

## ภาคผนวกที่ 4

### เอกสารสอบเทียบความถูกต้องของเครื่องมือตรวจวัดคุณภาพสิ่งแวดล้อม (ระยะก่อสร้าง)

ลำดับที่ 1 คุณภาพอากาศในบรรยากาศ

ลำดับที่ 2 ระดับเสียงทั่วไป

**ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง  
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม (ระยะก่อสร้าง)**

รายการตรวจวัด	เครื่องมือเก็บตัวอย่าง	เครื่องมือตรวจวิเคราะห์
	ชื่อเครื่องมือ	ชื่อเครื่องมือ
<b>1. คุณภาพอากาศในบรรยากาศ</b> Total Suspended Particulate (TSP)	High Volume Air Sampler No. R04, R07	Digital Balance
Particulate Matter less than 10 microns (PM-10)	High Volume PM-10 Air Sampler No. R10, R12	Digital Balance
<b>2. ระดับเสียง</b> $L_{eq}$ 24 hr, $L_{90}$ , $L_{max}$	Acoustic Calibrator Sound Level Meter No. ACO-R36, R38, R42, R44	-

## ลำดับที่ 1

คุณภาพอากาศในบรรยากาศ



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

## High Volume Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

### Calibration Data

High Volume Air Sampler Data		Calibration Data		
Recorder No.	Blower No.	Date	Actual Flowrate (ft <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	$y = 1.201x - 4.686$	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	$y = 1.235x - 6.759$	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	$y = 1.277x - 6.891$	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 :

Approved by :



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

## High Volume PM-10 Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

### Calibration Data

High Volume PM-10 Data		Calibration Data		
Recorder No.	Blower No.	Date	Actual Flowrate (ft <sup>3</sup> /min)	R <sup>2</sup>
R01	R01	01/05/2023	$y = 1.189x - 4.728$	0.996
R02	R02	01/05/2023	$y = 1.265x - 5.602$	0.999
R03	R03	01/05/2023	$y = 1.215x - 5.146$	0.997
R04	R04	01/05/2023	$y = 1.226x - 6.655$	0.997
R05	R05	01/05/2023	$y = 1.212x - 5.960$	1.000
R06	R06	04/05/2023	$y = 1.238x - 5.381$	0.995
R07	R07	04/05/2023	$y = 1.283x - 7.908$	0.998
R08	R08	04/05/2023	$y = 1.281x - 7.778$	1.000
R09	R09	03/05/2023	$y = 1.202x - 6.317$	0.999
R10	R10	02/05/2023	$y = 1.169x - 2.499$	0.999
R11	R11	01/05/2023	$y = 1.210x - 4.423$	0.996
R12	R12	01/05/2023	$y = 1.176x - 3.099$	0.997
R13	R13	01/05/2023	$y = 1.276x - 6.852$	0.997
R14	R14	03/05/2023	$y = 1.207x - 4.849$	0.996
R15	R15	03/05/2023	$y = 1.198x - 4.617$	0.997
R16	R16	04/05/2023	$y = 1.199x - 5.485$	0.995
R17	R17	04/05/2023	$y = 1.184x - 4.669$	0.998
R18	R18	04/05/2023	$y = 1.167x - 4.142$	0.998
R19	R19	04/05/2023	$y = 1.197x - 5.308$	0.997
R20	R20	02/05/2023	$y = 1.244x - 8.211$	0.999

Calibrated by :

Approved by :





# QUALITY CALIBRATION CO.,LTD.

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

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

[www.qcalibration.com](http://www.qcalibration.com)



CERTIFICATE No : 23M2441

REFERENCE No : 68471-1

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE

MANUFACTURER : METTLER TOLEDO

MODEL : XS105DU

SERIAL No : 1126422905

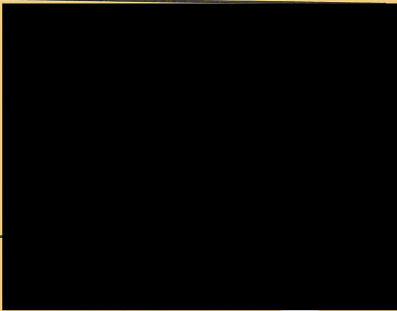
ID No : BA 05/50

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 : 

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 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 :-

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

3. 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

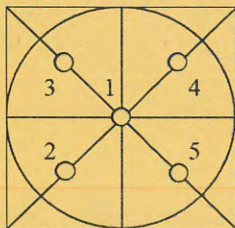
2. TARE FUNCTION : NORMAL

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

ลำดับที่ 2

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ระดับเสียงทั่วไป



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

## CALIBRATION CERTIFICATE

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

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

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

### Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : ACO

Model : 2127

Serial No. : 130006

### Ambient Environment

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

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

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

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

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

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

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

Date of Receipt : 27 Mar. 2023

Date of Calibration : 29 Mar. 2023

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

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

FM.BL.MTC.002 Rev.4

#### Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,  
Changwat Pathumthani 12120, Thailand

Tel. (66) 0 2577 9000

Fax. (66) 0 2577 9009

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

#### Office/Laboratory

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang, Changwat Samutprakan 10280, Thailand

Tel. (66) 0 2323 1672-80 ext. 115, 116

Fax. (66) 0 2323 9165

E-mail : mtc@tistr.or.th

#### Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand

Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217

Fax. (66) 0 2579 8592

E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

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

Nominal Output of Unit Under Test = 94 dB re 20 $\mu$ Pa at 1000 Hz

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

1. Sound Pressure Level

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

2. Frequency

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

3. Total distortion

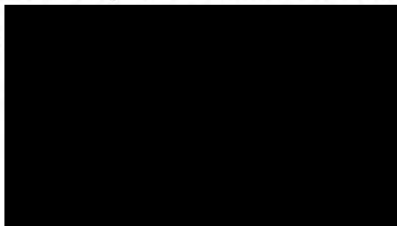
Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1.80	$\pm 0.50$	$\pm 3.0\%$

Note : 1. No adjustment.

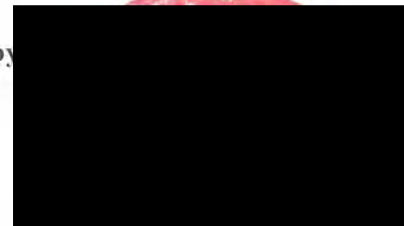
2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :



Approved by



Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 29 Mar. 2023

Date of Issue : 30 Mar. 2023

Ref : 2011266032701228001

End of Certificate

2 / 2

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

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

FM.BL.MTC.002 Rev.4

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Fax. (66) 0 2577 9009  
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

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Amphoe Muang, Changwat Samutprakan 10280, Thailand  
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Fax. (66) 0 2323 9165  
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Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

Noise R\_304/23

## Sound Level Meter Calibration Report

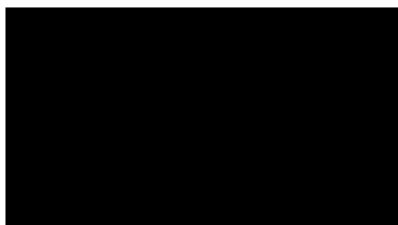
### Acoustic Calibrator Data

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

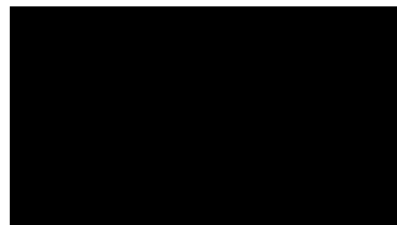
### Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
ACO-R36	ACO	6236	00192048	11 June 2023	94.0	94.0
ACO-R38	ACO	6236	00192050	11 June 2023	94.0	94.0
ACO-R42	ACO	6236	00192054	11 June 2023	94.1	94.0
ACO-R44	ACO	6236	00192056	11 June 2023	94.0	94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.94 ± 0.10 dB	

Calibrated by :



Approved by :





## ภาคผนวกที่ 4

### เอกสารสอบเทียบความถูกต้องของเครื่องมือตรวจวัดคุณภาพสิ่งแวดล้อม (ระยะดำเนินการ)

ลำดับที่ 1	คุณภาพอากาศในบรรยากาศ
ลำดับที่ 2	คุณภาพอากาศจากปล่อง
ลำดับที่ 3	ระดับเสียง
ลำดับที่ 4	คุณภาพน้ำ
ลำดับที่ 5	คุณภาพอากาศในการทำงาน
ลำดับที่ 6	ระดับเสียงในการทำงาน
ลำดับที่ 7	ระดับความร้อนในการทำงาน

**ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง  
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม (ระยะดำเนินการ)**

รายการตรวจวัด	เครื่องมือเก็บตัวอย่าง	เครื่องมือตรวจวิเคราะห์
	ชื่อเครื่องมือ	ชื่อเครื่องมือ
<b>1. คุณภาพอากาศในบรรยากาศ</b> Total Suspended Particulate (TSP)	High Volume Air Sampler No. R04, R07	Digital Balance
Particulate Matter less than 10 microns (PM-10)	High Volume PM-10 Air Sampler No. R10, R12	Digital Balance
Nitrogen Dioxide (NO <sub>x</sub> )	NO <sub>x</sub> Analyzer No. R03, R04	NO <sub>x</sub> Analyzer No. R03, R04
<b>2. คุณภาพอากาศจากปล่อง</b> Total Suspended Particulate (TSP)	Console No. B05 Pitot Tube No. B48	Digital Balance
Oxides of Nitrogen (NO <sub>x</sub> )	Vacuum Gauge	Spectrophotometer
<b>3. ระดับเสียงในบรรยากาศ</b> L <sub>eq</sub> 24 hr, L <sub>90</sub> , L <sub>max</sub> , L <sub>dn</sub>	Acoustic Calibrator Sound Level Meter No. ACO-R36, R38, R42, R44	-
<b>4. คุณภาพน้ำ</b> pH	-	pH Meter
Total Suspended Solids (TSS)	-	Digital Balance
COD	-	COD Reactor
Grease & Oil	-	Digital Balance
<b>5. คุณภาพอากาศในสถานที่ทำงาน</b> Total Dust	Personal Pump SKC No. R12, R22 Rotameter No. H-R06	Digital Balance
Respirable Dust	Personal Pump SKC No. R07 Rotameter No. H-R06	Digital Balance
Aluminum	Personal Pump SKC No. R24, R25 Rotameter No. H-R06	ICP
Hydrogen Fluoride	Personal Pump SKC No. R22 Rotameter No. H-R06	Ion Chromatography
Oil Mist	Personal Pump SKC No. R08 Rotameter No. H-R06	Ion Chromatography

ตารางสรุปรายการเอกสารการสอบเทียบความถูกต้องของเครื่องมือเก็บตัวอย่าง  
และเครื่องมือตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม (ระยะดำเนินการ) (ต่อ)

รายการตรวจวัด	เครื่องมือเก็บตัวอย่าง	เครื่องมือตรวจวิเคราะห์
	ชื่อเครื่องมือ	ชื่อเครื่องมือ
6. ระดับเสียงในการทำงาน $L_{eq}$ 8 hr	Acoustic Calibrator Sound Level Meter No. ACO-R03, R37, R38	-
Noise Dose	Acoustic Calibrator Sound Level Meter No. NMD-R07, R26, R34	-
7. ระดับความร้อนในการทำงาน WBGT	Heat Meter No. R04, R09, R11	-



## ลำดับที่ 1

คุณภาพอากาศในบรรยากาศ



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

## High Volume Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

### Calibration Data

High Volume Air Sampler Data		Calibration Data		
Recorder No.	Blower No.	Date	Actual Flowrate (ft <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	$y = 1.201x - 4.686$	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	$y = 1.235x - 6.759$	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	$y = 1.277x - 6.891$	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 :

Approved by :



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

## High Volume PM-10 Air Sampler Calibration Report

Calibration Method : Multipoint Orifice Flow Transfer Standard

Model : TE 5025A

S/N : 3611

### Calibration Data

High Volume PM-10 Data		Calibration Data		
Recorder No.	Blower No.	Date	Actual Flowrate (ft <sup>3</sup> /min)	R <sup>2</sup>
R01	R01	01/05/2023	$y = 1.189x - 4.728$	0.996
R02	R02	01/05/2023	$y = 1.265x - 5.602$	0.999
R03	R03	01/05/2023	$y = 1.215x - 5.146$	0.997
R04	R04	01/05/2023	$y = 1.226x - 6.655$	0.997
R05	R05	01/05/2023	$y = 1.212x - 5.960$	1.000
R06	R06	04/05/2023	$y = 1.238x - 5.381$	0.995
R07	R07	04/05/2023	$y = 1.283x - 7.908$	0.998
R08	R08	04/05/2023	$y = 1.281x - 7.778$	1.000
R09	R09	03/05/2023	$y = 1.202x - 6.317$	0.999
R10	R10	02/05/2023	$y = 1.169x - 2.499$	0.999
R11	R11	01/05/2023	$y = 1.210x - 4.423$	0.996
R12	R12	01/05/2023	$y = 1.176x - 3.099$	0.997
R13	R13	01/05/2023	$y = 1.276x - 6.852$	0.997
R14	R14	03/05/2023	$y = 1.207x - 4.849$	0.996
R15	R15	03/05/2023	$y = 1.198x - 4.617$	0.997
R16	R16	04/05/2023	$y = 1.199x - 5.485$	0.995
R17	R17	04/05/2023	$y = 1.184x - 4.669$	0.998
R18	R18	04/05/2023	$y = 1.167x - 4.142$	0.998
R19	R19	04/05/2023	$y = 1.197x - 5.308$	0.997
R20	R20	02/05/2023	$y = 1.244x - 8.211$	0.999

Calibrated by :

Approved by :





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

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

7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900

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

## CALIBRATION REPORT

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

DATE : 11 June 2023

BRAND : API

MODEL : 200E

NO. NOX-R04

SERIAL NO. 4411

#### Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 04 August 2022

Serial No. : 911

#### Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : D636192

Certified Date : 20 April 2022

Expired Date : 20 April 2024

Cylinder Conc. : 49.1 ppm

#### CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.5 °C

% RH 49

#### CALIBRATION SETTING

Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
Set Point	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	-0.10	-	0	-
NO Span	400	399.6	-0.100	400.0	1.003
NO <sub>x</sub> Span	400	399.8	-0.050	400.0	1.006

#### API Model 200E NO<sub>x</sub> Analyzer Check List

Test Values	Observed Value	Units	Nominal Range
RANGE	500	PPB	500 standard
STABILITY (Zero Gas)	0.1	PPB	< 2 with zero air
SAMPLE FLOW	506	cc/min	500 ± 50
OZONE FLOW	78	cc/min	80 ± 15
PMT	103.6	mV	-20 - 150
AZERO	93.9	mV	-20 - 150
HVPS	672	V	420 - 900 constant
RCELL TEMP	50.3	°C	50 ± 1
BOX TEMP	29.3	°C	8 - 48
PMT TEMP	7.1	°C	7 ± 2
MOLY TEMP	315.1	°C	315 ± 5
RCELL PRESS	8.5	IN-Hg-A	2 - 10 constant
SAMPLE PRESS	28.7	IN-Hg-A	25 - 30 constant
NO Span Conc	400	PPB	20 - 20,000
NO <sub>x</sub> Span Conc	400	PPB	20 - 20,000
NO Slope	1.003	-	1.0 ± 0.3
NO <sub>x</sub> Slope	1.006	-	1.0 ± 0.3
NO Offset	1.2	mV	-20 to +150
NO <sub>x</sub> Offset	0.6	mV	-20 to 150
Stability at Zero	0.1	PPB	< 0.2
Stability at Span	0.2	PPB	< 2 ppb @ 400 ppb span gas

Calibrated by :

Approved by :



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

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## CALIBRATION REPORT

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

DATE : 11 June 2023

BRAND : API

MODEL : 200E

NO. NOX-R03

SERIAL NO. 4410

#### Calibrator (Dilution System)

Brand : API

Model : 700

Last Cal. Date : 04 August 2022

Serial No. : 911

#### Reference Standard Gas

Standard Gas : Nitric Oxide (NO)

Cylinder No. : D636192

Certified Date : 20 April 2022

Expired Date : 20 April 2024

Cylinder Conc. : 49.1 ppm

#### CALIBRATING CONDITION

Pressure 1011 mmbar

Temp. 24.6 °C

% RH 48

#### CALIBRATION SETTING

Span	Initial Reading (Before Adj.),PPB			Final Reading (After Adj.),PPB	
Set Point	Expected Concentration	Analyzer Response	%Dif	Analyzer Response	Slope
Zero	0	0.11	-	0	-
NO Span	400	400.2	0.050	400.0	1.001
NO <sub>x</sub> Span	400	400.3	0.075	400.0	1.006

#### API Model 200E NO<sub>x</sub> Analyzer Check List

Test Values	Observed Value	Units	Nominal Range
RANGE	500	PPB	500 standard
STABILITY (Zero Gas)	0.1	PPB	< 2 with zero air
SAMPLE FLOW	505	cc/min	500 ± 50
OZONE FLOW	78	cc/min	80 ± 15
PMT	102.8	mV	-20 - 150
AZERO	94.2	mV	-20 - 150
HVPS	670	V	420 - 900 constant
RCELL TEMP	50.2	°C	50 ± 1
BOX TEMP	29.1	°C	8 - 48
PMT TEMP	7.5	°C	7 ± 2
MOLY TEMP	314.7	°C	315 ± 5
RCELL PRESS	8.3	IN-Hg-A	2 - 10 constant
SAMPLE PRESS	28.5	IN-Hg-A	25 - 30 constant
NO Span Conc	400	PPB	20 - 20,000
NO <sub>x</sub> Span Conc	400	PPB	20 - 20,000
NO Slope	1.001	-	1.0 ± 0.3
NO <sub>x</sub> Slope	1.006	-	1.0 ± 0.3
NO Offset	1.7	mV	-20 to +150
NO <sub>x</sub> Offset	1.0	mV	-20 to 150
Stability at Zero	0.1	PPB	< 0.2
Stability at Span	0.2	PPB	< 2 ppb @ 400 ppb span gas

Calibrated by :

Approved by :



# QUALITY CALIBRATION CO.,LTD.

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

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

[www.qcalibration.com](http://www.qcalibration.com)



CERTIFICATE No : 23M2441

REFERENCE No : 68471-1

PAGE : 1 OF 2

## 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 : 

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 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 :-

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

3. 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

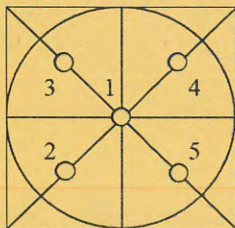
2. TARE FUNCTION : NORMAL

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 M  
COVERAGE FACTOR  $k=2$ , PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



ลำดับที่ 2

คุณภาพอากาศจากปล่อง



บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด  
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Tel : (662) 939-4370-72. Fax : (662) 513-4221, E-mail : sale@spscon.com., www.spscon.com

## Console Calibration Report

Calibration Method

Critical Orifices

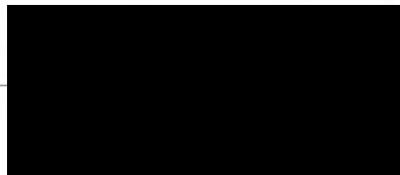
### Calibration Data

Console Data		Calibration Data		
No.	Serial No.	Date	y	$\Delta H_{@}$ (mmH <sub>2</sub> O)
B01	1563	02/06/2023	1.002	50.06
B02	8002514	05/06/2023	0.998	49.11
B03	1503016	01/06/2023	1.004	50.26
B04	00006659	05/06/2023	0.996	49.89
B05	00007428	02/06/2023	0.997	49.51
R01	1561	01/06/2023	0.995	49.93
R02	8002513	02/06/2023	1.003	49.77
R03	1570	01/06/2023	0.996	49.70
R04	8002519	05/06/2023	0.995	49.44
R05	1503015	01/06/2023	0.997	50.37

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

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

Calibrated by :



Approved by :





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด  
S.P.S. CONSULTING SERVICE CO., LTD.  
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## Pitot Tube Calibration Report

Calibration Method

Standard Pitot Tube

### Calibration Data

Pitot Tube Data			Calibration Data		
No.	Type of Pitot	Coefficient of Standard Pitot	Date	Avg. of Cp (test)	
				Side A	Side B
B36	S	0.99	02/05/2023	0.84	0.84
B37	S	0.99	02/05/2023	0.83	0.84
B38	S	0.99	03/05/2023	0.85	0.84
B39	S	0.99	03/05/2023	0.84	0.83
B40	S	0.99	02/05/2023	0.84	0.83
B41	S	0.99	02/05/2023	0.84	0.84
B44	S	0.99	03/05/2023	0.85	0.84
B45	S	0.99	03/05/2023	0.85	0.84
B46	S	0.99	04/05/2023	0.84	0.83
B47	S	0.99	03/05/2023	0.84	0.85
B48	S	0.99	03/05/2023	0.83	0.84
B49	S	0.99	03/05/2023	0.85	0.84
B54	S	0.99	03/05/2023	0.83	0.84
B56	S	0.99	02/05/2023	0.84	0.85
B57	S	0.99	02/05/2023	0.84	0.83
B58	S	0.99	02/05/2023	0.85	0.84

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

Calibrated by :

Approved by :



**QUALITY CALIBRATION CO.,LTD.**

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

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

[www.qcalibration.com](http://www.qcalibration.com)

CERTIFICATE No : 23M2441

REFERENCE No : 68471-1

PAGE : 1 OF 2

**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** : 

**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 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 :-

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

3. 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

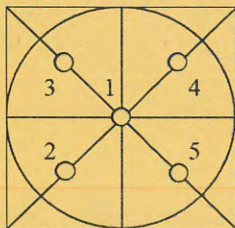
2. TARE FUNCTION : NORMAL

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  
COVERAGE FACTOR  $k=2$ , PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



# SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY



451-451/1 Sirinthorn Rd., Bangbumru, 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,  
CHOMPHON, CHATUCHAK,  
BANGKOK 10900, THAILAND.  
  
**Location :** ORGANIC LABORATORY IV  
  
**Ambient Temperature :** ( 24.4 ± 5 ) °C  
**Relative Humidity :** ( 60.1 ± 25 ) %  
  
**Received Date :** 30 AUGUST 2022  
**Calibration Date :** 30 AUGUST 2022  
**Date of Issue :** 31 AUGUST 2022

**Calibrated by :**

**Approved by :**

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

## Continuation of Calibration Certificate

Cert. No. : SP22018

Job No. : VC65SP0008

Pages : 2 of 3

**Calibration Method :**

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

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

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

**Condition of this result of calibration :**

## 1. Certified reference materials

Material	Ref. type	Cell serial No.	Cert. No.	Due Date
Holmium liquid	RM-HL	29706	87569	13/10/2022
Didymium liquid	RM-DL	28912	87588	15/10/2022
Neutral density filter	RM-1N2N3N	13877	87600	15/10/2022
Potassium dichromate solutions	RM-0204060810	14204	87614	16/10/2022
Potassium Iodide solution	-	KI-0701-001	CI-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
	640.50	640.5	0.00	0.16	2.00
RM-DL	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	235.0	20	0.2436	0.2419	-0.0017	0.0101	2.00	
		40	0.4905	0.4855	-0.0050	0.0115	2.00	
		60	0.7453	0.7388	-0.0065	0.0067	2.00	
		80	0.9920	0.9839	-0.0081	0.0071	2.00	
		100	1.2487	1.2414	-0.0073	0.0073	2.00	

UUC\* = Unit Under Calibration

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

Resolution of Wavelength Mode 0.1 nm

Resolution of Photometric Mode 0.0001 A

Parameter Setting

Measurement Mode Wavelength, Absorbance

Wavelength Scan 1100 nm-190 nm

Scanning Speed 7.5 nm/min

Data Pitch 0.1 nm

Band width(Wavelength) 1.0 nm

Band width(Vis) 1.0 nm

Band width(Uv) 1.0 nm

Stray Light\*\* UUC\* Reading at 220 nm

Transmission T(%) Absorbance(A)

0.0107

3.9886

\*\*Specific Acceptance :

Transmission  $\leq 1.0$  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



ลำดับที่ 3

ระดับเสียง

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

## CALIBRATION CERTIFICATE

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

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

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

### Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : ACO

Model : 2127

Serial No. : 130006

### Ambient Environment

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

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

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

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

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

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

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

Date of Receipt : 27 Mar. 2023

Date of Calibration : 29 Mar. 2023

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

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

FM.BL.MTC.002 Rev.4

#### Head Office

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

#### Office/Laboratory

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

#### Office

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

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

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

Nominal Output of Unit Under Test = 94 dB re 20 $\mu$ Pa at 1000 Hz

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

1. Sound Pressure Level

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

2. Frequency

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

3. Total distortion

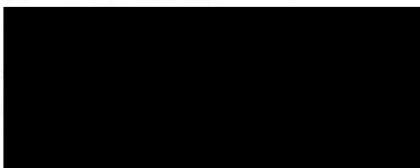
Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1.80	$\pm 0.50$	$\pm 3.0\%$

Note : 1. No adjustment.

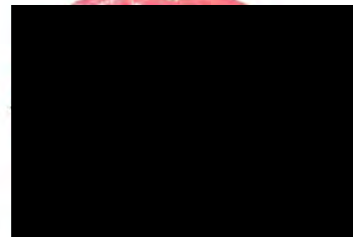
2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :



Approved by :



Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 29 Mar. 2023

Date of Issue : 30 Mar. 2023

Ref : 2011266032701228001

End of Certificate

2 / 2

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

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

FM.BL.MTC.002 Rev.4

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

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

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



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

Noise R\_304/23

## Sound Level Meter Calibration Report

### Acoustic Calibrator Data

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

### Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
ACO-R36	ACO	6236	00192048	11 June 2023	94.0	94.0
ACO-R38	ACO	6236	00192050	11 June 2023	94.0	94.0
ACO-R42	ACO	6236	00192054	11 June 2023	94.1	94.0
ACO-R44	ACO	6236	00192056	11 June 2023	94.0	94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.94 ± 0.10 dB	

Calibrated by :



Approved by :





ลำดับที่ 4

คุณภาพน้ำ



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 21CH1216

Page.: 1 of 2

## Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	HANNA
Model :	HI 3512
Serial No. :	08685754
ID No. :	-
Condition As-Received:	Used Item
Received Date :	14 September 2021
Calibration Date :	16 September 2021
Reference :	2109-0508WN-1
Submitted by :	S.P.S. Consulting Service Co.,Ltd. 7 Phaholyothin 24, Phaholyothin Road, Jompol, Chatuchak, Bangkok10900
Ambient Temperature :	(25 ± 2.5) °C
Relative Humidity :	(50 ± 15) %
Calibration Procedure :	In - house method : - CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)

Calibrated by :

Approved by :

- (✓) Malee Butkruea  
( ) Saithip Meangmai  
( ) Warakorn Lernagtrakul

Issue Date :

22 September 2021

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 Corporate Services 3 : Equipment Calibration and Testing Services.

A 0032410



Cert. No.: 21CH1216

Page.: 2 of 2

**Condition of this calibration result**

1. Reference Standard Instrument : -

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Document Process Calibrator	46530031	130RC098	20E3666	14 Oct 2021

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

- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd.,  
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.008	CPA chem	754028	28 June 2023
pH 6.985	CPA chem	725927	12 Jan 2022
pH 10.015	CPA chem	761018	02 Aug 2022

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

**Calibration Results****Function : mV Measurement**

Performing standard curve by Fluke at pH (4,7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement ( $\pm$ mV)	Coverage factor <i>k</i>
	pH	mV	mV	pH		
pH Meter S/N.: 08685754	4.000	177.48	177.9	4.000	0.058	2.00
	7.000	0.00	0.4	7.000	0.058	2.00
	10.000	-177.48	-177.2	10.000	0.058	2.00

**Function : pH Measurement**

Performing three buffers standard curve by using buffer nominal pH (4,7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement ( $\pm$ )	Coverage factor <i>k</i>
pH Electrode S/N.: 061416CM	4.008	4.008	169.2	0.0046	2.00
	6.985	6.985	-4.4	0.0075	2.00
	10.015	10.013	-178.9	0.013	2.05

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-





CERTIFICATE No : 23M2442

REFERENCE No : 68471-2

PAGE : 1 OF 2

## Certificate of Calibration

**EQUIPMENT** : DIGITAL BALANCE

**MANUFACTURER** : SARTORIUS

**MODEL** : BSA224S-CW

**SERIAL No** : 36591843

**ID No** : BA 09/61

**CONDITION AS RECEIVED** : USED ITEM

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

**CALIBRATED BY** : ATSAWIN Y.

**CALIBRATION DATE** : 10-Mar-23

**APPROVED BY** : 

**ISSUED DATE** : 16-Mar-23

**RECEIVED DATE** : 10-Mar-23





CERTIFICATE No : 23M2442

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : BSA224S-CW  
MANUFACTURER : SARTORIUS S/N : 36591843  
ID No : BA 09/61 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	QK-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

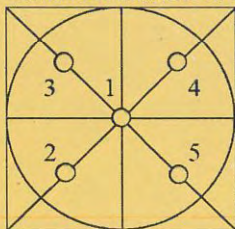
2. TARE FUNCTION : NORMAL

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)
0.0	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





# QUALITY CALIBRATION CO.,LTD.

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

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

[www.qcalibration.com](http://www.qcalibration.com)

CERTIFICATE No : 22T10972  
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 :

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 : 22T10972

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

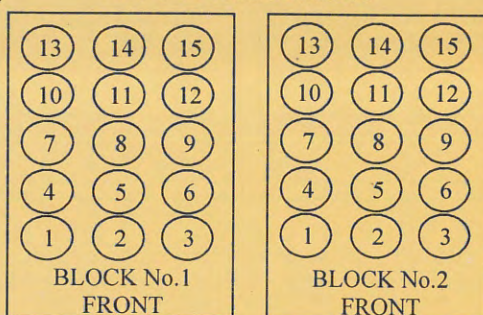
1. THIS INSTRUMENT WAS CALIBRATED BY DIRECT MEASUREMENT TEMPERATURE RECORDER WITH THERMOCOUPLE TYPE K UNDER NO LOAD CONDITION. THE THERMOCOUPLES WERE PLACED ON 15 POINTS AND LOCATED ONE THERMOCOUPLE IN EACH OF THE FOUR CORNERS OF THE REACTOR AND PLACED THE EIGHTH THERMOCOUPLE AT THE CENTER OF THE REACTOR.

### 2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH TC TYPE K	HYDRA 2635A	8009008	22T7511	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



### 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	149.8
	9	149.9
	10	149.8
	11	149.9
	12	149.7
	13	149.9
	14	149.9
	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

## ลำดับที่ 5

คุณภาพอากาศในการทำงาน





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

Personal Pump Calibration Report

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Environmental Conditions

Temperature : 25  $\pm$  3  $^{\circ}$ C  
Pressure : 1010  $\pm$  15 mmbar

Personal Pump Data				Calibration Data								
No.	Brand	Model	Serial No.	Date	Flow Rate (ml/min)						Value From Calibration Curve	
					Setting			Actual (Q std.)				
					1	2	3	1	2	3	y	R <sup>2</sup>
R01	SKC	224-PCXR4	602467	10/04/2023	1,000	1,500	2,000	992	1,507	2,005	1.009x - 15.491	1.000
R02	SKC	224-PCXR4	626450	10/04/2023	1,000	2,000	3,000	997	1,497	1,989	0.990x + 10.155	1.000
R03	SKC	224-PCXR4	691592	10/04/2023	1,000	1,500	2,000	1,005	1,498	2,003	1.010x - 19.567	0.999
R04	SKC	224-PCXR4	691672	04/04/2023	1,000	1,500	2,000	998	1,491	1,997	0.998x - 1.962	1.000
R05	SKC	224-PCXR4	798470	10/04/2023	1,000	1,500	2,000	994	1,506	1,998	1.012x - 28.038	0.999
R06	SKC	224-PCXR4	798456	05/04/2023	1,000	1,500	2,000	993	1,497	1,995	1.004x - 10.749	1.000
R07	SKC	224-PCXR4	798480	10/04/2023	1,000	1,500	2,000	996	1,492	1,998	1.005x - 11.766	1.000
R08	SKC	224-PCXR4	883215	10/04/2023	1,000	1,500	2,000	1,010	1,503	2,003	0.998x + 3.526	1.000
R09	SKC	224-PCXR4	034650	04/04/2023	1,000	1,500	2,000	994	1,505	2,003	1.017x - 33.985	0.999
R10	SKC	224-PCXR4	091765	07/04/2023	1,000	1,500	2,000	998	1,492	1,996	1.000x - 3.929	1.000
R11	SKC	224-PCXR4	091763	04/04/2023	1,000	1,500	2,000	1,002	1,497	2,003	1.012x - 23.883	0.999
R12	SKC	224-PCXR4	091568	10/04/2023	1,000	1,500	2,000	995	1,503	1,998	1.002x - 7.698	1.000
R13	SKC	224-PCXR4	091638	10/04/2023	1,000	1,500	2,000	1,005	1,497	1,993	0.989x + 13.679	1.000
R14	SKC	224-PCXR4	091764	10/04/2023	1,000	1,500	2,000	992	1,503	1,998	1.015x - 32.167	0.999
R15	SKC	224-PCXR8	529457	10/04/2023	1,000	1,500	2,000	1,003	1,501	2,005	1.005x - 9.429	1.000
R16	SKC	224-PCXR8	529643	04/04/2023	1,000	1,500	2,000	999	1,496	1,995	0.999x - 3.290	1.000
R17	SKC	224-PCXR8	529645	05/04/2023	1,000	1,500	2,000	995	1,511	2,001	1.012x - 23.233	0.999
R18	SKC	224-PCXR8	566756	07/04/2023	1,000	1,500	2,000	992	1,497	1,999	1.002x - 7.359	1.000
R19	SKC	224-PCXR8	566802	07/04/2023	1,000	1,500	2,000	1,002	1,498	1,999	1.009x - 19.671	0.999
R20	SKC	224-PCXR8	529089	07/04/2023	1,000	1,500	2,000	992	1,501	2,004	1.015x - 28.270	1.000
R21	SKC	224-PCXR8	665728	10/04/2023	1,000	1,500	2,000	997	1,494	1,997	1.001x - 7.797	1.000
R22	SKC	224-PCXR8	707444	05/04/2023	1,000	1,500	2,000	1,003	1,501	2,003	1.003x - 6.218	1.000
R23	SKC	224-PCXR8	761067	10/04/2023	1,000	1,500	2,000	996	1,495	1,993	0.995x + 0.263	1.000
R24	SKC	224-PCXR8	707893	10/04/2023	1,000	1,500	2,000	997	1,506	2,002	1.009x - 17.713	0.999
R25	SKC	224-PCXR8	761052	10/04/2023	1,000	1,500	2,000	1,009	1,497	1,992	0.983x + 22.945	1.000
R26	SKC	224-PCXR8	707956	10/04/2023	1,000	1,500	2,000	1,004	1,502	2,005	1.008x - 14.326	0.999
R27	SKC	224-PCXR8	707398	07/04/2023	1,000	1,500	2,000	995	1,502	2,002	1.007x - 16.361	1.000
R28	SKC	224-PCXR8	707481	10/04/2023	1,000	1,500	2,000	1,006	1,501	2,003	1.009x - 18.291	0.999
R29	SKC	224-PCXR8	707402	07/04/2023	1,000	1,500	2,000	1,002	1,494	1,989	0.987x + 14.566	1.000
R30	SKC	224-PCXR8	093811	04/04/2023	1,000	1,500	2,000	1,001	1,494	1,996	0.997x + 0.646	1.000
R31	SKC	224-PCXR8	093183	10/04/2023	1,000	1,500	2,000	1,001	1,502	2,004	1.004x - 5.652	1.000
R32	SKC	224-PCXR8	671950	05/04/2023	1,000	1,500	2,000	999	1,501	1,993	0.994x + 7.163	1.000
R33	SKC	224-PCXR4	626254	10/04/2023	1,000	1,500	2,000	996	1,504	2,001	1.015x - 30.192	0.999
R34	SKC	224-PCXR4	626131	04/04/2023	1,000	1,500	2,000	1,003	1,498	2,004	1.004x - 9.377	1.000
R35	SKC	224-PCXR8	707460	10/04/2023	1,000	1,500	2,000	998	1,496	1,996	0.996x + 3.677	1.000
R36	SKC	224-PCXR8	707446	10/04/2023	1,000	1,500	2,000	1,003	1,498	2,002	1.010x - 20.668	0.999
R37	SKC	224-PCXR8	707432	10/04/2023	1,000	1,500	2,000	998	1,496	2,000	0.999x - 0.873	1.000
R38	SKC	224-PCXR8	707349	07/04/2023	1,000	1,500	2,000	997	1,497	2,001	1.003x - 8.747	1.000
R39	SKC	224-PCXR8	761095	10/04/2023	1,000	1,500	2,000	1,001	1,497	1,997	0.999x + 0.140	1.000

Calibrated by :

Approved by





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

Rotameter Calibration Report (For Personal Pump High Flow Adjust)

Calibration Method : Dry Cal Primary Flowmeter

Model : Defender 510-H

S/N : 136164

Calibration Data

Rotameter Data			Calibration Data								
No.	Brand	Model	Date	Flow Rate (ml/min)						Value From Calibration Curve	
				Flow Rate (Reading)			Actual (Q std.)				
				1	2	3	1	2	3	y	R²
H-R01	Dwyer	VFB-65	05/04/2023	500	1,000	2,000	502.1	993.6	1981.1	1.000x - 3.647	0.999
H-R02	Dwyer	VFB-65	10/04/2023	500	1,000	2,000	500.4	998.7	1988.7	1.001x - 3.457	1.000
H-R03	Dwyer	VFB-65	07/04/2023	500	1,000	2,000	502.1	990.3	1997.7	0.993x + 4.022	1.000
H-R04	Dwyer	VFB-65	10/04/2023	500	1,000	2,000	497.2	992.2	2016.9	1.007x - 11.203	1.000
H-R05	Dwyer	VFB-65	05/04/2023	500	1,000	2,000	499.2	988.5	1990.7	1.003x - 7.136	1.000
H-R06	Dwyer	VFB-65	10/04/2023	500	1,000	2,000	504.8	994.6	1982.6	0.999x - 1.961	0.999

Calibrated by :

Approved by :

**QUALITY CALIBRATION CO.,LTD.**

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

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

[www.qcalibration.com](http://www.qcalibration.com)

CERTIFICATE No : 23M2441

REFERENCE No : 68471-1

PAGE : 1 OF 2

**Certificate of Calibration**

**EQUIPMENT** : DIGITAL BALANCE

**MANUFACTURER** : METTLER TOLEDO

**MODEL** : XS105DU

**SERIAL No** : 1126422905

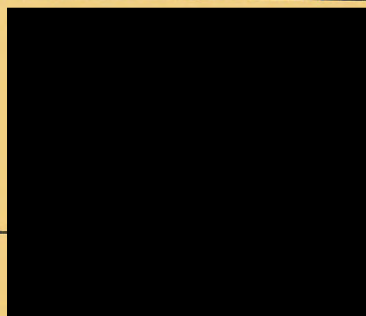
**ID No** : BA 05/50

**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** :

**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 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 :-

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

3. 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

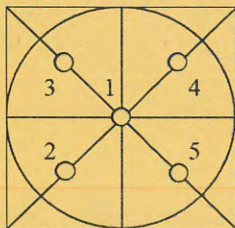
2. TARE FUNCTION : NORMAL

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





## MAINTENANCE AND TEST CERTIFICATE MODEL

### OPTIMA 5300DV

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

CONFIGURATION TESTED		ACCESSORIES/COMPONENT NOT INCLUDED
<b>MODEL</b>	<b>SERIAL NUMBER</b>	
<u>OPTIMA 5300DV</u>	<u>077C7042401</u>	
<b>TESTED EQUIPMENT</b>	<b>CALIBRATION NUMBER</b>	<b>EXPIRATION</b>
<u>IPV Methods</u>		
<b>TEST STANDARD USED</b>	<b>PART NUMBER</b>	<b>EXPIRATION DATE</b>
<u>Multielement Standard</u>	<u>N069-1579</u>	<u>May 30, 2023</u>
<u>Wavecal Solution</u>	<u>N058-2152</u>	<u>February 28, 2023</u>
<u>VIS Wavecal solution</u>	<u>N930-2946</u>	<u>August 30, 2023</u>
<u>Instrument Cal. STD4</u>	<u>N930-0221</u>	<u>November 30, 2023</u>
<b>CUSTOMER SUPPLIED</b>	<b>COMMENTS</b>	<b>CUSTOMER INITIALS</b>
<u>2 % HNO3</u>		
<u>10 % HNO3</u>		



## MAINTENANCE AND TEST CERTIFICATE MODEL

### OPTIMA 5300DV

**SERIAL NUMBER** 077C7042401**DATE TESTED** January 11, 2023**1. MECHANICAL CHECKS**

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

**2. OPTICAL CHECKS**

- |   |                             |
|---|-----------------------------|
| A. Inspect and clean all optical components.        | <input type="checkbox"/> OK |
| B. As required, check and replace all purgefilters. | <input type="checkbox"/> OK |
| C. Recheck optical alignment.                       | <input type="checkbox"/> OK |

**3. COOLING SYSTEM CHECKS**

- |   |                              |
|---|------------------------------|
| A. Perform preventive maintenance on chiller. | <input type="checkbox"/> OK  |
| B. Flush out the chiller every year.          | <input type="checkbox"/> N/A |

**4. PERFORMANCE CHECKS**

- |                            |                             |
|----------------------------|-----------------------------|
| A. Torch View Alignment.   | <input type="checkbox"/> OK |
| B. Wavelength Calibration. | <input type="checkbox"/> OK |



## MAINTENANCE AND TEST CERTIFICATE MODEL

### OPTIMA 5300DV

**SERIAL NUMBER :** 077C7042401
**DATE TESTED :** January 11, 2023

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





## MAINTENANCE AND TEST CERTIFICATE MODEL

### OPTIMA 5300DV

**SERIAL NUMBER** 077C7042401**DATE TESTED** January 11, 2023**Remarks :**

Commissioning follow as commissioning performance sheets.

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

☒

meets

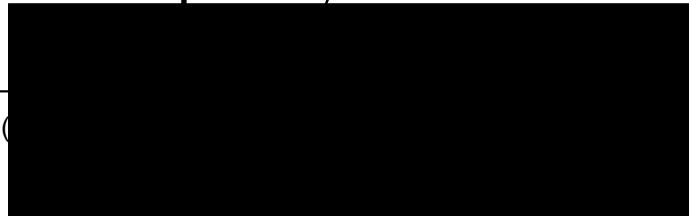
☐

does not meet

the PerkinElmer Specifications listed on this certificate.

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

**Service Department PerkinElmer Ltd.**

**Authorized Representative:**



## 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.**



บริษัท อาร์เคมีคัล แล็บ จำกัด

Operator Signa

te : Jan 4, 2023

Test Engineer

## ลำดับที่ 6

ระดับเสียงในการทำงาน



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

## CALIBRATION CERTIFICATE

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

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

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

### Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : ACO

Model : 2127

Serial No. : 130006

### Ambient Environment

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

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

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

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

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

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

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

Date of Receipt : 27 Mar. 2023

Date of Calibration : 29 Mar. 2023

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

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FM.BL.MTC.002 Rev.4

#### Head Office

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0413

MTC No. EEL. BP. 109/0366

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

Nominal Output of Unit Under Test = 94 dB re 20 $\mu$ Pa at 1000 Hz

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

1. Sound Pressure Level

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

2. Frequency

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

3. Total distortion

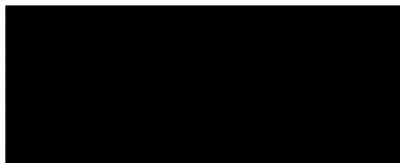
Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1.80	$\pm 0.50$	$\pm 3.0\%$

Note : 1. No adjustment.

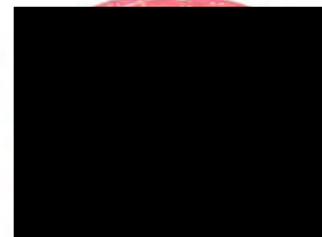
2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :



Approved by :



Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 29 Mar. 2023

Date of Issue : 30 Mar. 2023

Ref : 2011266032701228001

End of Certificate

2 / 2

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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

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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



Request No. 21-65/0760

MTC No. EEL. BP. 24/0965

## 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 : Acoustic Calibrator

Manufacturer : SVANTEK

Model : SV34

Serial No. : 33139

### Ambient Environment

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

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

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

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

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

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

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

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

6. Audio Analyzer Panasonic VP-7722A S/N 041477D122.

7. Condenser Microphone Bruel&Kjaer 4180 S/N 2633526.

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 : 13 Sep. 2022

Date of Calibration : 19 Sep. 2022

1 / 2

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Amphoe Muang, Changwat Samutprakan 10280, Thailand  
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E-mail : mtc@tistr.or.th

#### Office

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E-mail : sumalee@tistr.or.th



**Request No.** 21-65/0760

**MTC No.** EEL. BP. 24/0965

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

**Nominal Output of Unit Under Test = 114 dB re 20 $\mu$ Pa at 1000 Hz**

**Acoustic Output in dB re 20 $\mu$ Pa, Corrected to Reference Conditions: 101.325 kPa, 23.0 °C and 50 %RH.**

**1. Sound Pressure Level**

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	113.63	-0.37	$\pm 0.10$	$\pm 0.75$ dB

**2. Frequency**

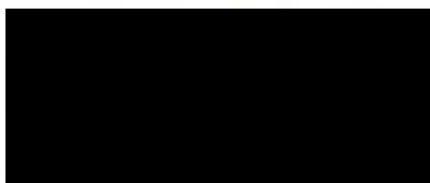
Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	1000.0	0.0	$\pm 1.5$	$\pm 2.0$ %

**3. Total Distortion**

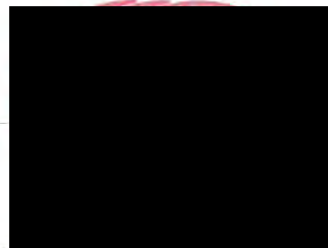
Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	0.24	$\pm 0.50$	$\pm 4.0$ %

- Note :**
1. No adjustment.
  2. The calibrator pressure correction was not included.
  3. The microphone volume correction was not included.

**Calibrated by :**



**Approved by :**



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

**Date of Calibration** : 19 Sep. 2022

**Date of Issue** : 20 Sep. 2022

**Ref** : 2011265091304034002

2 / 2

End of Certificate

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E-mail : sumalee@tistr.or.th



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

Noise R\_177/23

## Sound Level Meter Calibration Report

### Acoustic Calibrator Data

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

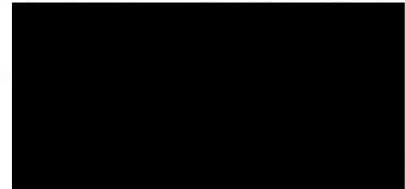
### Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
ACO-R08	ACO	6236	00152082	18 April 2023	94.1	94.0
ACO-R37	ACO	6236	00192049	18 April 2023	94.1	94.0
ACO-R38	ACO	6236	00192050	18 April 2023	94.0	94.0
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					93.94 ± 0.10 dB	

Calibrated by :



Approved by :







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

Noise Dose R\_184/23

### Noise Dose Meter Calibration Report

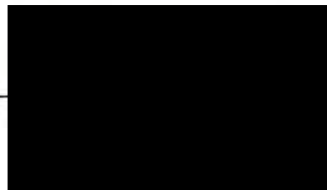
#### Acoustic Calibrator Data

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

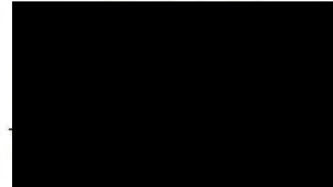
#### Calibration Data

Sound Level Meter Data				Calibration Data		
SLM No.	Brand	Model	Serial No.	Date	Actual Reading [dB]	
					Before Adjustment	After Adjustment
NMD-R07	SVANTEK	SV-104IS	60147	18 April 2023	113.6	113.6
NMD-R26	SVANTEK	SV-104IS	80836	18 April 2023	113.6	113.6
NMD-R34	SVANTEK	SV-104IS	80872	18 April 2023	113.5	113.6
Acoustic Certified Value : Thailand Institute of Scientific and Technological Research (TISTR)					113.63 ± 0.10 dB	

Calibrated by :



Approved by :



## ลำดับที่ 7

ระดับความร้อนในการทำงาน



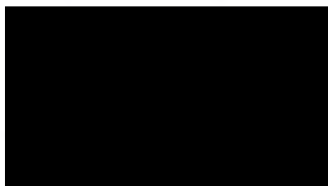


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7 Soi Phaholyothin 24, Phaholyothin Rd., Jompol, Chatuchak, Bangkok 10900  
Tel : (662) 939-4370-72, Fax : (662) 513-4221, E-mail : sale@spscon.com, www.spscon.com

Heat R020\_1

Heat Stress WBGT Meter Verification Report			
Verification Data			
Heat Stress WBGT Meter No.	: R04	Verification Date	: 18 April 2023
Brand	: 3M	Ambient Temp.	: 24.5 °C
Model	: QUESTemp <sup>®</sup> 34	Barometric Pressure	: 1011 mmbar
Serial No.	: TEN040005	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	47.1	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 :



Approved by :



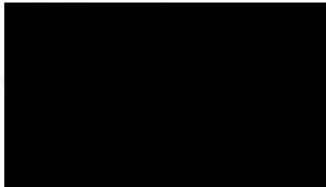


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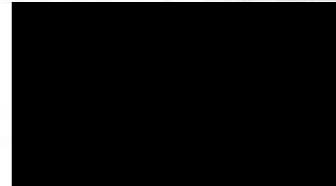
Heat R020\_3

Heat Stress WBGT Meter Verification Report			
Verification Data			
Heat Stress WBGT Meter No.	: R09	Verification Date	: 18 April 2023
Brand	: 3M	Ambient Temp.	: 24.5 °C
Model	: QUESTemp <sup>®</sup> 36	Barometric Pressure	: 1011 mmbar
Serial No.	: TKE060012	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	69.4	-0.1	± 0.5
UUC* = UNIT UNDER CALIBRATION			

Verified by :



Approved by :





บริษัท เอส.พี.เอส. คอนซัลติ้ง เซอร์วิส จำกัด

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

7 ซอยพหลโยธิน 24 ถนนพหลโยธิน แขวงจอมพล เขตจตุจักร กรุงเทพฯ 10900

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

Heat R046

### Heat Stress WBGT Meter Verification Report

#### Verification Data

Heat Stress WBGT Meter No.	: R11	Verification Date	: 18 May 2023
Brand	: 3M	Ambient Temp.	: 24.5 °C
Model	: QUESTemp <sup>OTM</sup> 32	Barometric Pressure	: 1011 mmbar
Serial No.	: TPM010103	Relative Humidity	: 49 %

#### Verification Module (Electronic Sensor Check) :

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

#### Result of Verification : Without Adjustment

##### Wet Probe Temperature Measurement

Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
12.5	12.6	-0.1	±0.5

##### Dry Probe Temperature Measurement

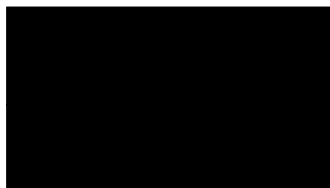
Verification Module Reading (°C)	UUC* Reading (°C)	Correction (°C)	Tolerance Limit (°C)
47.1	47.2	-0.1	± 0.5

##### Globe Probe Temperature Measurement

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

UUC\* = UNIT UNDER CALIBRATION

Verified by :



Approved by :

