04	0.54	Passed

10. Review:

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

## Additional Comments

Additional Comments Regarding the PM	
Zeeman Ratio	$= \frac{\text{Atomic Signal (Peak area)}}{\text{Atomic Signal (Peak area)} + \text{Background Signal (Peak area)}}$
	$= \frac{0.1855}{0.1855+0.1563}$
	$= 0.54$
REPLACE PM KIT	

## Review

The preventive maintenance checks and if applicable performance tests for PinAAcle 900T have been completed.	
This PinAAcle 900T Passes <input checked="" type="checkbox"/> Fails <input type="checkbox"/> the preventive maintenance.	
Review of Preventive Maintenance:	
Authorized PerkinElmer Representative:	Date: 06-Jan-2023 (DD-MM-YYYY)
Authorized Customer Representative:	Date: 06-Jan-2023 (DD-MM-YYYY)

CALIBRATION REPORT			
PM2.5 AIR SAMPLER (VERY SHARP CUT CYCLONE-VSCC)			
DATE : 07 May 2023	BRAND : BGI	MODEL : PQ200	
NO. PM2.5-B09		SERIAL NO. 152125 (VSCC)	
CALIBRATING CONDITION			
Pressure 1011	mmbar	Temp. 24.6	°C
		% RH	49
Calibration Method : Dry Cal Primary Flowmeter		Model : Defender 510 H	
		S/N : 136164	
CALIBRATION SETTING			
PM2.5 AIR SAMPLER			
detCal			
Flowrate Reading, L./min	Initial Flowrate Reading (Before Adj.), L./min	% Diff.	Final Flowrate Reading (After Adj.), L./min
16.70	16.65	0.299	16.70

Calibrated by : Mal Dangklor Approved by : (Mr. Peera Detudom)  
 (Mr. Adul Dangklor)

High Volume Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard				Model : TE 5025A	S/N : 3611
Calibration Data					
High Volume Air Sampler Data		Calibration Data			
Recorder No.	Blower No.	Date	Actual Flowrate (l <sup>3</sup> /min)	R <sup>2</sup>	
B01	B01	03/05/2023	y = 1.313x-6.873	0.998	
B02	B02	03/05/2023	y = 1.116x+2.378	0.999	
B03	B03	03/05/2023	y = 1.102x-0.827	0.997	
B04	B04	02/05/2023	y = 1.246x-6.815	0.999	
B05	B05	02/05/2023	y = 1.331x-9.589	0.998	
B06	B06	04/05/2023	y = 1.282x-7.814	0.999	
B07	B07	03/05/2023	y = 1.194x-5.233	0.999	
B08	B08	03/05/2023	y = 1.274x-8.294	0.998	
B09	B09	01/05/2023	y = 1.221x-3.849	0.997	
B10	B10	01/05/2023	y = 1.181x-2.610	0.997	
B11	B11	02/05/2023	y = 1.154x-1.998	0.998	
B12	B12	02/05/2023	y = 1.200x-4.528	0.999	
B13	B13	02/05/2023	y = 1.216x-4.270	0.998	
B14	B14	02/05/2023	y = 1.326x-8.548	1.000	
B15	B15	02/05/2023	y = 1.222x-5.693	0.997	
B16	B16	01/05/2023	y = 1.287x-7.502	0.997	
B17	B17	01/05/2023	y = 1.255x-6.198	0.999	
B18	B18	02/05/2023	y = 1.243x-6.744	0.997	
B19	B19	01/05/2023	y = 1.320x-8.840	0.999	
B20	B20	03/05/2023	y = 1.245x-6.585	0.998	
B21	B21	03/05/2023	y = 1.186x-3.464	0.999	
B22	B22	03/05/2023	y = 1.297x-8.592	0.997	
B23	B23	02/05/2023	y = 1.216x-4.912	0.998	
B24	B24	02/05/2023	y = 1.144x-1.869	0.999	
B25	B25	02/05/2023	y = 1.079x+1.654	0.999	
B26	B26	02/05/2023	y = 1.218x-5.191	0.997	
B27	B27	02/05/2023	y = 1.255x-5.812	0.998	
B28	B28	02/05/2023	y = 1.305x-8.342	0.999	
B29	B29	02/05/2023	y = 1.285x-8.182	0.996	
B30	B30	02/05/2023	y = 1.299x-8.294	0.997	
B31	B31	03/05/2023	y = 1.270x-6.531	0.998	
B32	B32	02/05/2023	y = 1.249x-6.292	0.997	
B33	B33	01/05/2023	y = 1.260x-7.688	0.997	
B34	B34	02/05/2023	y = 1.291x-8.548	0.999	

Calibrated by :

Adul Dangklom

(Mr. Adul Dangklom)

Approved by :

Peera Detudom

(Mr. Peera Detudom)

High Volume Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard				Model : TE 5025A	S/N : 3611
Calibration Data					
High Volume Air Sampler Data		Calibration Data			
Recorder No.	Blower No.	Date	Actual Flowrate (l <sup>3</sup> /min)	R <sup>2</sup>	
B35	B35	01/05/2023	y = 1.310x-9.363	0.996	
B36	B36	02/05/2023	y = 1.201x-4.866	0.999	
B37	B37	02/05/2023	y = 1.239x-4.586	0.998	
B38	B38	02/05/2023	y = 1.304x-9.606	0.997	
B39	B39	01/05/2023	y = 1.240x-5.469	0.998	
B40	B40	03/05/2023	y = 1.196x-4.045	0.999	
B41	B41	03/05/2023	y = 1.179x-2.611	0.999	
B42	B42	02/05/2023	y = 1.246x-7.813	0.996	
B43	B43	02/05/2023	y = 1.206x-3.694	0.999	
B44	B44	02/05/2023	y = 1.302x-9.108	0.999	
R01	R01	02/05/2023	y = 1.268x-7.113	0.995	
R02	R02	01/05/2023	y = 1.285x-6.759	0.997	
R03	R03	03/05/2023	y = 1.247x-7.848	0.996	
R04	R04	02/05/2023	y = 1.161x-1.778	0.999	
R05	R05	02/05/2023	y = 1.288x-9.494	0.999	
R06	R06	02/05/2023	y = 1.277x-8.891	0.997	
R07	R07	02/05/2023	y = 1.046x+2.772	1.000	
R08	R08	02/05/2023	y = 1.206x-5.068	0.997	
R09	R09	02/05/2023	y = 1.296x-8.463	0.999	
R10	R10	02/05/2023	y = 1.244x-6.477	0.999	
R11	R11	02/05/2023	y = 1.097x-0.462	0.998	
R12	R12	02/05/2023	y = 1.210x-5.084	0.998	
R13	R13	01/05/2023	y = 1.149x-1.965	1.000	
R14	R14	01/05/2023	y = 1.189x-3.035	0.998	
R15	R15	02/05/2023	y = 1.161x-3.437	0.998	
R16	R16	01/05/2023	y = 1.158x-4.330	0.997	
R17	R17	02/05/2023	y = 1.218x-5.356	0.998	
R18	R18	02/05/2023	y = 1.234x-5.546	0.999	
R19	R19	02/05/2023	y = 1.267x-7.058	0.999	
R20	R20	01/05/2023	y = 1.284x-8.743	0.999	

Calibrated by :

Adul Dangklom

(Mr. Adul Dangklom)

Approved by :

Peera Detudom

(Mr. Peera Detudom)





### Certificate of Calibration

EQUIPMENT	:	DIGITAL BALANCE
MANUFACTURER	:	METTLER TOLEDO
MODEL	:	XS105DU
SERIAL No	:	1126422905
ID No	:	BA 05/50
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	:	10-Mar-23
APPROVED BY	:	 PONGSAK J.
ISSUED DATE	:	16-Mar-23
RECEIVED DATE	:	10-Mar-23

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



### Calibration Report

EQUIPMENT	:	DIGITAL BALANCE	MODEL	:	XS105DU
MANUFACTURER	:	METTLER TOLEDO	S/N	:	1126422905
ID No	:	BA 05/50	RECEIVED DATE	:	10-Mar-23
AIR PRESSURE	:	1010mbar $\pm$ 1mbar	CALIBRATION DATE	:	10-Mar-23
AMBIENT TEMPERATURE	:	23°C $\pm$ 1°C	RELATIVE HUMIDITY	:	49 %RH $\pm$ 10 % RH

#### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.
2. REFERENCE STANDARD INSTRUMENTS :-  
1) STANDARD WEIGHT SET E2  
2) STANDARD WEIGHT E2  
3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.  
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.  
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-  
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

#### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL
2. TARE FUNCTION : NORMAL
3. REPEATABILITY OF READING AT 200 g WAS 0 g
4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY ( $\pm$ g)
0.00	0.00000	0.00000	0.000039
0.02	0.02000	0.00000	0.000039
0.10	0.10000	0.00000	0.000039
0.20	0.20001	-0.00001	0.000040
0.50	0.50001	-0.00001	0.000040
1.00	1.00000	0.00000	0.000041
2.00	2.00003	-0.00003	0.000042
5.00	5.00001	-0.00001	0.000046
10.00	10.00003	-0.00003	0.000053
20.00	20.00005	-0.00005	0.000067
50.00	50.00001	-0.00001	0.00011
100.00	100.0001	-0.0001	0.00019
200.00	200.0001	-0.0001	0.00032

#### 5. OFF CENTER LOADING ERROR




POINT	READING (g)
1	50.0000
2	50.0001
3	50.0000
4	50.0000
5	49.9999
OFF-CENTER LOADING	0.0001

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

PinAAcle 900T Preventive Maintenance (PM)				
Company Name:	SPS CONSULTING SERVICE CO.,LTD.			
Address (Instrument Location):	7 SOI PHAHOLYOTHIN 24,PHAHOLYOTHIN RD. JOMPOL,CHATUCHAK, BANGKOK 10110			
Serial Number:	PTCS14111103	PM Number:	1-2	
Customer Name (if applicable):	K. PHENPHA	Telephone Number:	083-926-9252	
Customer Support Engineer Name:	K. DUANG	Service Order Number:	WO-02044564	
Date PM Performed: (DD-MMM-YYY)	06-Jan-2023	Next PM Due Date: (DD-MMM-YYY)	06-Jul-2023	
Standard Labor Hours to Complete PM :			5 hours	

Part Number	Release	Publication Date
09370143 Rev.9	A	January 2018



**Scope**  
The purpose of this PM is to ensure the continued functionality of the PinAAcle 900T by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer.  
The customer should save their method before the PM begins.

**General Instructions:**  
The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM. Always check with the customer before making any changes that may affect the customer's analysis 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 #	Configuration Notes
AS900	AS9S14B1002	WINLAB 32

Parts Lists

Parts Included with the PM		
Part Number (if applicable)	Description	Quantity
B0501696	Fan Filters	2
B3002013	THGA Contact Cylinders	1
B3141064	Glycerol for THGA Cooling	N/A
N3160156	O-Ring Kits for Sampling Introduction ( Stainless Steels Nebulizer)	N/A
N3160157	O-Ring Kits for Sampling Introduction ( Plastic Nebulizer)	2
N9301714	Replacement Acetylene Filter Cartridge	1
TH001022	Replacement Air Filter Cartridge	2

Additional Reagents and Standards Required for PM			
Part Number (if applicable)	Description	Quality	Batch/Lot # Expired Date (MM/YY)
N9300183	1000 mg/L Copper Standard	AR	26-87CUY1 30-Jan-2024
N9300244	GFAAS Mixed Standard	AR	56-021CRY1 30-Jun-2023

Additional Reagents and Standards Required for PM (Customer Support Solution)			
Part Number (if applicable)	Description	Quantity	Batch/Lot # Expiration Date (MM/YY)
N/A	DI Water	250 ml.	AR AR
N/A	0.5% HNO <sub>3</sub>	250 ml.	AR AR

Additional Tools Required for PM			
Part Number (if applicable)	Description	Quantity	Serial #
N1013000	0.2A Neutral density filter	1	MGO-252
N1013002	1.0A Neutral density filter	1	MG2-358
B3100652 Or N9307029	Electronic Flow Meter	1	NA
B0505495	Test Jig	1	NA
03030997	System 2 EDL Driver	1	03030997
N3050605	As System 2 EDL	1	16148
N3050121	Cu Lumina HCL	1	092216-010130
N3050109	Ba Lumina HCL	1	102416-040160
N3050139	K Lumina HCL	1	110716-010060
N3050152	Ni Lumina HCL	1	100516-030190
N3050119	Cr Lumina HCL	1	091911-020150

## Procedure Checklist

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

### 1. General:

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

### 2. PC Instrument Software:

- ☒ Instrument Software user files/databases archived, packed, and/or deleted as needed.

### 3. Mechanical:

- ☒ Inspect and clean all fans and filters. Replace filters if necessary
- ☒ Inspect all gas and water lines for leaks and/or wear. Replace if needed. Thoroughly inspect all quick connects. Replace the Y connector. P/N 09921079, if needed.
- ☒ Clean exterior of the instrument.

#### 3.1 Flame Technique

- ☒ Inspect the burner head, burner chamber, and nebulizer. Clean if needed as stated in the Hardware Guide.
- ☒ Check burner head dimensions with the feeler gauge as stated in the Hardware Guide in the Maintenance chapter section on cleaning the burner head and checking sloth width. Replace if out of specification
- ☒ Check the condition of the end cap, burner head, and nebulizer O-rings. Replace if necessary.
- ☒ Check the drain system for signs of wear. Replace worn or damaged parts.
- ☒ Visually check for proper flame conditions when igniting the Air-C2H2 and N2O-C2H2 flames (if applicable).

#### 3.2 THGA Technique

- ☒ Inspect the pole pieces and clean where the pole pieces contact the furnace. Replace the pole piece p-rings as needed. P/N's B0501018 & B0501250. Grease the O-rings as needed with Apiezon L grease. P/N 09905148
- ☒ Inspect the four insulation pads on the front contact housing of the THGA in furnace. If the pads are missing replace the THGA furnace or replace the insulator pads on the furnace.
- ☒ Inspect the graphite tube and clean the contact cylinders. Replace if necessary.
- ☒ Check internal and external gas flows with the Electronic Gas Flow Meter and the Gas Flow Test Probe as described in the Service Manual. Correct if necessary.
- ☒ Check furnace open/close function.
- ☒ Verify the operation of the GFTV Camera for proper operation and viewing alignment in the furnace camera Tube View window. Align if needed.
- ☒ Check the operation of the Halogen Light ASSY for the GFTV Camera. Replace if needed.
- ☒ Check the water level/quality in the recirculation (if applicable). Add distilled water if necessary.
- ☒ Check the cooling system fluid flow rate with the FCS In-Line Flow Meter for proper levels if needed. Refer to SDB# COSY008.STN



8. After PIM Performance tests [Flame]:

8.1 Detector Linearity with Barium

Description: Ensures that the detector is linear in the Visible Range.

Parameter	Specification	Certificate Value at 553.6 nm (Abs.)	Test Results	Pass/Fail
1.0 A ND Filter	± 5% from Cert.	0.9798	0.1982	Passed
0.2 A ND Filter	± 5% from Cert.	0.2042	0.9942	Passed

8.2 Baseline Noise at 1.0 Absorbance with Barium

Description: Ensures that a high absorbance will not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0014	Passed

8.3 AA Baseline Noise with Copper

Description: Check baseline noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.001	0.0001	Passed

8.4 D<sub>2</sub> Background Compensation with Copper

Description: Verifies the instruments ability to compensate for Background absorption.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0083	Passed

8.5 AA-BG Baseline Noise with Copper

Description: Ensures that background correction does not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0002	Passed
8. After PIM Performance tests [Flame]:

8.1 Detector Linearity with Barium

Description: Ensures that the detector is linear in the Visible Range.

Parameter	Specification	Certificate Value at 553.6 nm (Abs.)	Test Results	Pass/Fail
1.0 A ND Filter	± 5% from Cert.	0.9798	0.1982	Passed
0.2 A ND Filter	± 5% from Cert.	0.2042	0.9942	Passed

8.2 Baseline Noise at 1.0 Absorbance with Barium

Description: Ensures that a high absorbance will not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0014	Passed

8.3 AA Baseline Noise with Copper

Description: Check baseline noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.001	0.0001	Passed

8.4 D<sub>2</sub> Background Compensation with Copper

Description: Verifies the instruments ability to compensate for Background absorption.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0083	Passed

8.5 AA-BG Baseline Noise with Copper

Description: Ensures that background correction does not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0002	Passed
4. Electrical:

Inspect PC boards. Clean if necessary.

Carefully check all internal and external cable connections.

Check instrument firmware revisions upgrade to current levels (if necessary)

Run Diagnostics Test within the Advanced function of the Spectrometer page. Check the results in the service log folder in the Spectrometer BM Log Viewer.

5. Optics:

Inspect and clean the sample compartment windows, if needed.

Inspect and clean the furnace windows, if needed.

Inspect and clean the GFTV camera lens, if needed.

Inspect optics. Clean or replace if necessary.

6. Gasses:

Verify that the Gasses supplied to the instrument are within the pressure and purity specifications found in the PinAAcle 900 Series Pre-Installation Checklist SDB.

Verify that the air filter element is dry. Replace if necessary.

7. Flame Interlock Check:

Description: Check to ensure that all safety interlocks are closed.

Parameter	Specification	Test Results	Pass/Fail
Flame Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Drain Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Nebulizer Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
C <sub>2</sub> H <sub>2</sub> Pressure Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Air Pressure Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Burner Head Sensor	Choosing Nitrous Oxide as the oxidant should trigger an interlock shuts down	Active	Passed
- PinAAcle 900T Preventive Maintenance (PM)
- Page 5 of 9
- PinAAcle 900T Preventive Maintenance (PM)
- Page 6 of 9



8.6 AA-BG Baseline Noise with Arsenic

Description: Ensures that background correction does not produce excessive noise at a low wavelength.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0021	Passed

8.7 Flame Sensitivity

Description: Instrument Sensitivity checked against Copper standard.

Standard Copper Sensitivity		Results (Abs.)	Pass/Fail
5 mg/L Sensitivity SS Neb (if applicable)	> 0.250 Abs.	NA	Not Applicable
2 mg/L Sensitivity HS Neb (if applicable)	> 0.250 Abs.	0.3281	Passed

9. After PM Performance tests [THGA]:

9.1 Furnace Gas Flows

Description: Ensures the flow rates are within specification.

Parameter	Specification	Test Results	Pass/Fail
Internal Flow Rate	250 mL/min ± 25 mL/min	255	Passed
External Flow Rate	100 mL/min ± 10 mL/min	105	Passed

9.2 Chromium Baseline Noise

Description: Signal to noise check.

Parameter	Specification	Results	Pass/Fail
Baseline Noise	≤ 0.005 Abs.	0.0000	Passed
Standard Deviation	≤ 0.005	0.0002	Passed

9.3 Chromium Characteristic Mass and Precision

Description: Calculate the characteristic mass using the characteristic mass tool and precision from the integrated absorbance values.

Parameter	Specification	Results	Pass/Fail
Cr m <sub>0</sub> Results	≤ 7.0 pg/0.0044 A-s	5.7	Passed
Precision	≤ 2.0 %	0.74	Passed

9.4 Copper Characteristic Mass and Zeeman Ratio

Description: Calculate the characteristic mass using the characteristic mass tool and check the Zeeman Ratio.

Parameter	Specification	Results	Pass/Fail
Cu m <sub>0</sub> Result	≤ 16.5 pg/0.0044 A-s	12.3	Passed
Zeeman Ratio	0.52 ± 0.04	0.54	Passed

10. Review:

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

Noise B 047/23

## Additional Comments

Additional Comments Regarding the PM	
Zeeman Ratio	$= \frac{\text{Atomic Signal (Peak area)}}{\text{Atomic Signal (Peak area)} + \text{Background Signal (Peak area)}}$
	$= \frac{0.1855}{0.1855+0.1563}$
	$= 0.54$
REPLACE PM KIT	

## Review

The preventive maintenance checks and if applicable performance tests for PinAcle 900T have been completed.	
This PinAcle 900T Passes <input checked="" type="checkbox"/> Fails <input type="checkbox"/> the preventive maintenance.	
Review of Preventive Maintenance:	
Authorized PerkinElmer Representative:	Date: 06-Jan-2023 (DD-MM-YYYY)
Authorized Customer Representative:	Date: 06-Jan-2023 (DD-MM-YYYY)

Sound Level Meter Calibration Report			
Acoustic Calibrator Data			
Brand	ACO	Number	AC 03/56
Model	2127	Serial No.	130006
Calibration Range	94 dB, 1000 Hz	Last Calibration	28 April 2022
		Due Date	28 April 2023
Calibration Data			
Sound Level Meter Data		Calibration Data	
SLM No.	Brand	Model	Serial No.
ACO-B40	ACO	6236	00192031
ACO-B41	ACO	6236	00192032
ACO-B42	ACO	6236	00192033
Actual Reading [dB]		Before Adjustment	
		94.0	
		94.0	
		94.0	
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)		93.93 ± 0.10 dB	

Calibrated by : Adul Dangklom  
(Mr. Adul Dangklom)

Approved by : Peera Detulom  
(Mr. Peera Detulom)

Sound Level Meter Calibration Report

Acoustic Calibrator Data			
Brand	ACO	Number	AC 03/56
Model	2127	Serial No.	130006
Calibration Range	94 dB, 1000 Hz	Last Calibration	29 March 2023
		Due Date	29 March 2024
Sound Level Meter Data			
SLM No.	Brand	Model	Serial No.
ACO-B17	ACO	6236	00172042
ACO-B21	ACO	6236	00172059
ACO-B30	ACO	6236	00182012
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)			
93.94 ± 0.10 dB			

Calibrated by : Adul Dangklom (Mr. Adul Dangklom)

Approved by :

Peera Detulom  
(Mr. Peera Detulom)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

CALIBRATION CERTIFICATE

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

Instrument Calibrated :

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

Standards used :

1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
4. Digital Multimeter Agilent 34401A S/N MY44005560.
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
6. Audio Analyzer Keithley 2015-P S/N 4106495.
7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871.

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

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

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

Date of Receipt : 27 Mar. 2023

Date of Calibration : 29 Mar. 2023

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 : rumpai@tistr.or.th Website: www.tistr.or.th

Office/Laboratory

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

Office

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





THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

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

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

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

#### 1. Sound Pressure Level

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

#### 2. Frequency

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

#### 3. Total distortion

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

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

(Mr. Weerachai Deechaiyae)

Approved by :

(Mr. Prateek Kluayapa)

Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 29 Mar. 2023

Date of Issue : 30 Mar. 2023

Ref : 2011266032701228001

End of Certificate

2 / 2

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

Head Office

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

Office/Laboratory

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

Office

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

FM.BLMTC.002 Rev.4



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



PAGE : 1 OF 3

## Certificate of Calibration

CERTIFICATE No : 22E9693  
REFERENCE No : 66476-1

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 : 15-Sep-22

APPROVED BY : PONGSAK J.

ISSUED DATE : 15-Sep-22

RECEIVED DATE : 14-Sep-22

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

F-G010 REV 02





# QUALITY CALIBRATION CO.,LTD.

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

CERTIFICATE No : 22E9693

PAGE : 2 OF 3

## Calibration Report

EQUIPMENT : pH METER  
MANUFACTURER : HANNA  
ID No : pH 04/56  
RECEIVED DATE : 14-Sep-22  
AMBIENT TEMPERATURE : 20 ° C ± 1 ° C  
MODEL : HI 3512  
SERIAL NUMBER : TH118035  
CALIBRATION DATE : 15-Sep-22  
RELATIVE HUMIDITY : 50 % RH ± 10% RH

### CONDITION OF THIS RESULTS OF CALIBRATION

- THIS INSTRUMENT WAS CALIBRATED BY DIRECT MEASUREMENT METHOD BASED ON WL-TQ-062 AND WL-TQ-063. THE DISPLAY UNIT WAS TESTED BY GENERATING STANDARD VOLTAGE TO THE UNIT AND READ THE VALUE COMPARED WITH CALCULATED VALUE. THE DISPLAY AND ELECTRODE WAS CALIBRATED BY USING STANDARD pH BUFFER
- REFERENCE STANDARD INSTRUMENTS :-

#### INSTRUMENT

MODEL	SERIAL No/ LOT No	CERTIFICATE No	DUE DATE
1) pH STANDARD SOLUTION	00651-06	4880-12119147	05-Apr-23
2) pH STANDARD SOLUTION	00651-08	4881-12110709	31-Mar-23
3) pH STANDARD SOLUTION	00651-10	4882-12065386	17-Mar-23
4) PROCESS CALIBRATOR	CA150	22E1145	31-Mar-23
5) BATH	260014	1247 48074	13-Sep-23
6) THERMOMETER WITH PROBE	421504	55000379	13-Sep-23

- THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.
- THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

- 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

- 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	-0.171	0.14	2.0
354.95	355.6	-0.65	0.860	0.14	2.0
295.80	296.4	-0.60	1.892	0.14	2.0
236.64	237.2	-0.56	2.922	0.14	2.0
177.48	178.0	-0.52	3.954	0.14	2.0
118.32	118.8	-0.48	4.985	0.14	2.0
59.16	59.7	-0.54	6.016	0.14	2.0
0.00	0.5	-0.50	7.049	0.14	2.0
-59.16	-58.8	-0.36	8.136	0.14	2.0
-118.32	-117.9	-0.42	9.223	0.14	2.0
-177.48	-177.1	-0.38	10.311	0.14	2.0
-236.64	-236.3	-0.34	11.399	0.14	2.0
-295.80	-295.5	-0.30	12.487	0.14	2.0
-354.95	-354.7	-0.25	13.575	0.14	2.0
-414.11	-413.9	-0.21	14.662	0.14	2.0

END OF CALIBRATION REPORT PAGE 2 OF 3



# QUALITY CALIBRATION CO.,LTD.

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CERTIFICATE No : 22E9693

PAGE : 3 OF 3

## Calibration Report

### RESULT OF CALIBRATION (CONTINUE) :

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
4.007	4.007	0.000	3.996	0.012	2.0
7.004	7.006	-0.002	6.944	0.012	2.0
10.016	10.012	0.004	10.194	0.014	2.0

3. DISPLAY UNIT WITH TEMPERATURE

STANDARD READING (°C)	UUC READING (°C)	CORRECTION (°C)	VALUE BEFORE ADJUSTMENT	UNCERTAINTY OF MEASUREMENT (± °C)	COVERAGE FACTOR k
25.003	25.0	0.003	---	0.0085	2.0

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





# CALIBRATION LABORATORY Co., LTD.

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



NSC-TIS-17025  
CALIBRATION 0659  
CLC



Accredited  
ISO/IEC 17025  
CLC

# CALIBRATION LABORATORY Co., LTD.

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



NSC-TIS-17025  
CALIBRATION 0659  
CLC

## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : CONDUCTIVITY METER  
MANUFACTURER : METTLER TOLEDO  
MODEL / TYPE : SEVEN COMPACT S230  
SERIAL NO. : C141708983/5821320179  
CLID. NO. : 272300452  
JOB CONTROL NO. : 230211016445

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

DATE OF RECEIVED : 11 February 2023

DATE OF ISSUED : 15 February 2023

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

Calibrated By :

Sukgasem Sechanart  
Calibration Engineer



Approved By :

Mongkol Yotsoontorn  
Authorized Signatory

15 February 2023

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. Q23016445

F3-011-04/01-12

page 1 of 4



@cccalibration

## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : CONDUCTIVITY METER  
MANUFACTURER : METTLER TOLEDO  
MODEL / TYPE : SEVEN COMPACT S230  
SERIAL NO. : C141708983/5821320179  
DATE OF CALIBRATION : 13 February 2023

#### ENVIRONMENT CONDITIONS :

Temperature :  $(25 \pm 2.5)$  °C

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

#### PROCEDURE USED :

This instrument [ Conductivity Meter ] was calibrated under procedure No. WI-305-130. The calibration was performed by direct measurement with Certified Reference Material (CRM) and Reference Material (RM).

This instrument [ Temperature ] was calibrated under procedure No. WI-305-244. The calibration was performed by Comparison with Calibration Bath, Precision Thermometer and IPRT which maintained by the Calibration Laboratory Co., Ltd.

#### REFERENCE STANDARD USED :

1. Potassium Chloride Solution ( nominal 1.41 mS/cm , nominal 12.8 mS/cm )
2. Conductivity Solution , Hanna Product Code HI 7033L Lot Number 6436.
3. Calibration Bath, Kambie Model OB-22/2 ULT S/N. 17115653.
4. Precision Thermometer, ASL Model F250 S/N. 1334023800.
5. IPRT, ASL Model T100-250-1D S/N. L0193A-1-1.

Certificate No. Q23016445

F3-011-04/01-12

page 2 of 4



@cccalibration



# CALIBRATION LABORATORY Co., LTD.

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



NSC-TISI-TIS 17025  
CALIBRATION 0059  
CLC

## TRACEABILITY :

1. The measurements are traceable to International System of Units (SI), through Merck Co., Ltd.  
Certificate No. HC02139203 , HC04515254, Due Date 30 June 2023 , 30 November 2023.
2. The measurements are traceable to International System of Units (SI), through Hanna instruments.  
Certificate No. 12E12 , Due Date May 2024 .
3. The measurements are traceable to International System of Units (SI), through Calibration Laboratory Co., Ltd.  
Certificate No. Q22130792, Due Date 05 January 2024.
4. The measurements are traceable to International System of Units (SI), through Thailand Institute of Scientific and Technological Research (TISTR). Certificate No. PSL-T 0823/65, Due Date 22 August 2023.
5. The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand).  
Certificate No. TT-0166-22, Due Date 01 December 2023.

## UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor complies with the table which for a normal distribution corresponds to a coverage probability of approximately 95 %.

It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-402 M:2022)"

Certificate No. Q23016445

F3-011-04/01-12

page 3 of 4



@clcalibration



# CALIBRATION LABORATORY Co., LTD.

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



NSC-TISI-TIS 17025  
CALIBRATION 0059  
CLC

## CONDITION OF CALIBRATION ITEM : GOOD

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

The table in the following gives the calibration results and associated measurement uncertainties of Conductivity Meter.

### CALIBRATION DATA

#### 1. Conductivity Solution Test @ 25°C

Standard Conductivity Solution	DUC Reading	Uncertainty of Measurement	k Factor
*84.00 µS/cm	84.04 µS/cm [Cell Constant 0.548589]	± 1.00 µS/cm	2.00
1412.0 µS/cm	1413 µS/cm [Cell Constant 0.548589]	± 21.0 µS/cm	2.00
12.85 mS/cm	12.88 mS/cm [Cell Constant 0.573538]	± 0.19 mS/cm	2.00

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

The Scope of Accredited TISI Certificate No. 23-LB0092 Issue 01 Page 138 of 138

#### \*2. Temperature Result [ Probe Conductivity ]

Immersion depth (mm)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ± (°C)
100	25.00	25.0	0.00	0.07

Note. The reported uncertainty is based on a standard uncertainty multiplied by coverage factor of k = 2.00.

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

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

### End of Certificate ###

Certificate No. Q23016445

F3-011-04/01-12

page 4 of 4



@clcalibration



## Certificate of Calibration

Certificate No. : 66-400065-2

Page : 1 of 2

Submitted by :

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

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

Equipment :

Liquid in Glass Thermometer

Manufacturer : SK

Model : N/A

Range : 0 °C to 100 °C

Resolution : 1 °C

Serial No. : N/A

Immersion : Total

ID No. : TM21/59

Environment :

Ambient Temperature : (23 ± 2) °C

Relative Humidity : (50 ± 15) %

Line Voltage : (220 ± 22) VAC

Date of Received :

01 February 2023

Date of Calibration :

06 February 2023

Date of Issue :

06 February 2023

Calibrated by :

Chortip Samchusri

**Calibration Method :** This instrument was calibrated by In-house method comparison technique CAL-M4001 based on ASTM E77-07 by compared with PRT in the liquid bath at the constant controlled temperature.

The temperature scale used was based on ITS-90

**Reference Standard Instruments :** This certification is traceable to the International System of Units

1. Platinum Resistance Thermometer (PRT)

ID No. Cert. No. Due Date Traceability

400001 TT-0016-22 07 Feb 2024

National Institute of Metrology Thailand (NIMT)

2. Standard Digital Thermometer

ID No. Cert. No. Due Date Traceability

400003 21E1850 14 Jun 2023

National Institute of Metrology Thailand (NIMT)

400004 21E1850 14 Jun 2023

National Institute of Metrology Thailand (NIMT)

Approved by :

( Bunjerd Mastri )

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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



## Certificate of Calibration

Certificate No. : 66-400065-2

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

Ice point check : UUC\* reading 0 °C Standard reading 0.3606 °C

Standard Reading ( °C )	UUC Reading ( °C )	Correction ( °C )	Uncertainty ( ± °C )
20.3607	20	0.4	0.31

Remark

UUC : Unit Under Calibration

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

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

-o0o-

B/







TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3 : EQUIPMENT CALIBRATION AND TESTING SERVICES

53/4/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-29 FAX. 0-2719-9484

Cert.No.: 23CH432  
Page.: 1 of 2

## Certificate of Calibration

Equipment : Turbidity Meter  
Manufacturer : Eutech  
Model : Cyberscan WL TB1000  
Serial No. : 201802206  
ID. No. : TB 03/61  
Condition As-Received : Used Item  
Received Date : 29 March 2023  
Calibration Date : 30 March 2023  
Reference : 2303-1034WN-1

Submitted by : S.P.S. Consulting Service Co.,Ltd.  
7 Phaholyothin 24, Phaholyothin Road.,  
Jompol, Chatuchak, Bangkok 10900

Ambient Temperature : (25 ± 2.5) °C  
Relative Humidity : (50 ± 20) %  
Calibration Procedure : In - house method : CP-CH11  
based on direct measurement by  
using Formazin standard solution

Calibrated by : Walalak Sirthean

Approved by :  Approved Signatory

( ) Malee Butkruea  
( ) Saithip Meangmai  
( ) Warakorn Lerngagtrakul

Issue Date : 31 March 2023

The Uncertainties are for a confidence probability of approximately 95%.

This certificate may not be reproduced other than in full, except with the prior written approval of the head of Calibration and Testing Equipment Services.

A 0010867



Cert.No. : 23CH432  
Page. : 2 of 2

### Condition of this calibration result

1. Reference Standard Instruments :

This certification is traceable to the International System of unit (SI unit) through Technology Promotion Association (Thailand-Japan).

Instruments	Serial No.	ID No.	Certificate No.	Due date
1) Thermo-Hygrograph	1103328	130EC010	22H1313	12 June 2023
2) Electronic Balance	N03679	140RC001	22MM49	20 Sep 2023

2. Standard Material : The Formazin suspension has been prepared gravimetric from

Material	Manufacturer	Lot No.	Assay
1) Hexamethylenetetramine	HIMEDIA	0000493947	99.65%
2) Hydrazinium Sulfate	HIMEDIA	0000522014	99.40%

3. This certificate is valid only to the item calibrated on date and place of calibration.

### Calibration result

Performing three - Formazin suspension standard curve by using 0,10,1000 NTU  
Turbidity Meter Serial Number : 201802206

Standard Formazine suspension ( NTU )	UUC* Reading ( NTU )	Uncertainty of Measurement ( ± NTU )	Coverage Factor k
20	19.3	0.38	2.00
40	39.0	0.40	2.00
100	99.2	0.70	2.00
400	391	1.5	2.00

Remark  
- UUC\* = Unit Under Calibration  
- NTU = Nephelometric Turbidity Units

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

-o0o-



a 1155462





### Certificate of Calibration

EQUIPMENT	:	DIGITAL BALANCE
MANUFACTURER	:	METTLER TOLEDO
MODEL	:	XS105DU
SERIAL No	:	1126422905
ID No	:	BA 05/50
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	:	10-Mar-23
APPROVED BY	:	 PONGSAK J.
ISSUED DATE	:	16-Mar-23
RECEIVED DATE	:	10-Mar-23

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



### Calibration Report

EQUIPMENT	:	DIGITAL BALANCE	MODEL	:	XS105DU
MANUFACTURER	:	METTLER TOLEDO	S/N	:	1126422905
ID No	:	BA 05/50	RECEIVED DATE	:	10-Mar-23
AIR PRESSURE	:	1010mbar $\pm$ 1mbar	CALIBRATION DATE	:	10-Mar-23
AMBIENT TEMPERATURE	:	23°C $\pm$ 1°C	RELATIVE HUMIDITY	:	49 %RH $\pm$ 10 % RH

#### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.
2. REFERENCE STANDARD INSTRUMENTS :-  
1) STANDARD WEIGHT SET E2  
2) STANDARD WEIGHT E2  
3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.  
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.  
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-  
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

#### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL
2. TARE FUNCTION : NORMAL
3. REPEATABILITY OF READING AT 200 g WAS 0 g
4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY ( $\pm$ g)
0.00	0.00000	0.00000	0.000039
0.02	0.02000	0.00000	0.000039
0.10	0.10000	0.00000	0.000039
0.20	0.20001	-0.00001	0.000040
0.50	0.50001	-0.00001	0.000040
1.00	1.00000	0.00000	0.000041
2.00	2.00003	-0.00003	0.000042
5.00	5.00001	-0.00001	0.000046
10.00	10.00003	-0.00003	0.000053
20.00	20.00005	-0.00005	0.000067
50.00	50.00001	-0.00001	0.00011
100.00	100.0001	-0.0001	0.00019
200.00	200.0001	-0.0001	0.00032

#### 5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.0000
2	50.0001
3	50.0000
4	50.0000
5	49.9999
OFF-CENTER LOADING	0.0001

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





## QUALITY CALIBRATION CO.,LTD.

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



## QUALITY CALIBRATION CO.,LTD.

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

CERTIFICATE No : 22TI0972  
REFERENCE No : 66837-1

PAGE : 1 OF 3

### Certificate of Calibration

EQUIPMENT : COD REACTOR  
MANUFACTURER : HACH  
MODEL : DRB 200  
SERIAL No : 15110C0497  
ID No : DRB 04/59  
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 : 20-Dec-22

APPROVED BY :  PONGSAK J.  
ISSUED DATE : 20-Dec-22  
RECEIVED DATE : 20-Dec-22

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

F-G010 REV : 02

CERTIFICATE No : 22TI0972

PAGE : 2 OF 2

### Calibration Report

EQUIPMENT : COD REACTOR  
MANUFACTURER : HACH  
ID NUMBER : DRB 04/59  
RECEIVED DATE : 20-Dec-22  
AMBIENT TEMPERATURE : 23°C ± 1°C  
MODEL : DRB 200  
SERIAL NUMBER : 15110C0497  
CALIBRATION DATE : 20-Dec-22  
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 22TI7511 10-Jul-23  
3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.  
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.  
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-  
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

#### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

BLOCK No.1 FRONT					BLOCK No.2 FRONT				
13	14	15	13	14	15	13	14	15	13
10	11	12	10	11	12	10	11	12	10
7	8	9	7	8	9	7	8	9	7
4	5	6	4	5	6	4	5	6	4
1	2	3	1	2	3	1	2	3	1

#### TEMPERATURE MEASUREMENT ACCURACY TEST

Block No.	1	2
Controller temperature (°C)	145	145
Indicating Temperature	145	145
Measured Temperature (°C) at Spread Locations	1	149.8
	2	149.6
	3	149.7
	4	149.8
	5	149.9
	6	149.8
	7	149.8
	8	150.1
	9	149.8
	10	149.9
	11	149.8
	12	149.7
	13	149.9
	14	149.8
	15	149.7
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 MULTIPLIED BY A COVERAGE FACTOR k=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.  
END OF CALIBRATION REPORT

F-G010 REV : 02





Harikul Science Co., Ltd.  
694 Soi Ratchadaniwet 24, Pracharabamphen,  
Samsaenok, Huaihwang, Bangkok 10310  
Tel: 0-2274-2456 Fax: 0-2274-2443  
Email: info@harikul.com www.harikul.com  
Certificate of Calibration

CERT No.: HS-U017D

Calibration Date : 3 Apr 23

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: E00522

Barometric ref : S/N: E00522

Water Temp ref : S/N: 11431

Technician : Kittipong M.

#### 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)	9.08	(PASS)	-
Measurement 5 (mg/l)	9.08	(PASS)	-
Measurement 6 (mg/l)	9.08	(PASS)	-
Measurement 7 (mg/l)	9.08	(PASS)	-
Measurement 8 (mg/l)	9.08	(PASS)	-
Measurement 9 (mg/l)	9.08	(PASS)	-
Measurement 10 (mg/l)	9.08	(PASS)	-

Mean Measurement	9.08	mg/l	-
Inaccuracy	0.01	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 Pisakunchon)

## SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd, Bangbunru, Bangplud Bangkok 10700 THAILAND.

Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiphorn.com http://www.sithiphorn.com

NSC-TSI-TIS 17025

CALIBRATION 0394

Cert. No. : SP22018

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,  
CHOMPON, CHATUCHAK,  
BANGKOK 10900, THAILAND.

Location : ORGANIC LABORATORY IV

Ambient Temperature : ( 24.4 ± 5 ) °C

Relative Humidity : ( 60.1 ± 25 ) %

Received Date : 30 AUGUST 2022

Calibration Date : 30 AUGUST 2022

Date of Issue : 31 AUGUST 2022

Calibrated by :

Nathakorn Pisutpaisan

Approved by :

T. Petchurai  
( Thanakul Petchurai )

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.

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : SP22018  
Job No. : VC65SP0008  
Pages : 2 of 3

**Calibration Method :**

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

**Condition of this result of calibration :**

1. Certified reference materials
 

Material	Ref. type	Cell serial No.	Cert. No.	Due Date
Holmium liquid	RM-HL	29706	87569	13/10/2022
Didymium liquid	RM-DL	28912	87588	15/10/2022
Neutral density filter	RM-IN2N3N	13877	87600	15/10/2022
Potassium dichromate solutions	RM-0204060810	14204	87614	16/10/2022
Potassium Iodide solution	-	KI-0701-001	CI-0090-22	08/04/2024
2. This result of calibration was found accurate as shown on date and place of calibration only.
3. This certificate is traceable to the international system of unit maintained at :
  - 3.1 The UK National Physical Laboratory (NPL)
  - 3.2 The National Institute of Standards and Technology, NIST.

**Result of calibration : Wavelength Accuracy**

(Without adjustment)

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

UUC\* = Unit Under Calibration

Continuation of Calibration Certificate

Cert. No. : SP22018  
Job No. : VC65SP0008  
Pages : 3 of 3

**Result of calibration : Photometric Accuracy**

(Without adjustment)

Material	Wavelength (nm)	Filter S/N	Nominal Absorbance (A)	Certified Absorbance (A)	UUC* Reading Absorbance (A)	Error (A)	Uncertainty ± (A)	k Factor
Neutral Density glass filter	440.0	29360	1.0	1.0524	1.0539	0.0015	0.0028	2.00
		29914	0.7	0.7454	0.7459	0.0005	0.0029	2.00
		29381	0.5	0.5426	0.5426	0.0000	0.0028	2.00
	546.1	29360	1.0	0.9822	0.9810	-0.0012	0.0028	2.00
		29914	0.7	0.6962	0.6960	-0.0002	0.0028	2.00
		29381	0.5	0.5076	0.5070	-0.0006	0.0029	2.00
	590.0	29360	1.0	1.0221	1.0202	-0.0019	0.0028	2.00
		29914	0.7	0.7238	0.7230	-0.0008	0.0029	2.00
		29381	0.5	0.5364	0.5360	-0.0004	0.0031	2.00
	635.0	29360	1.0	0.9751	0.9732	-0.0019	0.0028	2.00
		29914	0.7	0.6912	0.6902	-0.0010	0.0029	2.00
		29381	0.5	0.5214	0.5210	-0.0004	0.0032	2.00
Material	Wavelength (nm)	Solution (mg/l)	Certified Absorbance (A)	UUC* Reading Absorbance (A)	Error (A)	Uncertainty ± (A)	k Factor	
RM-0204060810		20	0.2436	0.2419	-0.0017	0.0101	2.00	
		40	0.4905	0.4855	-0.0050	0.0115	2.00	
	235.0	60	0.7453	0.7388	-0.0065	0.0067	2.00	
	80	0.9920	0.9839	-0.0081	0.0071	2.00		
	100	1.2487	1.2414	-0.0073	0.0073	2.00		

UUC\* = Unit Under Calibration

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

Resolution of Wavelength Mode 0.1 nm  
Resolution of Photometric Mode 0.0001 A

Parameter Setting	Wavelength, Absorbance
Measurement Mode	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

\*\*Specific Acceptance :

Transmission  $\leq 1.0$  T(%) Absorbance  $\geq 2.0$  A

\*\*Stray light not TISI Accredited

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

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



**MAINTENANCE AND TEST CERTIFICATE MODEL**  
**OPTIMA 5300DV**

<b>Customer :</b>	S.P.S.Consulting Service Co.,Ltd	<b>Date Tested:</b>	January 11, 2023
<b>Address :</b>	7 Soi Phaholyothin 24 Phaholyothin Road Jompol Chatuchak, Bangkok 1090	<b>Recommendation Recertification</b>	
<b>User Name:</b>	K.Phenpha Vipasthawatt	<b>Period</b>	6 Months
<b>Phone:</b>	083-9269252	<b>Recertification Due:</b>	July 11, 2023
<b>Fax:</b>	02-513-4221	<b>Date Last Certified:</b>	July 11, 2022
		<b>Visit Number:</b>	2 of 2
		<b>PerkinElmer Phone:</b>	02-719-6420 ext 206
		<b>PerkinElmer Fax:</b>	02-318-5597



**MAINTENANCE AND TEST CERTIFICATE MODEL**  
**OPTIMA 5300DV**

<b>SERIAL NUMBER</b>	077C7042401	<b>DATE TESTED</b>	January 11, 2023
<b>1. MECHANICAL CHECKS</b>			
A. Inspect and clean all fans and filters.			
B. Inspect and replace as necessary, all torch components including the RF coll.			
C. Inspect all tubing for sign of clacking or leaking.			
D. Adjust water and gas pressure regulator settings.			
E. Inspect and leak check pneumatics drawers.			
F. Clean the exterior of the instrument.			
<b>2. OPTICAL CHECKS</b>			
A. Inspect and clean all optical components.			
B. As required, check and replace all purgefilters.			
C. Recheck optical alignment.			
<b>3. COOLING SYSTEM CHECKS</b>			
A. Perform preventive maintenance on chiller.			
B. Flush out the chiller every year.			
<b>4. PERFORMANCE CHECKS</b>			
A. Torch View Alignment.			
B. Wavelength Calibration.			

<b>CONFIGURATION TESTED</b>		<b>ACCESSORIES/COMPONENT NOT INCLUDED</b>	
<b>MODEL</b>	OPTIMA 5300DV	<b>SERIAL NUMBER</b>	077C7042401
<b>TESTED EQUIPMENT</b>	IPV Methods	<b>CALIBRATION NUMBER</b>	
<b>TEST STANDARD USED</b>	Multielement Standard	<b>EXPIRATION</b>	
<b>CUSTOMER SUPPLIED</b>	2 % HNO3	<b>EXPIRATION DATE</b>	May 30, 2023
	10 % HNO3		February 28, 2023
			August 30, 2023
			November 30, 2023
		<b>CUSTOMER INITIALS</b>	



MAINTENANCE AND TEST CERTIFICATE MODEL  
OPTIMA 5300DV

SERIAL NUMBER : 077C7042401		DATE TESTED : January 11, 2023	
PARAMETER	SPECIFICATION	FINAL VALUE	
Spectral Resolution : UV	As 193.696 nm	≤ 0.007	0.00504
	Ni 231.604 nm	≤ 0.008	0.00646
	Ni 341.476 nm	≤ 0.012	0.00768
Spectral Resolution : VIS	La 408.672 nm	≤ 0.020	0.01597
	Ba 455.403 nm	≤ 0.025	0.02185
Precision	As 193.656 nm	% RSD < 1.0	0.89 %
	Zn 213.856 nm	% RSD < 1.0	0.77 %
	Mn 257.610 nm	% RSD < 1.0	0.51 %
	La 379.478 nm	% RSD < 1.0	0.44 %
	Ba 455.403 nm	% RSD < 1.0	0.44 %
	Ba 493.408 nm	% RSD < 1.0	0.46 %
Detection Limits : Axial	Tl 190.080 nm	3(sd)	4.04 ppb
	As 193.696 nm	3(sd)	3.58 ppb
	Pb 220.353 nm	3(sd)	1.90 ppb
Detection Limits : Radial	As 193.696 nm	3(sd)	47.72 ppb
	Zn 213.856 nm	3(sd)	1.02 ppb
	Mn 257.610 nm	3(sd)	0.68 ppb
	La 379.478 nm	3(sd)	1.43 ppb
	Ba 455.403 nm	3(sd)	0.10 ppb
	Ba 493.408 nm	3(sd)	0.36 ppb
BEC : Axial (IB X 500)/(IS-IB)	Cd 226.502 nm	≤ 150 ppb	58.36
BEC : Radial (IB X 1000)/(IS-IB)	Mn 257.610 nm	≤ 45 ppb	104142.80



MAINTENANCE AND TEST CERTIFICATE MODEL  
OPTIMA 5300DV

SERIAL NUMBER	077C7042401	DATE TESTED	January 11, 2023
Remarks :	Commissioning follow as commissioning performance sheets.		
This is to certify that the above tests have been performed and the configuration tested			
<div><input checked="" type="checkbox"/> meets</div> <div><input type="checkbox"/> does not meet</div>			
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	<div><div>Wiphan Promlumda</div><div>Service Engineer</div></div>		





## CALIBRATION CERTIFICATE

Certificate No. : S2022090647-0003  
 Date Issued : 03-Oct-22

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

**Equipment** : Incubator

**Manufacturer** : BINDER  
**Model** : BD 115  
**Serial No.** : 12-16967  
**ID No./Tag No.** : IN 05/56  
**Date Received** : 30-Sep-22  
**Date Calibrated** : 30-Sep-22

**Calibrated by** : Mr. Surat Aumarb

Calibration Method or Calibration Procedure Used

Standard method : CP-05 TLAS G-20.

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.

Approved by: *Sarayuth T.*  
 ( Mr. Sarayuth Tochua )

Page 1 of 2



Certificate No. : S2022090647-0003

**Environment :** Ambient Temperature : Start record 26.5 °C, Stop record 26.6 °C  
 Relative Humidity : Start record 54.8 %RH, Stop record 54.6 %RH

Calibration Temperature (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Stability <sup>1</sup> (°C)	Measured Uniformity <sup>2</sup> (°C)	Overall Variation <sup>3</sup> (°C)
35	35.0	35.0	0.03	0.07	0.14
41.5	41.5	41.5	0.03	0.08	0.15

Without adjustment

Calibration Temperature (°C)	STD No. 1 (°C)	STD No. 2 (°C)	STD No. 3 (°C)	STD No. 4 (°C)	STD No. 5 (°C)	STD No. 6 (°C)	STD No. 7 (°C)	STD No. 8 (°C)	STD No. 9 (°C)	STD Uncertainty <sup>4</sup> (°C)
35	34.88	34.86	34.89	34.90	34.93	34.92	34.95	34.89	34.93	0.18
41.5	41.40	41.33	41.32	41.41	41.43	41.43	41.38	41.33	41.37	0.18

Note : Probe No. 9 is Reference Probe

Setting Air Fresh No. 0



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. AD2207-125-0001 for Digital Thermometer with Probe (Agilent) Module 1 (73) NTC, Pt1000 Serial No. MY44024042, Due 01-Feb-23

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.

5. The temperature uniformity, stability, overall variation and indicating temperature is applicable to all air or gas filled temperature controlled enclosures at atmospheric pressure.

End of Certificate



PinAAcle 900T Preventive Maintenance (PM)				
Company Name:	SPS CONSULTING SERVICE CO.,LTD.			
Address (Instrument Location):	7 SOI PHAHOLYOTHIN 24,PHAHOLYOTHIN RD. JOMPOL,CHATUCHAK, BANGKOK 10110			
Serial Number:	PTCS14111103	PM Number:	1-2	
Customer Name (if applicable):	K. PHENPHA	Telephone Number:	083-926-9252	
Customer Support Engineer Name:	K. DUANG	Service Order Number:	WO-02044564	
Date PM Performed: (DD-MMM-YYY)	06-Jan-2023	Next PM Due Date: (DD-MMM-YYY)	06-Jul-2023	
Standard Labor Hours to Complete PM :			5 hours	

Part Number	Release	Publication Date
09370143 Rev.9	A	January 2018



**Scope**  
The purpose of this PM is to ensure the continued functionality of the PinAAcle 900T by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer.  
The customer should save their method before the PM begins.

**General Instructions:**  
The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM. Always check with the customer before making any changes that may affect the customer's analysis 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 #	Configuration Notes
AS900	AS9S14B1002	WINLAB 32

Parts Lists

Parts Included with the PM		
Part Number (if applicable)	Description	Quantity
B0501696	Fan Filters	2
B3002013	THGA Contact Cylinders	1
B3141064	Glycerol for THGA Cooling	N/A
N3160156	O-Ring Kits for Sampling Introduction ( Stainless Steels Nebulizer)	N/A
N3160157	O-Ring Kits for Sampling Introduction ( Plastic Nebulizer)	2
N9301714	Replacement Acetylene Filter Cartridge	1
TH001022	Replacement Air Filter Cartridge	2

Additional Reagents and Standards Required for PM			
Part Number (if applicable)	Description	Quality	Batch/Lot #  Expired Date (MM/YY)
N9300183	1000 mg/L Copper Standard	AR	26-87CUY1 30-Jan-2024
N9300244	GFAAS Mixed Standard	AR	56-021CRY1 30-Jun-2023

Additional Reagents and Standards Required for PM (Customer Support Solution)			
Part Number (if applicable)	Description	Quantity	Batch/Lot #  Expiration Date (MM/YY)
N/A	DI Water	250 ml.	AR AR
N/A	0.5% HNO <sub>3</sub>	250 ml.	AR AR

Additional Tools Required for PM			
Part Number (if applicable)	Description	Quantity	Serial #
N1013000	0.2A Neutral density filter	1	MGO-252
N1013002	1.0A Neutral density filter	1	MG2-358
B3100652 Or N9307029	Electronic Flow Meter	1	NA
B0505495	Test Jig	1	NA
03030997	System 2 EDL Driver	1	03030997
N3050605	As System 2 EDL	1	16148
N3050121	Cu Lumina HCL	1	092216-010130
N3050109	Ba Lumina HCL	1	102416-040160
N3050139	K Lumina HCL	1	110716-010060
N3050152	Ni Lumina HCL	1	100516-030190
N3050119	Cr Lumina HCL	1	091911-020150

## Procedure Checklist

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

### 1. General:

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

### 2. PC Instrument Software:

- ☒ Instrument Software user files/databases archived, packed, and/or deleted as needed.

### 3. Mechanical:

- ☒ Inspect and clean all fans and filters. Replace filters if necessary
- ☒ Inspect all gas and water lines for leaks and/or wear. Replace if needed. Thoroughly inspect all quick connects. Replace the Y connector. P/N 09921079, if needed.
- ☒ Clean exterior of the instrument.

#### 3.1 Flame Technique

- ☒ Inspect the burner head, burner chamber, and nebulizer. Clean if needed as stated in the Hardware Guide.
- ☒ Check burner head dimensions with the feeler gauge as stated in the Hardware Guide in the Maintenance chapter section on cleaning the burner head and checking sloth width. Replace if out of specification
- ☒ Check the condition of the end cap, burner head, and nebulizer O-rings. Replace if necessary.
- ☒ Check the drain system for signs of wear. Replace worn or damaged parts.
- ☒ Visually check for proper flame conditions when igniting the Air-C2H2 and N2O-C2H2 flames (if applicable).

#### 3.2 THGA Technique

- ☒ Inspect the pole pieces and clean where the pole pieces contact the furnace. Replace the pole piece p-rings as needed. P/N's B0501018 & B0501250. Grease the O-rings as needed with Apiezon L grease. P/N 09905148
- ☒ Inspect the four insulation pads on the front contact housing of the THGA in furnace. If the pads are missing replace the THGA furnace or replace the insulator pads on the furnace.
- ☒ Inspect the graphite tube and clean the contact cylinders. Replace if necessary.
- ☒ Check internal and external gas flows with the Electronic Gas Flow Meter and the Gas Flow Test Probe as described in the Service Manual. Correct if necessary.
- ☒ Check furnace open/close function.
- ☒ Verify the operation of the GFTV Camera for proper operation and viewing alignment in the furnace camera Tube View window. Align if needed.
- ☒ Check the operation of the Halogen Light ASSY for the GFTV Camera. Replace if needed.
- ☒ Check the water level/quality in the recirculation (if applicable). Add distilled water if necessary.
- ☒ Check the cooling system fluid flow rate with the FCS In-Line Flow Meter for proper levels if needed. Refer to SDB# COSY008.STN

8. After PIM Performance tests [Flame]:

8.1 Detector Linearity with Barium

Description: Ensures that the detector is linear in the Visible Range.

Parameter	Specification	Certificate Value at 553.6 nm (Abs.)	Test Results	Pass/Fail
1.0 A ND Filter	± 5% from Cert.	0.9798	0.1982	Passed
0.2 A ND Filter	± 5% from Cert.	0.2042	0.9942	Passed

8.2 Baseline Noise at 1.0 Absorbance with Barium

Description: Ensures that a high absorbance will not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0014	Passed

8.3 AA Baseline Noise with Copper

Description: Check baseline noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.001	0.0001	Passed

8.4 D<sub>2</sub> Background Compensation with Copper

Description: Verifies the instruments ability to compensate for Background absorption.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0083	Passed

8.5 AA-BG Baseline Noise with Copper

Description: Ensures that background correction does not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0002	Passed
8. After PIM Performance tests [Flame]:

8.1 Detector Linearity with Barium

Description: Ensures that the detector is linear in the Visible Range.

Parameter	Specification	Certificate Value at 553.6 nm (Abs.)	Test Results	Pass/Fail
1.0 A ND Filter	± 5% from Cert.	0.9798	0.1982	Passed
0.2 A ND Filter	± 5% from Cert.	0.2042	0.9942	Passed

8.2 Baseline Noise at 1.0 Absorbance with Barium

Description: Ensures that a high absorbance will not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0014	Passed

8.3 AA Baseline Noise with Copper

Description: Check baseline noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.001	0.0001	Passed

8.4 D<sub>2</sub> Background Compensation with Copper

Description: Verifies the instruments ability to compensate for Background absorption.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0083	Passed

8.5 AA-BG Baseline Noise with Copper

Description: Ensures that background correction does not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0002	Passed
4. Electrical:

Inspect PC boards. Clean if necessary.

Carefully check all internal and external cable connections.

Check instrument firmware revisions upgrade to current levels (if necessary)

Run Diagnostics Test within the Advanced function of the Spectrometer page. Check the results in the service log folder in the Spectrometer BM Log Viewer.

5. Optics:

Inspect and clean the sample compartment windows, if needed.

Inspect and clean the furnace windows, if needed.

Inspect and clean the GFTV camera lens, if needed.

Inspect optics. Clean or replace if necessary.

6. Gasses:

Verify that the Gasses supplied to the instrument are within the pressure and purity specifications found in the PinAAcle 900 Series Pre-Installation Checklist SDB.

Verify that the air filter element is dry. Replace if necessary.

7. Flame Interlock Check:

Description: Check to ensure that all safety interlocks are closed.

Parameter	Specification	Test Results	Pass/Fail
Flame Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Drain Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Nebulizer Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
C <sub>2</sub> H <sub>2</sub> Pressure Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Air Pressure Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Burner Head Sensor	Choosing Nitrous Oxide as the oxidant should trigger an interlock shuts down	Active	Passed
- PinAAcle 900T Preventive Maintenance (PM)
- Page 5 of 9
- PinAAcle 900T Preventive Maintenance (PM)
- Page 6 of 9

8.6 AA-BG Baseline Noise with Arsenic

Description: Ensures that background correction does not produce excessive noise at a low wavelength.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0021	Passed

8.7 Flame Sensitivity

Description: Instrument Sensitivity checked against Copper standard.

Standard Copper Sensitivity	Specification	Results (Abs.)	Pass/Fail
5 mg/L Sensitivity SS Neb (if applicable)	> 0.250 Abs.	NA	Not Applicable
2 mg/L Sensitivity HS Neb (if applicable)	> 0.250 Abs.	0.3281	Passed

9. After PM Performance tests [THGA]:

9.1 Furnace Gas Flows

Description: Ensures the flow rates are within specification.

Parameter	Specification	Test Results	Pass/Fail
Internal Flow Rate	250 mL/min ± 25 mL/min	255	Passed
External Flow Rate	100 mL/min ± 10 mL/min	105	Passed

9.2 Chromium Baseline Noise

Description: Signal to noise check.

Parameter	Specification	Results	Pass/Fail
Baseline Noise	≤ 0.005 Abs.	0.0000	Passed
Standard Deviation	≤ 0.005	0.0002	Passed

9.3 Chromium Characteristic Mass and Precision

Description: Calculate the characteristic mass using the characteristic mass tool and precision from the integrated absorbance values.

Parameter	Specification	Results	Pass/Fail
Cr m <sub>0</sub> Results	≤ 7.0 pg/0.0044 A-s	5.7	Passed
Precision	≤ 2.0 %	0.74	Passed

9.4 Copper Characteristic Mass and Zeeman Ratio

Description: Calculate the characteristic mass using the characteristic mass tool and check the Zeeman Ratio.

Parameter	Specification	Results	Pass/Fail
Cu m <sub>0</sub> Result	≤ 16.5 pg/0.0044 A-s	12.3	Passed
Zeeman Ratio	0.52 ± 0.04	0.54	Passed

10. Review:

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

## Additional Comments

### Additional Comments Regarding the PM

Zeeman Ratio =  $\frac{\text{Atomic Signal (Peak area)}}{\text{Atomic Signal (Peak area)} + \text{Background Signal (Peak area)}}$

0.1855

=  $0.1855 \div 0.1563$

= 0.54

REPLACE PM KIT

## Review

The preventive maintenance checks and if applicable performance tests for PinAAcle 900T have been completed.

This PinAAcle 900T Passes ☒ Fails ☐ the preventive maintenance.

### Review of Preventive Maintenance:

Authorized PerkinElmer Representative:	Pang	Date: 06-Jan-2023 (DD-MM-YYYY)
Authorized Customer Representative:	ศิริสมณ	Date: 06-Jan-2023 (DD-MM-YYYY)

Heat Stress WBGT Meter Verification Report					
Verification Data					
Heat Stress WBGT Meter No. : B28		Verification Date : 17 April 2023			
Brand : 3M	Ambient Temp. : 24.5 °C				
Model : QUESTemp 32	Barometric Pressure : 1011 mmbar				
Serial No. : TPH050046	Relative Humidity : 49 %				
Verification Module (Electronic Sensor Check) :					
Verification Module No. : 21		WB = 12.5 °C , DB = 47.1 °C , G = 69.3 °C			
Result of Verification : Without Adjustment					
Wet Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
12.5	12.5	0.0	± 0.5		
Dry Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
47.1	47.0	0.1	± 0.5		
Globe Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
69.3	69.2	0.1	± 0.5		
UUC* = UNIT UNDER CALIBRATION					

Verified by :

Adul Dangklom

(Mr. Adul Dangklom)

Approved by :

(Mr. Peera Detudom)





# CALIBRATION LABORATORY Co., LTD.

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NSC-TS-17025  
CALIBRATION 0659  
CLC



# CALIBRATION LABORATORY Co., LTD.

2/10-11, 14, 55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230  
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NSC-TS-17025  
CALIBRATION 0659  
CLC

## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)  
MANUFACTURER : 3M  
MODEL / TYPE : QUESTemp<sup>32</sup>  
SERIAL NO. : TPH050046  
CLID. NO. : 231801943  
JOB CONTROL NO. : 221028109979

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

7 SOI PHAHOLYOTHIN 24 ROAD., JOMPOL,  
CHATUCHAK, BANGKOK 10900

DATE OF RECEIVED : 28 October 2022

DATE OF ISSUED : 31 October 2022

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

Calibrated By :

Oranut Kamchatphai  
Calibration Engineer



Approved By :

Mongkol Yotsoontorn  
Authorized Signatory

31 October 2022

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

Certificate No. Q22109979

F3-011-04/01-12

page 1 of 3



@clccalibration

## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)  
MANUFACTURER : 3M  
MODEL / TYPE : QUESTemp<sup>32</sup>  
SERIAL NO. : TPH050046  
DATE OF CALIBRATION : 29 October 2022

### ENVIRONMENT CONDITIONS :

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

### PROCEDURE USED :

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

### REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, Edgetech Model Dew Master S/N. 44602.  
Temperature & Humidity Chamber, PGC Model 9141-5116 S/N. 1304261.

### TRACEABILITY :

The measurements are traceable to International System of Units (SI), through Thunder Scientific Corporation. Certificate No. 19944, Due Date 26 January 2023.

### UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k = 2.00$  which for a normal distribution corresponds to a coverage probability of approximately 95 %. It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2012)"

Certificate No. Q22109979

F3-011-04/01-12

page 2 of 3



@clccalibration

**CONDITION OF CALIBRATION ITEM : GOOD**

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

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

**CALIBRATION DATA**

**1. CORRECTION OF TEMPERATURE : WET**

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

**2. CORRECTION OF TEMPERATURE : DRY**

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

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

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

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

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

### End of Certificate ###

Certificate No. Q22109979

F3-011-04/01-12

page 3 of 3



@cccalibration

Heat B057\_2/23

**Heat Stress WBGT Meter Verification Report**

Verification Data					
Heat Stress WBGT Meter No.	: B30	Verification Date	: 17 April 2023		
Brand	: 3M	Ambient Temp.	: 24.5 °C		
Model	: QUESTemp 32	Barometric Pressure	: 1011 mmbar		
Serial No.	: TPI050057	Relative Humidity	: 49 %		
Verification Module (Electronic Sensor Check) :					
Verification Module No. :	21	WB = 12.5 °C , DB = 47.1 °C , G = 69.3 °C			
Result of Verification : Without Adjustment					
Wet Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
12.5	12.6	-0.1	± 0.5		
Dry Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
47.1	47.1	0.0	± 0.5		
Globe Probe Temperature Measurement					
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)		
69.3	69.1	0.2	± 0.5		
UUC* = UNIT UNDER CALIBRATION					

Verified by :

  
(Mr. Abdul Dangklom)

Approved by :

  
(Mr. Pera Detudom)





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NSC-TS-1755  
CALIBRATION 0659  
CLC

## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)  
MANUFACTURER : 3M  
MODEL / TYPE : QUESTemp<sup>32</sup>  
SERIAL NO. : TPH050057  
CLID. NO. : 231801945  
JOB CONTROL NO. : 221028109977

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

DATE OF RECEIVED : 28 October 2022

DATE OF ISSUED : 31 October 2022

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

Calibrated By :

Oranut Kamchatphai  
Calibration Engineer



Approved By :

Mongkol Yotsontorn  
Authorized Signatory

31 October 2022

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

Certificate No. Q22109977

F3-011-04/01-12

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NSC-TS-1755  
CALIBRATION 0659  
CLC

## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)  
MANUFACTURER : 3M  
MODEL / TYPE : QUESTemp<sup>32</sup>  
SERIAL NO. : TPH050057  
DATE OF CALIBRATION : 29 October 2022

### ENVIRONMENT CONDITIONS :

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

### PROCEDURE USED :

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

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

### REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, EdgeTech Model Dew Master S/N. 44602.

Temperature & Humidity Chamber, PGC Model 9141-5116 S/N. 1304261.

### TRACEABILITY :

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

Certificate No. 19944, Due Date 26 January 2023.

### UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k = 2.00$  which for a normal distribution corresponds to a coverage probability of approximately 95 %. It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2021)"

Certificate No. Q22109977

F3-011-04/01-12

page 2 of 3



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## CONDITION OF CALIBRATION ITEM : GOOD

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

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

#### CALIBRATION DATA

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

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ± (°C)
30.0	30.01	30.1	-0.09	0.40
35.0	35.00	35.1	-0.10	
40.0	40.01	39.8	+0.21	

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

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ± (°C)
30.0	30.01	30.0	+0.01	0.40
35.0	35.00	35.1	-0.10	
40.0	40.01	39.9	+0.11	

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

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ± (°C)
30.0	30.01	30.1	-0.09	0.40
35.0	35.00	35.1	-0.10	
40.0	40.01	39.8	+0.21	

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

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

### End of Certificate ###

Certificate No. Q22109977

F3-011-04/01-12

page 3 of 3



@cdcalibration

Heat B057\_3/23

## Heat Stress WBGT Meter Verification Report

### Verification Data

Heat Stress WBGT Meter No.	: B31	Verification Date	: 17 April 2023
Brand	: 3M	Ambient Temp.	: 24.5 °C
Model	: QUESTemp®32	Barometric Pressure	: 1011 mmbar
Serial No.	: TP1050047	Relative Humidity	: 49 %

### Verification Module (Electronic Sensor Check) :

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

### Result of Verification : Without Adjustment

#### Wet Probe Temperature Measurement

Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
12.5	12.5	0.0	± 0.5

#### Dry Probe Temperature Measurement

Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
47.1	47.0	0.1	± 0.5

#### Globe Probe Temperature Measurement

Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
69.3	69.2	0.1	± 0.5

UUC\* = UNIT UNDER CALIBRATION

Verified by :

Adul Dangklom

(Mr. Adul Dangklom)

Approved by :

Perera Detudom

(Mr. Perera Detudom)



# CALIBRATION LABORATORY Co., LTD.

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NSC-TISI-TIS 17025  
CALIBRATION 0059  
CLC



NSC-TISI-TIS 17025  
CALIBRATION 0059  
CLC

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NSC-TISI-TIS 17025  
CALIBRATION 0059  
CLC

## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)  
MANUFACTURER : 3M  
MODEL / TYPE : QUESTemp<sup>o</sup>32  
SERIAL NO. : TPH050047  
CLID. NO. : 231801946  
JOB CONTROL NO. : 221028109982

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

DATE OF RECEIVED : 28 October 2022

DATE OF ISSUED : 31 October 2022

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

Calibrated By :

Oranut Kamchatphai  
Calibration Engineer



Approved By :

Mongkol Yotsontorn  
Authorized Signatory

31 October 2022

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

Certificate No. Q22109982

F3-011-04/01-12

page 1 of 3



@cdcalibration

## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)  
MANUFACTURER : 3M  
MODEL / TYPE : QUESTemp<sup>o</sup>32  
SERIAL NO. : TPH050047  
DATE OF CALIBRATION : 29 October 2022

### ENVIRONMENT CONDITIONS :

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

### PROCEDURE USED :

This instrument was calibrated under procedure No. W1-305-74. The calibration was performed by using Chilled Mirror Hygrometer and Temperature & Humidity Chamber which maintained by the Calibration Laboratory Co., Ltd.

### REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, EdgeTech Model Dew Master S/N. 44602.  
Temperature & Humidity Chamber, PGC Model 9141-5116 S/N. 1304261.

### TRACEABILITY :

The measurements are traceable to International System of Units (SI), through Thunder Scientific Corporation. Certificate No. 19944, Due Date 26 January 2023.

### UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k = 2.00$  which for a normal distribution corresponds to a coverage probability of approximately 95 %. It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4:02 M:2021)"

Certificate No. Q22109982

F3-011-04/01-12

page 2 of 3



@cdcalibration





## CONDITION OF CALIBRATION ITEM : GOOD

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

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

#### CALIBRATION DATA

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

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

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

Test point ( ° C )	Actual Temperature ( ° C )	DUC Reading ( ° C )	Correction ( ° C )	Uncertainty ± ( ° C )
30.0	30.01	30.1	-0.09	0.40
35.0	35.00	35.2	-0.20	
40.0	40.01	40.2	-0.19	

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

Test point ( ° C )	Actual Temperature ( ° C )	DUC Reading ( ° C )	Correction ( ° C )	Uncertainty ± ( ° C )
30.0	30.01	30.0	+0.01	0.40
35.0	35.00	35.1	-0.10	
40.0	40.01	39.9	+0.11	

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

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



Heat B057\_4/23

## Heat Stress WBGT Meter Verification Report

### Verification Data

Heat Stress WBGT Meter No.	: B32	Verification Date	: 17 April 2023
Brand	: 3M	Ambient Temp.	: 24.5 °C
Model	: QUESTemp <sup>®</sup> 32	Barometric Pressure	: 1011 mmbar
Serial No.	: TP0500015	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	47.1	0.0	± 0.5
Globe Probe Temperature Measurement			
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
69.3	69.3	0.0	± 0.5
UUC* = UNIT UNDER CALIBRATION			

Verified by :

Adul Dangklom

(Mr. Adul Dangklom)

Approved by :

Peera Detudom

(Mr. Peera Detudom)





## Certificate of Calibration

Certificate Number

: SPR23030505-4

Customer

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

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

Page : 1 of 3

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

: 30 Mar 2023

Relative Humidity

: 50 % ± 15 %

Calibration Date

: 31 Mar 2023

Location of Calibration

: In-Lab

Recommend Due Date

: 31 Mar 2024

Calibration Procedure

: SP-CPT-04-13

Date of Issue

: 01 Apr 2023

Method of Calibration

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

Calibrated by : Mr.Sarawut Khitmai

Calibration Officer

Approved by :

( Mr.Nirut Loha )

Authorized Signatory



## Calibration Report

Certificate Number : SPR23030505-4

Page : 2 of 3

### Reference Standards

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

### Traceability

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



# Result of Calibration

Certificate No. : SPR23030505-4

Page : 3 of 3

Temperature Accuracy in the Measurement. (WET)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty ( ± )
30.0	30.013	30.1	0.087	0.50
35.0	35.010	35.1	0.090	0.50
40.0	40.015	40.1	0.085	0.50

Temperature Accuracy in the Measurement. (DRY)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty ( ± )
30.0	30.013	30.1	0.087	0.50
35.0	35.010	35.1	0.090	0.50
40.0	40.015	40.1	0.085	0.50

Temperature Accuracy in the Measurement. (GLOBE)

Unit : °C

Temperature Setting	Standard Reading	UUC Reading	Error	Uncertainty ( ± )
30.0	30.013	30.2	0.187	0.50
35.0	35.010	35.2	0.190	0.50
40.0	40.015	40.2	0.185	0.50

## Note:

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

## Measurement Uncertainty

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

- End of Certificate -

Heat B057\_5/23

## Heat Stress WBGT Meter Verification Report

### Verification Data

Heat Stress WBGT Meter No.	: B33	Verification Date	: 17 April 2023
Brand	: 3M	Ambient Temp.	: 24.5 °C
Model	: QUESTemp <sup>®</sup> 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	12.6	-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			

Verified by :

Adul Dangklew  
(Mr. Adul Dangklew)

Approved by :

Peera Detudom  
(Mr. Peera Detudom)





## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp<sup>STM</sup>32

SERIAL NO. : TPK120034

CLID. NO. : 231801948

JOB CONTROL NO. : 221108113507

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

DATE OF RECEIVED : 08 November 2022

DATE OF ISSUED : 11 November 2022

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

Calibrated By :

Oranut Kamcharphai  
Calibration Engineer



Approved By :

Mongkol Yotsoontorn  
Authorized Signatory  
11 November 2022



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

Certificate No. Q22113507

F3-011-04/01-12

page 1 of 3



@clcalibration

## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : DIGITAL THERMOHYGRO METER  
(THERMAL ENVIRONMENT MONITOR)

MANUFACTURER : 3M

MODEL / TYPE : QUESTemp<sup>STM</sup>32

SERIAL NO. : TPK120034

DATE OF CALIBRATION : 10 November 2022

#### ENVIRONMENT CONDITIONS :

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

#### PROCEDURE USED :

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

#### REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, Edgetech Model Dew Master S/N. 44602.  
Temperature & Humidity Chamber, PGC Model 9141-5116 S/N. 1304261.

#### TRACEABILITY :

The measurements are traceable to International System of Units (SI), through Thunder Scientific Corporation.  
Certificate No. 19944, Due Date 26 January 2023.

#### UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k = 2,00$  which for a normal distribution corresponds to a coverage probability of approximately 95 %.  
It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2011)"

Certificate No. Q22113507

F3-011-04/01-12

page 2 of 3



@clcalibration





**CONDITION OF CALIBRATION ITEM : GOOD**

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

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

**CALIBRATION DATA**

**1. CORRECTION OF TEMPERATURE : WET**

Test point ( ° C )	Actual Temperature ( ° C )	DUC Reading ( ° C )	Correction ( ° C )	Uncertainty ± ( ° C )
30.0	29.95	29.9	+0.05	0.41
35.0	34.99	34.9	+0.09	
40.0	40.01	39.9	+0.11	

**2. CORRECTION OF TEMPERATURE : DRY**

Test point ( ° C )	Actual Temperature ( ° C )	DUC Reading ( ° C )	Correction ( ° C )	Uncertainty ± ( ° C )
30.0	29.95	30.0	-0.05	0.41
35.0	34.99	35.0	-0.01	
40.0	40.01	40.0	+0.01	

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

Test point ( ° C )	Actual Temperature ( ° C )	DUC Reading ( ° C )	Correction ( ° C )	Uncertainty ± ( ° C )
30.0	29.95	29.8	+0.15	0.41
35.0	34.99	34.8	+0.19	
40.0	40.01	39.8	+0.21	

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

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

### End of Certificate ###

Certificate No. Q22113507

F3-011-04/01-12

page 3 of 3



@cccalibration

**Sound Level Meter Calibration Report**

Acoustic Calibrator Data			
Brand	ACO	Number	AC 03/56
Model	2127	Serial No.	130006
Calibration Range	94 dB, 1000 Hz	Last Calibration	29 March 2023
		Due Date	29 March 2024
Calibration Data			
Sound Level Meter Data			Calibration Data
SLM No.	Brand	Model	Serial No.
ACO-B18	ACO	6236	00172048
ACO-B29	ACO	6236	00182011
ACO-B33	ACO	6236	00182015
ACO-B36	ACO	6236	00192027
ACO-B41	ACO	6236	00192032
ACO-B43	ACO	6236	00192034
ACO-R40	ACO	6236	00192052
ACO-R41	ACO	6236	00192053
ACO-R50	ACO	6236	00192062
ACO-R52	ACO	6236	00192064
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)			93.94 ± 0.10 dB

Calibrated by :

Adul Dangklom  
(Mr. Adul Dangklom)

Approved by :

Peem Detadom  
(Mr. Peem Detadom)

Request No. 21-66/0413 MTC No. EEL. BP. 109/03566

## CALIBRATION CERTIFICATE

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

### Instrument Calibrated :

Description : Sound Calibrator  
 Manufacturer : ACO  
 Model : 2127  
 Serial No. : 130006

### Standards used :

1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.
3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
4. Digital Multimeter Agilent 34401A S/N MY44005560.
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
6. Audio Analyzer Keithley 2015-P S/N 4106495.
7. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.

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

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

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

**Date of Receipt** : 27 Mar. 2023

**Date of Calibration** : 29 Mar. 2023

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

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

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

FM.BLMTC.002 Rev.4

Request No. 21-66/0413 MTC No. EEL. BP. 109/03566

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

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

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

### 1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit
1/2 inch Brüel&Kjær 4180	93.94	-0.06	$\pm 0.10$	$\pm 0.40$ dB

### 2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit
1/2 inch Brüel&Kjær 4180	999.9	-0.1	$\pm 1.5$	$\pm 1.0\%$

### 3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit
1/2 inch Brüel&Kjær 4180	1.80	$\pm 0.50$	$\pm 3.0\%$

**Note** : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

**Calibrated by** :

*(Signature)*  
 (Mr. Weerachai Deechaiyae)

**Approved by** :

*(Signature)*  
 (Mr. Pravee Klusypa)

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref : 2011266032701228001

End of Certificate

2 / 2

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

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

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

FM.BLMTC.002 Rev.4



Sound Level Meter Calibration Report

Acoustic Calibrator Data					
Brand	CIRRUS	Number	AC-CR01/63		
Model	CR515	Serial No.	92002		
Calibration Range	94 dB, 1000 Hz	Last Calibration	13 March 2023		
		Due Date	13 March 2024		
Calibration Data					
Sound Level Meter Data				Calibration Data	
SLM No.	Brand	Model	Serial No.	Date	
CR-B03	Cirrus	CR161B	G301155	17 April 2023	
CR-B05	Cirrus	CR161B	G301134	17 April 2023	
CR-B06	Cirrus	CR161B	G301151	17 April 2023	
CR-B09	Cirrus	CR161B	G301401	17 April 2023	
CR-B10	Cirrus	CR161B	G301407	17 April 2023	
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.99 ± 0.10 dB

Calibrated by :

Adul Dangklom  
(Mr. Adul Dangklom)

Approved by :

Peera Detudom  
(Mr. Peera Detudom)

Request No. 21-66/0358

MTC No. EEL. BP. 22/0366

CALIBRATION CERTIFICATE

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

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

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

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

Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : Cirrus

Model : CR-515

Serial No. : 92002

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 Briel&Kjaer 2636 S/N 1537484.

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

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

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

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

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

Calibration Procedure: CP-102-04 based on IEC 60942-2003. The sound pressure level of instrument was

measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 3 Mar. 2023

Date of Calibration : 13 Mar. 2023

1 / 2

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

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

Head Office

35 Mu. 3 Tambon Khlong Ha, Amphoe Khlong Luang,  
Changwat Pathumthani 12120, Thailand  
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E-mail : rumpal@tistr.or.th Website: www.tistr.or.th

Office/Laboratory

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

Office

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





THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0358

MTC No. EEL, BP, 22/0366

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

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

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

#### 1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class I
1/2 inch Brüel&Kjaer 4180	93.99	-0.01	± 0.10	± 0.40 dB

#### 2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class I
1/2 inch Brüel&Kjaer 4180	1000.3	0.3	± 1.5	± 1.0%

#### 3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class I
1/2 inch Brüel&Kjaer 4180	1.39	± 0.50	± 3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

*N. N. Pong*

(Mr. Nuttapong Nilrusvannit)

Approved by :



(Mr. Prawat Khuyap)

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref : 2011266030300928001

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End of Certificate

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,  
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Amphoe Muang, Changwat Samutprakan 10280, Thailand  
Tel. (66) 0 2323 1672-80 ext. 115, 116  
Fax. (66) 0 2323 9165  
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Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th

FM.BLMTC.002 Rev.4



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด  
S.P.S. CONSULTING SERVICE CO., LTD.  
7 ถนนพหลโยธิน 24 แขวงพญาไท เขตพญาไท กรุงเทพฯ 10500  
Tel. (66) 02-2579 1121 Fax. (66) 02-2579 8592 E-mail : info@sps.co.th, www.sps.co.th

Noise Dose B\_141/23

### Noise Dose Meter Calibration Report

Acoustic Calibrator Data			
Brand	SVANTEK	Number	SV 06/62
Model	SV34	Serial No.	33139
Calibration Range	114 dB, 1000 Hz	Last Calibration	19 September 2022
		Due Date	19 September 2023
Calibration Data			
Sound Level Meter Data			Calibration Data
SIM No.	Brand	Model	Serial No.
NMD-B08	SVANTEK	SV-104IS	80818
NMD-B09	SVANTEK	SV-104IS	80829
NMD-B10	SVANTEK	SV-104IS	80830
NMD-B16	SVANTEK	SV-104IS	108120
NMD-B17	SVANTEK	SV-104IS	108122
NMD-B18	SVANTEK	SV-104IS	108123
NMD-B19	SVANTEK	SV-104IS	108124
NMD-B20	SVANTEK	SV-104IS	108131
NMD-R05	SVANTEK	SV-104IS	60155
NMD-R06	SVANTEK	SV-104IS	60146
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)			113.63 ± 0.10 dB

Calibrated by :

*Adul Dangklom*

(Mr. Adul Dangklom)

Approved by :

*Mr. Peera Detulom*

(Mr. Peera Detulom)



Request No. 21-66/0344

MTC No. EEL. BP.

159/0266

## CALIBRATION CERTIFICATE

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

Address : 7 Soi Phaholyothin 24, Phaholyothin Rd., 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 : Noise Dosimeter

Manufacturer : Svantek

Model : SV-104IS

Serial No. : 80818

## Standards used :

Multifunction Acoustic Calibrator Brüel&amp;Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.

## Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

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

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

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

Date of Receipt : 27 Feb. 2023

Date of Calibration : 7 Mar. 2023

1/2  
G. Samy

The results relate only to the items tested/calibrated or value assigned.  
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FM.BLMTC.002 Rev.4

## Head Office

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E-mail : sumalee@tistr.or.th



Request No. 21-66/0344

MTC No. EEL. BP.

159/0266

## Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)		
125	0.1	-0.1	0.25	2.0
1 000	-0.1	0.0	0.25	1.4
4 000	-0.3	-0.2	0.25	3.6

Note : 1) There was no adjustment.

2) The calibration was performed at a sound pressure level of 114 dB.

3) The measured values did not include the correction of microphone of UUT.

4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).

Calibrated by :

G. Samy

(Mr. Sanaey Grajang)

Approved by :

P. Prawate Klutaypa

(Mr. Prawate Klutaypa)

Director

Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Ref : 2011266022700826002

Date of Calibration : 7 Mar. 2023

Date of Issue : 8 Mar. 2023

2 / 2

End of Certificate

The results relate only to the items tested/calibrated or value assigned.  
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FM.BLMTC.002 Rev.4

## Head Office

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Request No. 21-66/0344

MTC No. EEL. BP.

160/0266

## CALIBRATION CERTIFICATE

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

Address : 7 Soi Phaholyothin 24, Phaholyothin Rd., 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 :

## Ambient Environment

Description : Noise Dosimeter Temperature : (23 ± 3) °C

Manufacturer : Svanlek Relative Humidity : (50 ± 15) %

Model : SV-104IS Ambient Pressure : (101.325 ± 1.5) kPa

Serial No. : 80829

## Standards used :

Multifunction Acoustic Calibrator Brüel&amp;Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.

## Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

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

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

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

Date of Receipt : 27 Feb. 2023

Date of Calibration : 7 Mar. 2023

1 / 2

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

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Request No. 21-66/0344

MTC No. EEL. BP.

160/0266

## Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)		
125	-0.2	-0.1	0.25	2.0
1 000	-0.1	-0.1	0.25	1.4
4 000	0.2	0.3	0.25	3.6

Note : 1) There was no adjustment.

2) The calibration was performed at a sound pressure level of 114 dB.

3) The measured values did not include the correction of microphone of UUT.

4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).

Calibrated by :

G. Samy

(Mr. Sanaey Grajang)

Approved by :

Prawate Kluyapa

(Mr. Prawate Kluyapa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref : 2011266022700826003

Date of Calibration : 7 Mar. 2023

Date of Issue : 8 Mar. 2023

End of Certificate

2 / 2

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

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## Head Office

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Request No. 21-66/0344

MTC No. EEL. BP. 161/0266

## CALIBRATION CERTIFICATE

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

Address : 7 Soi Phaholyothin 24, Phaholyothin Rd., 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 : Noise Dosimeter

Manufacturer : Svantek

Model : SV-104IS

Serial No. : 80830

## Standards used :

Multifunction Acoustic Calibrator Brüel&amp;Kjær 4226 S/N 2810358 with Coupler UAA0915 S/N 2810358.

## Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

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

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

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

Date of Receipt : 27 Feb. 2023

Date of Calibration : 7 Mar. 2023

1 / 2

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Request No. 21-66/0344

MTC No. EEL. BP. 161/0266

## Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)		
125	0.1	-0.3	0.25	2.0
1 000	0.0	-0.1	0.25	1.4
4 000	0.1	0.1	0.25	3.6

Note : 1) There was no adjustment.

2) The calibration was performed at a sound pressure level of 114 dB.

3) The measured values did not include the correction of microphone of UUT.

4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).

Calibrated by :

G. Samy

(Mr. Sanaey Grajang)

Approved by :

  
(Mr. Prawate Kluaypa)

Director

Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Ref : 2011266022700826004

Date of Calibration : 7 Mar. 2023

Date of Issue : 8 Mar. 2023

2 / 2

End of Certificate

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

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FM.BLMTC.002 Rev.4

## Head Office

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Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th



Request No. 21-66/0399 MTC No. EEL. BP. 90/0366

## CALIBRATION CERTIFICATE

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

Address : 7 Soi Phaholyothin 24, Phaholyothin Rd., 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 : Noise Dosimeter

Manufacturer : Svantek

Model : SV-104IS

Serial No. : 106120

## Standards used :

Multifunction Acoustic Calibrator Brüel&amp;Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.

## Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

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

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

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

Date of Receipt : 20 Mar. 2023

Date of Calibration : 31 Mar. 2023

1 / 2

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

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FM.BLMTC.002 Rev.4



Request No. 21-66/0399

MTC No. EEL. BP.

90/0366

## Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
	A-weighting (dB)	C-weighting (dB)		
125	0.3	-0.3	0.25	2.0
1 000	0.0	-0.1	0.25	1.4
4 000	-0.1	-0.1	0.25	3.6

Note : 1) There was no adjustment.

2) The calibration was performed at a sound pressure level of 114 dB.

3) The measured values did not include the correction of microphone of UUT.

4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).

Calibrated by :

(Mr. Sanaey Grajang)

Approved by :

(Mr. Prawate Kluaypa)

Director

Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Ref : 2011266032001153001

Date of Calibration : 31 Mar. 2023

Date of Issue : 31 Mar. 2023

2 / 2

End of Certificate

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

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FM.BLMTC.002 Rev.4





Request No. 21-66/0414

MTC No. EEL. BP. 110/0366

## CALIBRATION CERTIFICATE

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

Address : 7 Soi Phaholyothin 24, Phaholyothin Rd., 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 : Noise Dosimeter

Manufacturer : Svantek

Model : SV-104IS

Serial No. : 106122

## Standards used :

Multifunction Acoustic Calibrator Brüel&amp;Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.

## Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

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

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

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

Date of Receipt : 27 Mar. 2023

Date of Calibration : 3 Apr. 2023

1 / 2

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

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## Head Office

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FM.BLMTC.002 Rev.4



Request No. 21-66/0414

MTC No. EEL. BP. 110/0366

## Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)		
125	0.3	0.5	0.25	2.0
1 000	0.1	-0.1	0.25	1.4
4 000	0.4	0.2	0.25	3.6

Note : 1) There was no adjustment.

2) The calibration was performed at a sound pressure level of 114 dB.

3) The measured values did not include the correction of microphone of UUT.

4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).

Calibrated by :

.....  
G. Samy

(Mr. Sanaey Grajang)

Approved by :

.....  
Prawate Kiatyapa  
(Mr. Prawate Kiatyapa)  
DirectorElectrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Ref : 2011266032701229001

Date of Calibration : 3 Apr. 2023

Date of Issue : 4 Apr. 2023

2 / 2

End of Certificate

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

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## Head Office

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FM.BLMTC.002 Rev.4





Request No. 21-66/0414

MTC No. EEL. BP. 111/0366

## CALIBRATION CERTIFICATE

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

Address : 7 Soi Phaholyothin Rd., 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 : Noise Dosimeter

Manufacturer : Svantek

Model : SV-104IS

Serial No. : 106123

## Standards used :

Multifunction Acoustic Calibrator Brüel&amp;Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.

## Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

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

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

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

Date of Receipt : 27 Mar. 2023

Date of Calibration : 3 Apr. 2023

1 / 2

The results relate only to the items tested/calibrated or value assigned.  
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Request No. 21-66/0414

MTC No. EEL. BP. 111/0366

## Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
	A-weighting (dB)	C-weighting (dB)		
125	-0.2	-0.3	0.25	2.0
1 000	0.6	-0.3	0.25	1.4
4 000	-0.4	-0.4	0.25	3.6

Note : 1) There was no adjustment.

2) The calibration was performed at a sound pressure level of 114 dB.

3) The measured values did not include the correction of microphone of UUT.

4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).

Calibrated by :

.....  
(Mr. Sanacy Grajang)

Approved by :

.....  
(Mr. Piawate Kluyapa)

Director

Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Ref : 2011266032701229002

Date of Calibration : 3 Apr. 2023

Date of Issue : 4 Apr. 2023

2 / 2

End of Certificate

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  
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E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

## Office/Laboratory

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Tel. (66) 0 2323 1672-80 ext. 115, 116  
Fax. (66) 0 2323 9165  
E-mail : mtc@tistr.or.th

## Office

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Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th

FM.BLMTC.002 Rev.4



Request No. 21-66/0399

MTC No. EEL. BP. 91/0366

## CALIBRATION CERTIFICATE

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

Address : 7 Soi Phaholyothin 24, Phaholyothin Rd., 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 : Noise Dosimeter

Manufacturer : Svantek

Model : SV-104IS

Serial No. : 106124

## Standards used :

Multifunction Acoustic Calibrator Brüel&amp;Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.

## Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

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

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

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

Date of Receipt : 20 Mar. 2023

Date of Calibration : 31 Mar. 2023

1 / 2

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## Head Office

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FM.BLMTC.002 Rev.4



Request No. 21-66/0399

MTC No. EEL. BP. 91/0366

## Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
	A-weighting (dB)	C-weighting (dB)		
125	0.6	0.2	0.25	2.0
1 000	0.0	-0.1	0.25	1.4
4 000	-0.6	-0.4	0.25	3.6

Note : 1) There was no adjustment.

2) The calibration was performed at a sound pressure level of 114 dB.

3) The measured values did not include the correction of microphone of UUT.

4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).

Calibrated by :

G. Samy

(Mr. Sanaey Grajang)

Approved by :

Prawate Kluyypa

(Mr. Prawate Kluyypa)

Director

Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Ref : 2011266032001153002

Date of Calibration : 31 Mar. 2023

Date of Issue : 31 Mar. 2023

End of Certificate

2 / 2

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

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## Head Office

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E-mail : sumalee@tistr.or.th

FM.BLMTC.002 Rev.4





Request No. 21-66/0399 MTC No. EEL. BP. 92/0366

## CALIBRATION CERTIFICATE

Submitted by : S.P.S.Consulting Service Co., Ltd.  
Address : 7 Soi Phaholyothin 24, Phaholyothin Rd., 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 : Noise Dosimeter  
Manufacturer : SvanteK  
Model : SV-104IS  
Serial No. : 106131  
Ambient Environment  
Temperature :  $(23 \pm 3) ^\circ\text{C}$   
Relative Humidity :  $(50 \pm 15) \%$   
Ambient Pressure :  $(101.325 \pm 1.5) \text{ kPa}$

## Standards used :

Multifunction Acoustic Calibrator Brüel&amp;Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.

## Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

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

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

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

Date of Receipt : 20 Mar. 2023  
Date of Calibration : 31 Mar. 2023

1 / 2

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

Head Office  
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E-mail : sumalee@tistr.or.th

FMBL-MTC.002 Rev.4



Request No. 21-66/0399 MTC No. EEL. BP. 92/0366

## Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
	A-weighting (dB)	C-weighting (dB)		
125	0.5	0.4	0.25	2.0
1 000	0.0	0.1	0.25	1.4
4 000	-0.4	-0.5	0.25	3.6

Note : 1) There was no adjustment.

2) The calibration was performed at a sound pressure level of 114 dB.

3) The measured values did not include the correction of microphone of UUT.

4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).

Calibrated by :

(Mr. Sanaey Grajang)

Approved by :

(Mr. Prawate Khaypa)

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

Ref : 2011266032001153003

Date of Calibration : 31 Mar. 2023

Date of Issue : 31 Mar. 2023

2 / 2

End of Certificate

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,  
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FMBL-MTC.002 Rev.4





Request No. 21-66/0414

MTC No. EEL. BP. 114/0366

## CALIBRATION CERTIFICATE

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

Address : 7 Soi Phaholyothin 24, Phaholyothin Rd., 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 : Noise Dosimeter

Manufacturer : SvanteK

Model : SV-104IS

Serial No. : 60155

## Standards used :

Multifunction Acoustic Calibrator Brüel&amp;Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.

## Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

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

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

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

Date of Receipt : 27 Mar. 2023

Date of Calibration : 3 Apr. 2023

1 / 2

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

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

## Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,  
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FM.BLMTC.002 Rev.4



Request No. 21-66/0414

MTC No. EEL. BP. 114/0366

## Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
	A-weighting (dB)	C-weighting (dB)		
125	0.8	0.7	0.25	2.0
1 000	0.1	-0.1	0.25	1.4
4 000	-0.1	0.0	0.25	3.6

Note : 1) There was no adjustment.

2) The calibration was performed at a sound pressure level of 114 dB.

3) The measured values did not include the correction of microphones of UUT.

4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).

Calibrated by :

G. Sanying

(Mr. Sanaey Grajang)

Approved by :

Prawate Khuyapa  
(Mr. Prawate Khuyapa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref : 2011266032701229005

Date of Calibration : 3 Apr. 2023

Date of Issue : 4 Apr. 2023

2 / 2

End of Certificate

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

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## Head Office

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E-mail : sumalee@tistr.or.th

FM.BLMTC.002 Rev.4



Request No. 21-66/0414

MTC No. EEL. BP. 115/0366

## CALIBRATION CERTIFICATE

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

Address : 7 Soi Phaholyothin 24, Phaholyothin Rd., 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 : Noise Dosimeter

Manufacturer : SvanteK

Model : SV-104IS

Serial No. : 60146

## Standards used :

Multifunction Acoustic Calibrator Brüel&amp;Kjær 4226 S/N 2810358 with Coupler UA0915 S/N 2810358.

## Calibration Procedure :

This instrument was calibrated by using calibration procedure no CP-102-01, which was based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). This calibration procedure was related to the acoustical signal test of frequency weightings using a multifunction acoustic calibrator.

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

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

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

Date of Receipt : 27 Mar. 2023

Date of Calibration : 3 Apr. 2023

1 / 2

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FMBL/MTC.002 Rev.4



Request No. 21-66/0414

MTC No. EEL. BP. 115/0366

## Acoustic signal test of frequency weightings

Frequency (Hz)	Deviation from response curve		Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)		
125	0.1	0.1	0.25	2.0
1 000	0.0	-0.1	0.25	1.4
4 000	-1.2	-1.1	0.25	3.6

Note : 1) There was no adjustment.

2) The calibration was performed at a sound pressure level of 114 dB.

3) The measured values did not include the correction of microphone of UUT.

4) The deviation was produced from the absolute difference between the measured values and the responding sound pressure levels in IEC 61672-1 (2002).

Calibrated by :

G. Samy

(Mr. Sanaey Grajang)

Approved by :

Mr. Prawate Kluyappa  
(Mr. Prawate Kluyappa)  
Director

Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Ref : 2011266032701229006

Date of Calibration : 3 Apr. 2023

Date of Issue : 4 Apr. 2023

2 / 2

End of Certificate

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

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## Head Office

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FMBL/MTC.002 Rev.4





# CALIBRATION LABORATORY Co., LTD.

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



## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : LUX METER  
MANUFACTURER : EXTECH INSTRUMENTS  
MODEL / TYPE : 407026  
SERIAL NO. : A.052151/A.052151 [LUX-B07]  
CLID. NO. : 252201551  
JOB CONTROL NO. : 220704067250

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

DATE OF RECEIVED : 04 July 2022

DATE OF ISSUED : 18 July 2022

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

Calibrated By : Suwit Phuanbusabong  
Calibration Engineer



Approved By : Mongkol Yotsoontorn  
Authorized Signatory  
18 July 2022

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

Certificate No. Q22067250

F3-011-04/01-12

page 1 of 3



@cdcalibration



# CALIBRATION LABORATORY Co., LTD.

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



## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : LUX METER  
MANUFACTURER : EXTECH INSTRUMENTS  
MODEL / TYPE : 407026  
SERIAL NO. : A.052151/A.052151 [LUX-B07]  
DATE OF CALIBRATION : 12 July 2022

### ENVIRONMENT CONDITIONS :

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

Relative Humidity :  $(55 \pm 15) \% \text{RH}$

### PROCEDURE USED :

This instrument was calibrated under procedure No. CLC-CFEE-18 by comparison with Illuminance Sensor which maintained by the Calibration Laboratory Co., Ltd.

### REFERENCE STANDARD USED :

Illuminance Sensor, Bentham Model ORM400/DH400VL S/N. 277101/27585/3.

### TRACEABILITY :

The measurements are traceable to International System of Units (SI), through Optical Test and Calibration Ltd. Certificate No. 131916/ABU/1. Due Date 25 February 2023.

### UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k = 2,00$  which for a normal distribution corresponds to a coverage probability of approximately 95 %. It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2021)"

Certificate No. Q22067250

F3-011-04/01-12

page 2 of 3



@cdcalibration





CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment ( ) adjustment

**CALIBRATION DATA**

**LUX METER RESULT**

STD Applied ( lux )	DUC Reading ( lux )	Correction ( lux )	Uncertainty $\pm$ ( % of rdg. )
100	101	-1	3.5
200	202	-2	3.8
300	300	0	4.7
1000	998	+2	4.7
2000	1996	+4	4.9
3000	3000	0	5.6

Note. The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 46 of 54

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

### End of Certificate ###



**CERTIFICATE OF CALIBRATION**

**FOR**

NOMENCLATURE : LUX METER  
MANUFACTURER : EXTECH  
MODEL / TYPE : 407026  
SERIAL NO. : A.052156 [B08]  
CLID. NO. : 252201678  
JOB CONTROL NO. : 220721073767

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

DATE OF RECEIVED : 21 July 2022

DATE OF ISSUED : 26 July 2022

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

Calibrated By : Suwit Phuanbusabong  
Calibration Engineer



Approved By : Mongkol Yotsoontorn  
Authorized Signatory

26 July 2022

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

Certificate No. Q22073767

F3-011-04/01-12



## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : LUX METER  
MANUFACTURER : EXTECH  
MODEL / TYPE : 407026  
SERIAL NO. : A.052156 [B08]  
DATE OF CALIBRATION : 22 July 2022

#### ENVIRONMENT CONDITIONS :

Temperature :  $(23 \pm 2)^{\circ}\text{C}$  Relative Humidity :  $(55 \pm 15)\% \text{RH}$

#### PROCEDURE USED :

This instrument was calibrated under procedure No. CLC-CPEE-18 by comparison with Illuminance

Sensor which maintained by the Calibration Laboratory Co., Ltd.

#### REFERENCE STANDARD USED :

Illuminance Sensor, Bentham Model ORM400/DH400VL S.N. 27710/1/27585/3.

#### TRACEABILITY :

The measurements are traceable to International System of Units (SI), through Optical Test and Calibration Ltd.

Certificate No. 131916/ABU/1. Due Date 25 February 2023.

#### UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k = 2.00$  which for a normal distribution corresponds to a coverage probability of approximately 95 %. It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2021)"

Certificate No. Q22073767

F3-011-04/01-12



page 2 of 3

@cclcalibration

#### CONDITION OF CALIBRATION ITEM : GOOD

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

#### CALIBRATION DATA

#### LUX METER RESULT

STD Applied ( lux )	DUC Reading ( lux )	Correction ( lux )	Uncertainty $\pm$ ( % of rdg. )
100	104	-4	2.6
200	207	-7	2.6
300	310	-10	2.6
1000	1027	-27	2.6
2000	2000	0	2.6
3000	3000	0	3.8

Note. The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 46 of 54

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

### End of Certificate ###

Certificate No. Q22073767

F3-011-04/01-12

page 3 of 3



@cclcalibration





# CALIBRATION LABORATORY CO., LTD.

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



# CALIBRATION LABORATORY CO., LTD.

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



## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : LUX METER  
MANUFACTURER : EXTECH  
MODEL / TYPE : 407026  
SERIAL NO. : A.052239 [B09]  
CLID. NO. : 252201677  
JOB CONTROL NO. : 220721073766

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

DATE OF RECEIVED : 21 July 2022

DATE OF ISSUED : 26 July 2022

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

Calibrated By :

Suwit Phuanbusabong

Calibration Engineer



Approved By :

Mongkol Yotsoontorn

Authorized Signatory

26 July 2022

This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to

the International System of Units (SI)

Certificate No. Q22073766

F3-011-04/01-12

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@cccalibration

## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : LUX METER  
MANUFACTURER : EXTECH  
MODEL / TYPE : 407026  
SERIAL NO. : A.052239 [B09]  
DATE OF CALIBRATION : 22 July 2022

#### ENVIRONMENT CONDITIONS :

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

Relative Humidity :  $(55 \pm 15) \% \text{RH}$

#### PROCEDURE USED :

This instrument was calibrated under procedure No. CLC-CPEE-18 by comparison with Illuminance

Sensor which maintained by the Calibration Laboratory Co., Ltd.

#### REFERENCE STANDARD USED :

Illuminance Sensor, Beniham Model ORM400/DH400VL SN. 27710/1/27585/3.

#### TRACEABILITY :

The measurements are traceable to International System of Units (SI), through Optical Test and Calibration Ltd.  
Certificate No. 131916/ABU/1. Due Date 25 February 2023.

#### UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k = 2.00$  which for a normal distribution corresponds to a coverage probability of approximately 95 %.  
It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2021)"

Certificate No. Q22073766

F3-011-04/01-12

page 2 of 3



@cccalibration



# CALIBRATION LABORATORY CO., LTD.

210-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230  
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com Email:sale@cal-laboratory.com



CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : ( X ) without adjustment ( ) adjustment

## CALIBRATION DATA

### LUX METER RESULT

STD Applied ( lux )	DUC Reading ( lux )	Correction ( lux )	Uncertainty $\pm$ ( % of rdg. )
100	104	-4	2.6
200	209	-9	2.6
300	313	-13	2.6
1000	1033	-33	2.6
2000	2020	-20	2.6
3000	3040	-40	3.8

Note. The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 46 of 54

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

Certificate No. Q22073766

F3-011-04/01-12

page 3 of 3



@clcalibration



# QUALITY CALIBRATION CO.,LTD.

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

www.qcalibration.com

CERTIFICATE No : 23M2441

REFERENCE No : 68471-1

## Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE  
MANUFACTURER : METTLER TOLEDO  
MODEL : XS105DU  
SERIAL No : 1126422905  
ID No : BA 05/50  
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 : 10-Mar-23  
APPROVED BY :   
PONGSAK J.  
ISSUED DATE : 16-Mar-23  
RECEIVED DATE : 10-Mar-23

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





CERTIFICATE No : 23M2441

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL BALANCE  
MANUFACTURER : METTLER TOLEDO  
ID No : BA 05/50  
AIR PRESSURE : 1010mbar  $\pm$  1mbar  
AMBIENT TEMPERATURE : 23°C  $\pm$  1°C  
RELATIVE HUMIDITY : 49%RH  $\pm$  10% RH

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

2. REFERENCE STANDARD INSTRUMENTS :-  
1) STANDARD WEIGHT SET E2  
2) STANDARD WEIGHT E2  
3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION.  
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.  
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-  
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

2. REFERENCE STANDARD INSTRUMENTS :-

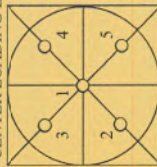
INSTRUMENT MODEL SERIAL No CERTIFICATE No DUE DATE  
1) STANDARD WEIGHT SET E2 OK-I-151 M2302013S 02-Feb-25  
2) STANDARD WEIGHT E2 15843 M2302014S 02-Feb-25

## RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL
2. TARE FUNCTION : NORMAL
3. REPEATABILITY OF READING AT 200 g WAS 0 g
4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY ( $\pm$ g)
0.00	0.00000	0.00000	0.000039
0.02	0.02000	0.00000	0.000039
0.10	0.10000	0.00000	0.000039
0.20	0.20001	-0.00001	0.000040
0.50	0.50001	-0.00001	0.000041
1.00	1.00000	0.00000	0.000042
2.00	2.00003	-0.00003	0.000046
5.00	5.00001	-0.00001	0.000053
10.00	10.00003	-0.00003	0.00011
20.00	20.00005	-0.00005	0.00019
50.00	50.00001	-0.00001	0.00032
100.00	100.00001	-0.00001	
200.00	200.00001	-0.00001	

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	50.0000
2	50.0001
3	50.0000
4	50.0000
5	49.9999
OFF-CENTER LOADING	0.0001

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

CERTIFICATE No : 23M2442

REFERENCE No : 68471-2

## 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 : 10-Mar-23

APPROVED BY : PONGSAK J.

ISSUED DATE : 16-Mar-23

RECEIVED DATE : 10-Mar-23

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





CERTIFICATE No : 23M2442

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL BALANCE : BSA224S-CW  
MANUFACTURER : SARTORIUS : 36591843  
ID No : BA 09/61  
AIR PRESSURE : 1010mbar  $\pm$  1mbar : 10-Mar-23  
AMBIENT TEMPERATURE : 23°C  $\pm$  1°C : 49%RH  $\pm$  10% RH

**CONDITION OF THIS RESULTS OF CALIBRATION**

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

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT : MODEL : SERIAL No : CERTIFICATE No : DUE DATE :  
1) STANDARD WEIGHT SET E2 QK-1151 M2302013S 02-Feb-25  
2) STANDARD WEIGHT E2 15843 M2302014S 02-Feb-25

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

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

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

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

## RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

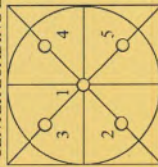
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY ( $\pm$ g)
0.0	0.0000	0.0000	0.000058
0.1	0.1000	0.0000	0.000059
0.2	0.2000	0.0000	0.000059
0.5	0.5000	0.0000	0.000060
1.0	1.0000	0.0000	0.000060
2.0	2.0000	0.0000	0.000061
5.0	5.0000	0.0000	0.000063
10.0	10.0000	0.0000	0.000067
20.0	20.0001	-0.0001	0.000073
50.0	50.0000	0.0000	0.00011
100.0	100.0001	-0.0001	0.00019
200.0	200.0000	0.0000	0.00032

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	100.0000
2	99.9999
3	99.9998
4	100.0001
5	100.0000

OFF-CENTER LOADING 0.0002

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



## 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.

ARCHEMICA LAB  
บริษัท อาร์เคมีคา แล็บ จำกัด  
ARCHEMICA LAB CO.,LTD.Operator Signature : *K. Channarong*

Date : Jan 4, 2023

(Mr. Channarong Khiao-Un)

Test Engineer





## Calibration Certificate

**Equipment :** UV-VIS SPECTROPHOTOMETER

**Manufacturer :** PERKINELMER

**Model :** LAMBDA 25

**Serial No.:** 501S14123010

**ID No.:** SP03/58

**Calibration Mode :** WAVELENGTH ACCURACY  
PHOTOMETRIC ACCURACY

**Condition As Found :** GOOD

**Customer :** S.P.S. CONSULTING SERVICE CO., LTD.  
7 SOI PHAHOLYOTHIN 24, PHAHOLYOTHIN ROAD,  
CHOMPON, CHATUCHAK,  
BANGKOK 10900, THAILAND.

**Location :** ORGANIC LABORATORY IV

**Ambient Temperature :** ( 24.4 ± 5 ) °C

**Relative Humidity :** ( 60.1 ± 25 ) %

**Received Date :** 30 AUGUST 2022

**Calibration Date :** 30 AUGUST 2022

**Date of Issue :** 31 AUGUST 2022

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*T. Petchurai*  
( Thanakul Petchurai )

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

## Continuation of Calibration Certificate

### Calibration Method :

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

### Condition of this result of calibration :

#### 1. Certified reference materials

Material	Ref. type	Cell serial No.	Cert. No.	Due Date
Holmium liquid	RM-HL	29706	87569	13/10/2022
Didymium liquid	RM-DL	28912	87588	15/10/2022
Neutral density filter	RM-1N2N3N	13877	87600	15/10/2022
Potassium dichromate solutions	RM-0204060810	14204	87614	16/10/2022
Potassium Iodide solution	-	KI-0701-001	CI-0090-22	08/04/2024

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

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

3.1 The UK National Physical Laboratory (NPL)

3.2 The National Institute of Standards and Technology, NIST.

### Result of calibration : Wavelength Accuracy

(Without adjustment)

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

UUC\* = Unit Under Calibration

*T. Petchurai*

Continuation of Calibration Certificate

Cert. No. : SP22018  
Job No. : VC65SP0008  
Pages : 3 of 3

Result of calibration : Photometric Accuracy

(Without adjustment)

Material	Wavelength (nm)	Filter S/N	Nominal Absorbance (A)	Certified Absorbance (A)	UUC* Reading Absorbance (A)	Error (A)	Uncertainty ± (A)	k Factor
Neutral Density glass filter	440.0	29360	1.0	1.0524	1.0539	0.0015	0.0028	2.00
		29914	0.7	0.7454	0.7459	0.0005	0.0029	2.00
		29381	0.5	0.5426	0.5426	0.0000	0.0028	2.00
	546.1	29360	1.0	0.9822	0.9810	-0.0012	0.0028	2.00
		29914	0.7	0.6962	0.6960	-0.0002	0.0028	2.00
Neutral Density glass filter	590.0	29381	0.5	0.5076	0.5070	-0.0006	0.0029	2.00
		29360	1.0	1.0221	1.0202	-0.0019	0.0028	2.00
		29914	0.7	0.7238	0.7230	-0.0008	0.0029	2.00
	635.0	29381	0.5	0.5364	0.5360	-0.0004	0.0031	2.00
		29360	1.0	0.9751	0.9732	-0.0019	0.0028	2.00
RM-0204060810	235.0	29914	0.7	0.6912	0.6902	-0.0010	0.0029	2.00
		29381	0.5	0.5214	0.5210	-0.0004	0.0032	2.00

UUC\* = Unit Under Calibration

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

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

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

\*\*Specific Acceptance :

Transmission ≤ 1.0 T(%) Absorbance ≥ 2.0 A

\*\*Stray light not TISI Accredited

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

End of Calibration Certificate