

เอกสารแนบ 6

เอกสารสอบเทียบเครื่องมือที่ใช้ในการ
ตรวจวิเคราะห์



CERTIFICATE No : 24M9746
REFERENCE No : 74774-1

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : SARTORIUS
MODEL : BSA224S-CW
SERIAL No : 3142616377
ID No : LE-SVP-001
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : GEM ENVIRONMENTAL MANAGEMENT CO., LTD. (SUARNABHUMI) WASTEWATER TREATMENT PLANT, SUARNABUMIAIRPORT, 999 MOO.1 NONGPRUE, BANGPHLI, SAMUTPRAKAN 10540

CALIBRATED BY

CALIBRATION DATE

APPROVED BY

ISSUED DATE

RECEIVED DATE

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



CERTIFICATE No : 24M9746

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : SARTORIUS
ID No : 3142616377
AIR PRESSURE : 1009mbar $\pm$ 1mbar
AMBIENT TEMPERATURE : 25° C $\pm$ 1° C
RECEIVED DATE : 27-Sep-24
CALIBRATION DATE : 27-Sep-24
RELATIVE HUMIDITY : 50 %RH $\pm$ 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 62019 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 : MODEL : SERIAL No : CERTIFICATE No : DUE DATE :
E2 : QK-1-151 : M2302013S : 02-Feb-25
E2 : 15843 : M2302014S : 02-Feb-25
2) STANDARD WEIGHT :
3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND)

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 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	0.000082
0.1	0.1000	0.0000	0.000083
0.2	0.2000	0.0000	0.000083
0.5	0.5000	0.0000	0.000083
1.0	1.0000	0.0000	0.000084
2.0	2.0000	0.0000	0.000084
5.0	5.0000	0.0000	0.000086
10.0	10.0000	0.0000	0.000089
20.0	20.0000	0.0000	0.000094
50.0	50.0000	0.0000	0.00012
100.0	100.0000	0.0000	0.00019
200.0	200.0000	0.0000	0.00019

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	100.0000
2	100.0000
3	100.0000
4	100.0000
5	100.0000
OFF-CENTER LOADING	0.0000

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

END OF CALIBRATION REPORT



CERTIFICATE No : 24M9747
REFERENCE No : 74774-2

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : SARTORIUS
MODEL : BSA3202S-CW
SERIAL No : 3142612617
ID No : LE-SVP-002
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : GEM ENVIRONMENTAL MANAGEMENT CO., LTD. (SUARNABHUMI) WASTEWATER TREATMENT PLANT, SUARNABUMIAIRPORT, 999 MOO.1 NONGPRUE, BANGPHLI, SAMUTPRAKAN 10540

CALIBRATED BY

CALIBRATION DATE

APPROVED BY

ISSUED DATE

RECEIVED DATE



CERTIFICATE No : 24M9747

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : SARTORIUS
ID No : LE-SVP-002
AIR PRESSURE : 1009mbar $\pm$ 1mbar
AMBIENT TEMPERATURE : 25°C $\pm$ 1°C
MODEL : BSA3202S-CW
S/N : 3142612617
RECEIVED DATE : 27-Sep-24
CALIBRATION DATE : 27-Sep-24
RELATIVE HUMIDITY : 50 %RH $\pm$ 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

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

2. REFERENCE STANDARD INSTRUMENTS :-

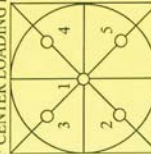
1. STANDARD WEIGHT SET
2. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
3. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
4. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND)

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL
2. TARE FUNCTION : NORMAL
3. REPEATABILITY OF READING AT 2500 g WAS 0 g
4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY ($\pm$ g)
0.0	0.00	0.00	0.0088
5.0	5.00	0.00	0.0088
10.0	10.00	0.00	0.0088
20.0	20.00	0.00	0.0088
50.0	50.00	0.00	0.0088
100.0	100.00	0.00	0.0088
200.0	200.00	0.00	0.0088
500.0	500.00	0.00	0.0088
1000.0	1000.00	0.00	0.0088
2000.0	2000.00	0.00	0.0088
3000.0	3000.00	0.00	0.0088

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	1000.00
2	1000.00
3	1000.00
4	1000.00
5	1000.00
OFF-CENTER LOADING	0.00

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 : 24T9748
REFERENCE No : 74774-3

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : HOT AIR OVEN
MANUFACTURER : MEMMERT
MODEL : UF 55
SERIAL No : B222.032
ID No : LE-SVP-003
CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : GEM ENVIRONMENTAL MANAGEMENT CO., LTD. (SUARNABHUMI) WASTEWATER TREATMENT PLANT, SUARNABUMIAIRPORT, 999 MOO.1 NONGPRUE, BANGPHLI, SAMUTPRAKAN 10540

CALIBRATED BY :
CALIBRATION DATE :

APPROVED BY :
ISSUED DATE :
RECEIVED DATE :



CERTIFICATE No : 24T9748

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : HOT AIR OVEN
MANUFACTURER : MEMMERT
MODEL : UF 55
ID No : B222.032
RECEIVED DATE : 27-Sep-24
AMBIENT TEMPERATURE : 25 °C ± 1 °C
S/N :
CALIBRATION DATE : 27-Sep-24
RELATIVE HUMIDITY : 50 %RH ± 10 %RH

CONDITION OF THIS RESULTS OF CALIBRATION

- THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED RTD Pt100 UNDER NO LOAD CONDITION. THE TEMPERATURE PROBES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOMETER PROBE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOMETER PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.
- REFERENCE STANDARD INSTRUMENTS :-
 - 1) DATA LOGGER WITH RTD HYDRA 2635A
 3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
 4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
 5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
 - NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO., LTD.
- RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 0
Overall Line Voltage (V) variation : 1
Instrument Condition : Normal
Chamber Size (W*L*H): 40*33*40 cm

CHAMBER PERFORMANCE

Calibration Point (°C)	Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
104.0	104.0	104.0	0.06	0.55	0.60

TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (± °C)
		#1	#2	#3	#4	Ref. 5	#6	#7	#8	#9	
104.0	104.0	104.27	104.13	104.07	104.21	104.42	104.21	103.91	104.12	104.22	0.38

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

NOTE 2 : LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

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

END OF CALIBRATION REPORT



CERTIFICATE No : 24T9749
REFERENCE No : 74774-4

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : HOT AIR OVEN
MANUFACTURER : MEMMERT
MODEL : UF 55
SERIAL No : B222.033
ID No : LE-SVP-004
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : GEM ENVIRONMENTAL MANAGEMENT CO., LTD. (SUARNABHUMI) WASTEWATER TREATMENT PLANT, SUARNABUMIAIRPORT, 999 MOO.1 NONGPRUE, BANGPHLI, SAMUTPRAKAN 10540

CALIBRATED BY :

CALIBRATION DATE :

APPROVED BY :

ISSUED DATE :

RECEIVED DATE :



CERTIFICATE No : 24T9749

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : HOT AIR OVEN
MANUFACTURER : MEMMERT
MODEL : UF 55
ID No : B222.033
RECEIVED DATE : 27-Sep-24
AMBIENT TEMPERATURE : 25 °C ± 1 °C
RELATIVE HUMIDITY : 50 %RH ± 10 %RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED THERMOCOUPLE TYPE K OR TYPE K UNDER NO LOAD CONDITION. THE THERMOCOUPLES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOCOUPLE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOCOUPLE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT : DATA LOGGER WITH TC TYPE K
MODEL : HYDRA 2635A
SERIAL No : 7301307
CERTIFICATE No : 24T6467
DUE DATE : 26-Jun-25

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

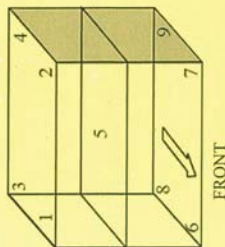
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

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

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 0
Overall Line Voltage (V) variation : 2
Instrument Condition : Normal
Chamber Size (W*L*H): 40*33*40 cm



CHAMBER PERFORMANCE

Calibration Point (°C)	Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
180	180.0	180.0	0.21	0.99	0.99

TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations							Uncertainty (±°C)
		#1	#2	#3	#4	#5	#6	#7	
180.0	180.0	179.75	179.70	179.64	179.42	180.02	179.94	179.46	179.59
									1.1

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

NOTE 2 : LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

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

END OF CALIBRATION REPORT



CERTIFICATE No : 24E9752
REFERENCE No : 74774-7

PAGE : 1 OF 3

Certificate of Calibration

EQUIPMENT : pH METER
MANUFACTURER : WTW
MODEL : PH 7310
SERIAL No : 22241035
ID No : LE-SVP-005
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : GEM ENVIRONMENTAL MANAGEMENT CO., LTD. (SUARNABHUMI) WASTEWATER TREATMENT PLANT, SUARNABUMIAIRPORT, 999 MOO.1 NONGPRUE, BANGPHLI, SAMUTPRAKAN 10540

CALIBRATED BY :
CALIBRATION DATE :
APPROVED BY :
ISSUED DATE :
RECEIVED DATE :

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



CERTIFICATE No : 24E9752

PAGE : 2 OF 3

Calibration Report

EQUIPMENT : pH METER
MANUFACTURER : WTW
MODEL : PH 7310
ID No : LE-SVP-005
SERIAL NUMBER : 22241035
RECEIVED DATE : 27-Sep-24
CALIBRATION DATE : 27-Sep-24
AMBIENT TEMPERATURE : 25° C ± 1° C
RELATIVE HUMIDITY : 50 %RH ± 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

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

INSTRUMENT	MODEL	SERIAL No/		DUE DATE
		LOT No	CERTIFICATE No	
1) pH STANDARD SOLUTION	00651-06	CC767907	4880-13836406	29-Dec-24
2) pH STANDARD SOLUTION	00651-08	CC765602	4881-13757019	18-Nov-24
3) pH STANDARD SOLUTION	00651-10	CC767180	4882-13813369	14-Dec-24
4) PROCESS CALIBRATOR	CA150	91S6079	24E1251	09-Apr-25
5) BATH	260014	1247 48074	24T9693	12-Sep-25
6) THERMOMETER WITH PROBE	421504	55000379	24T9694	12-Sep-25

3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO SI UNIT MAINTAINED AT :-

- NATIONAL INSTITUTE OF STANDARD AND TECHNOLOGY, USA.

- NATIONAL INSTITUTE OF METROLOGY (THAILAND)

RESULT OF CALIBRATION : WITHOUT ADJUSTMENT

1. DISPLAY UNIT ONLY

SLOPE FACTOR $k = 2.303 \text{ RT/F} = 59 \text{ mV/pH}$

mV APPLIED	UUC READING (mV)	CORRECTION (mV)	UUC READING (pH)	UNCERTAINTY OF MEASUREMENT (± mV)	COVERAGE FACTOR k
414.11	414.2	-0.09	0.22	0.150	2.00
354.95	355.1	-0.15	1.23	0.150	2.00
295.80	295.9	-0.10	2.24	0.150	2.00
236.64	236.8	-0.16	3.25	0.150	2.00
177.48	177.5	-0.02	4.27	0.150	2.00
118.32	118.5	-0.18	5.27	0.150	2.00
59.16	59.4	-0.24	6.29	0.150	2.00
0.00	0.1	-0.10	7.30	0.150	2.00
-59.16	-59.0	-0.16	8.31	0.150	2.00
-118.32	-118.2	-0.12	9.32	0.150	2.00
-177.48	-177.3	-0.18	10.33	0.150	2.00
-236.64	-236.5	-0.14	11.34	0.150	2.00
-295.80	-295.7	-0.10	12.35	0.150	2.00
-354.95	-354.8	-0.15	13.36	0.150	2.00
-414.11	-413.9	-0.21	14.37	0.150	2.00

END OF CALIBRATION REPORT PAGE 2 OF 3



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 : 24E9752

Calibration Report

PAGE : 3 OF 3

RESULT OF CALIBRATION (CONTINUE):

2. DISPLAY UNIT WITH pH ELECTRODE S/N: B222607002

STANDARD pH BUFFER SOLUTION (pH)	UUC READING (pH)	CORRECTION (pH)	VALUE BEFORE ADJUSTMENT	UNCERTAINTY OF MEASUREMENT ($\pm$ pH)	COVERAGE FACTOR k
4.006	4.00	0.004	---	0.012	2.00
7.000	7.00	-0.001	---	0.012	2.00
10.009	10.00	0.006	---	0.014	2.00

3. PERCENT SLOPE 99%

4. DISPLAY UNIT MEASUREMENT TEMPERATURE WITH PROBE

STANDARD READING ($^{\circ}$ C)	UUC* READING ($^{\circ}$ C)	IMMERSION DEPTH (mm)	CORRECTION ($^{\circ}$ C)	UNCERTAINTY OF MEASUREMENT ($\pm$ $^{\circ}$ C)
25.004	25.1	50	-0.096	0.21
40.003	40.1	50	-0.097	0.21
50.002	50.1	50	-0.098	0.21

UUC : UNIT UNDER CALIBRATION

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, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



Accredited
ISO/IEC 17025

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 E-mail: sale@cal-laboratory.com



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : pH METER
MANUFACTURER : HANNA
MODEL / TYPE : HI98191/Hi72911
SERIAL NO. : 03220019991/094406CN[LE-SVP-006]
CLID. NO. : 272400529
JOB CONTROL NO. : 240320029990
CALIBRATION SERVICE : ☒ IN-LABORATORY ☐ ON-SITE
CUSTOMER : GLOBAL UTILITIES SERVICES CO., LTD.

WASTEWATER TREATMENT PLANT, SUVARANBHUMIAIRPORT
999 MOO 1 NHONGPROB, BANG PHI, SAMUT PRAKARN 10540

DATE OF RECEIVED : 20 March 2024 DATE OF ISSUED : 23 March 2024

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

Calibrated By :

Sukgasem Sechanart

Approved By :

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



REPORT OF CALIBRATION

FOR

NOMENCLATURE : pH METER
MANUFACTURER : HANNA
MODEL / TYPE : HI98191/Hi72911
SERIAL NO. : 03220019991/094406CN[LE-SVP-006]
DATE OF CALIBRATION : 21 March 2024

ENVIRONMENT CONDITIONS :

Temperature : $(25 \pm 2.5) ^\circ\text{C}$ Relative Humidity : $(50 \pm 15) \% \text{ RH}$

PROCEDURE USED :

This instrument was calibrated under procedure No. CLC-CPCH-01 [pH Meter]. The calibration was performed by direct measurement with Certified Reference Material (CRM) and Documenting Process Calibrator.

This instrument was calibrated under procedure No. CLC-CPTH-04 [Temperature] based on ASTM E 644-04 as calibration guidelines. The calibration was performed by using Calibration Bath, Precision Thermometer and IPT which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

1. pH Standard Solution, NIMT TRM CODE TRM-S-2003, TRM CODE TRM-S-2007.
2. pH Standard Solution, Control Company Catalog Number 06-664-260, 11754256, Lot Number CC757348.
3. Documenting Process Calibrator , Fluke Model 744 S/N. 9226007.
4. Calibration Bath, Kambic Model OB-222 ULT S/N. 17115653.
5. Precision Thermometer, ASL Model F200-A-8 S/N. 01443303.
6. IPT, ASL Model T100-250-1D S/N. L0193A-1-1.

TRACEABILITY :

1. The measurements are traceable to International System of Units (SI) , through National Institute of Metrology (Thailand). Lot Number. 040822 , 230822. Due Date 26 April 2024.
2. The measurements are traceable to International System of Units (SI) , through Control Company. Certificate No. 4281-13507707 , Due Date 14 July 2024.
3. The measurements are traceable to International System of Units (SI) , through Calibration Laboratory Co., Ltd. Certificate No. Q23078640, Due Date 19 July 2024.
4. The measurements are traceable to International System of Units (SI) , through Calibration Laboratory Co., Ltd. Certificate No. Q23136342, Due Date 20 December 2024.
5. The measurements are traceable to International System of Units (SI) , through Thailand Institute of Scientific and Technological Research (TISTR). Certificate No. PSL-T 0203/67, Due Date 07 December 2024.
6. The measurements are traceable to International System of Units (SI) , through National Institute of Metrology (Thailand). Certificate No. TT-0136-23, Due Date 12 December 2024.

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-4/02 M:2022)"



CONDITION OF CALIBRATION ITEM : RECEIVED IN GOOD OPERATIONAL CONDITION

MEASUREMENT RESULTS : (X) without adjustment () adjustment

The table in the following gives the calibration results and associated measurement uncertainties of pH meter.

CALIBRATION DATA

1. pH ELECTRODE RESULT @ 25 °C

Standard pH Buffer Solution (pH)	pH Meter Reading (pH)	pH Meter Reading (mV)	Correction (pH)	Uncertainty of Measurement (± pH)	k Factor
4.003	4.00	140.4	+0.003	0.010	2.00
7.000	7.03	-27.5	-0.030	0.013	2.00
10.003	10.02	-189.9	-0.017	0.016	2.05

Technical Note. Setting function CAL 3 point (4,7,10).

The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 012 Page 4 of 67

2. pH SCALES RESULT @ 25 °C

Standard Voltage Input (mV)	pH Meter Reading		Correction (mV)	Uncertainty of Measurement (± mV)	k Factor
	(mV)	(pH)			
414.11	413.4	0.00	+0.71	0.06	2.00
118.32	117.6	5.01	+0.72	0.06	2.00
0.00	-0.7	7.01	+0.70	0.06	2.00
-177.48	-178.1	10.01	+0.62	0.06	2.00
-414.11	-414.8	14.01	+0.69	0.06	2.00

Note. The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 012 Page 14 of 67

CALIBRATION DATA

3. TEMPERATURE RESULT

Immersion depth (mm)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ± (°C)
40	25.00	25.2	-0.20	0.07
	40.01	39.9	+0.11	
	50.04	49.9	+0.14	

Note. Probe Ø 14 mm

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

The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 012 Page 56 of 67

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

End of Certificate



CERTIFICATE No : 24T9750
REFERENCE No : 74774-5

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : BOD INCUBATOR
MANUFACTURER : WST
MODEL : WST-BOD396L
SERIAL No : 22091421
ID No : LE-SVP-023
CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : GEM ENVIRONMENTAL MANAGEMENT CO., LTD. (SUARNABHUMI)
WASTEWATER TREATMENT PLANT,
SUARNABUMIAIRPORT, 999 MOO.1
NONGPRUE, BANGPHLI, SAMUTPRAKAN 10540

CALIBRATED BY :
CALIBRATION DATE :
APPROVED BY :
ISSUED DATE :
RECEIVED DATE :



CERTIFICATE No : 24T9750

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : BOD INCUBATOR
MANUFACTURER : WST
MODEL : WST-BOD396L
ID No : LE-SVP-023
RECEIVED DATE : 27-Sep-24
AMBIENT TEMPERATURE : 25 °C ± 1 °C
S/N : 22091421
CALIBRATION DATE : 27-Sep-24
RELATIVE HUMIDITY : 50 %RH ± 10 %RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED RTD PH100 UNDER NO LOAD CONDITION. THE TEMPERATURE PROBES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOMETER PROBE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOMETER PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

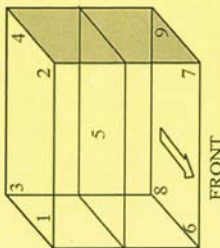
2. REFERENCE STANDARD INSTRUMENTS :-

1) DATA LOGGER WITH RTD
INSTRUMENT : HYDRA 2635A
MODEL : 6635300
SERIAL No : 24T6468
DUE DATE : 26-Jun-25
3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO., LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 0
Overall Line Voltage (V) variation : 3
Instrument Condition : Normal
Chamber Size (W*L*H): 50*45*135 cm



CHAMBER PERFORMANCE

Calibration Point (°C)	Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
20.0	20.0	20.0	0.04	0.25	0.28

TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)		Measured Temperature (°C) at Spread Locations									Uncertainty (± °C)
		#1	#2	#3	#4	#5	#6	#7	#8	#9	
20.0	20.0	20.27	20.19	20.20	20.11	20.10	20.11	20.14	20.20	20.23	0.25

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

NOTE 2 : LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

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

END OF CALIBRATION REPORT



CERTIFICATE No : 24T9751
REFERENCE No : 74774-6

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : REFRIGERATOR
MANUFACTURER : WST
MODEL : WST-396L
SERIAL No : 22091420
ID No : LE-SVP-024
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : GEM ENVIRONMENTAL MANAGEMENT CO., LTD. (SUARNABHUMI) WASTEWATER TREATMENT PLANT, SUARNABUMIAIRPORT, 999 MOO.1 NONGPRUE, BANGPHLI, SAMUTPRAKAN 10540

CALIBRATED BY :
CALIBRATION DATE :

APPROVED BY :
ISSUED DATE :
RECEIVED DATE :



CERTIFICATE No : 24T9751

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : REFRIGERATOR
MANUFACTURER : WST
MODEL : WST-396L
ID No : 22091420
RECEIVED DATE : 27-Sep-24
AMBIENT TEMPERATURE : 25 °C ± 1 °C
CALIBRATION DATE : 27-Sep-24
RELATIVE HUMIDITY : 50 %RH ± 10 %RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLA5 G-20 BY COMPARISON WITH CALIBRATED RTD Pt100 UNDER NO LOAD CONDITION. THE TEMPERATURE PROBES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOMETER PROBE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOMETER PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

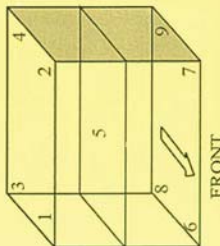
2. REFERENCE STANDARD INSTRUMENTS :-

- 1) DATA LOGGER WITH RTD HYDRA 2635A
2) REFERENCE TEMPERATURE POINTS : 26-Jun-25
3. THIS CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO., LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 1
Overall Line Voltage (V) variation : 3
Instrument Condition : Normal
Chamber Size (W*L*H): 50*45*135 cm



CHAMBER PERFORMANCE

Point (°C)	Controller Temperature (°C)	Indicating Temperature (°C)	Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
3.0	3.0	3.0	1.48	0.64	3.34

TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations	Uncertainty (± °C)
3.0	3.0	#1 3.26 #2 3.35 #3 3.30 #4 3.15 #5 3.01 #6 2.74 #7 3.16 #8 2.95 #9 2.95	1.8

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

NOTE 2 : LOCATION 5 WAS REFERENCE LOCATION.

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

END OF CALIBRATION REPORT



Certificate of Calibration

Equipment: SPECTROPHOTOMETER
Model: T8DCS
Serial No. (or ID.): 31-0197-00-0024
Manufacturer: PERSEE
Condition: In Condition

Certificate No.: C06240432
Issued Date: 02 October 2024
Job No.: WO-00044205
Page: 1 of 3

Customer: GEM ENVIRONMENTAL MANAGEMENT CO.,LTD (SUARNABHUMI)
WASTEWATER TREATMENT PLANT, SUARNABHUMIAIRPORT
999 MOO 1 NONGPRUE, BANGPHLI, SAMUTPRAKAN 10540

Environment Condition: Temperature 27.5 °C ± 0.8 °C
Humidity 64.3 %RH ± 3.3 %RH

Calibration Place: GEM ENVIRONMENTAL MANAGEMENT CO.,LTD (SUARNABHUMI)
WASTEWATER TREATMENT PLANT(LABORATORY ROOM),
SUARNABHUMIAIRPORT 999 MOO 1 NONGPRUE, BANGPHLI,
SAMUTPRAKAN 10540

Calibration By: Miss.Kaewkan Suradech
Calibration Date: 02 October 2024
The Method used: In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04
Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Siama Scientific Limited.
The standard for Wavelength Certificate No. 111583 and 111584
The standard for Photometric Certificate No. 9114984 and 111588
The standard for Stray light Certificate No. 111586 and 111585
The standard for Spectral resolution Certificate No. 111587

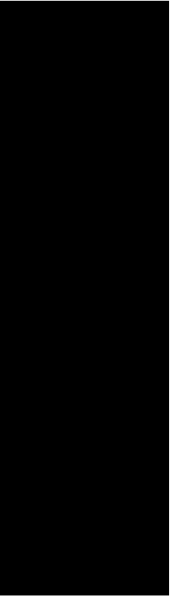
[Redacted]
national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.



Calibration Results: Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 1 nm and UUC at 1 nm				
Standard Wavelength	Unit Under Calibration	Correction	Uncertainty	
241.70	241.43	0.27	0.13	
279.44	279.25	0.19	0.13	
287.71	287.63	0.08	0.13	
334.02	333.95	0.07	0.13	
360.89	360.73	0.16	0.13	
418.53	418.50	0.03	0.13	
453.67	453.50	0.17	0.13	
459.99	459.83	0.16	0.13	
536.52	536.40	0.12	0.13	
638.00	638.00	0.00	0.13	
585.19	585.23	-0.04	0.13	
684.50	684.45	0.05	0.13	
741.02	741.03	-0.01	0.13	
748.56	748.50	0.06	0.13	
807.02	807.03	-0.01	0.13	

Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.2930	0.292	0.0010	0.0045
	0.5168	0.517	-0.0002	0.0045
440 nm	1.0298	1.029	0.0008	0.0045
	0.0000	0.000	0.0000	0.0045
	0.2867	0.284	0.0027	0.0045
465 nm	0.5073	0.506	0.0013	0.0045
	1.0083	1.003	0.0053	0.0045
	0.0000	0.000	0.0000	0.0045
465 nm	0.2516	0.249	0.0026	0.0045
	0.4595	0.460	-0.0005	0.0045
	0.9334	0.932	0.0014	0.0045





Calibration Results:
Without Adjustment

Photometric Accuracy (Absorbance)			
Wavelength	Standard absorbance	Unit Under Calibration	Uncertainty
546.1 nm	0.0000	0.000	0.0045
	0.2461	0.245	0.0045
	0.4652	0.465	0.0045
	0.9468	0.945	0.0045
590 nm	0.0000	0.000	0.0045
	0.2594	0.257	0.0045
	0.5040	0.503	0.0045
	1.0032	1.000	0.0045
635 nm	0.0000	0.000	0.0045
	0.2579	0.257	0.0045
	0.4971	0.497	0.0045
	0.9720	0.970	0.0045
235 nm	0.0000	0.000	0.0080
	0.7355	0.733	0.0080
	0.0000	0.000	0.0080
	0.8574	0.854	0.0080
313 nm	0.0000	0.000	0.0080
	0.2864	0.288	0.0080
	0.0000	0.000	0.0080
	0.6374	0.634	0.0080
Spectral Resolution *			
Nominal Concentration 0.02 % w/v	Peak	Trough	Ratio
Standard Wavelength (nm)	268.66	266.69	1.99
UUC: Wavelength (nm)	268.55	266.88	
Std Absorbance (A)	0.4566	0.2780	
UUC: Absorbance (A)	0.495	0.249	

* Calibration Marked "Not TISI Accredited" in this Certificate have been included for completeness.

The End of Certificate



ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00044205

หมายเลขเครื่อง: 31-0197-00-0024

รุ่น: T8DCS

ชนิดเครื่องมือ: SPECTROPHOTOMETER

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
☒	☐	1. ความสมบูรณ์เครื่อง	☒	☐	
☒	☐	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายในนอกเครื่อง)	☒	☐	
☒	☐	3. สวิตช์ ปิด - เปิด เครื่อง (On-Off Switch)	☒	☐	
☒	☐	4. ปุ่มกด (Keypad)	☒	☐	
☒	☐	5. หน้าจอ (Display, Screen Contrast)	☒	☐	
		Spectrophotometer			
☐	☐	6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC	☐	☐	
☐	☐	7. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control)	☐	☐	
☒	☐	8. ความยาวคลื่น (Wavelength Check)	☒	☐	
☒	☐	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	☒	☐	
☒	☐	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	☒	☐	
☐	☐	11. ช่องวัดหลายตัวอย่าง (Carousel Module)	☐	☐	
		pH Meter and Conductivity Meter			
☐	☐	12. อิเล็กโทรด (Electrode and Connection Cable)	☐	☐	
☐	☐	13. ระดับสารละลายใน Electrode (Level KCl)	☐	☐	
☐	☐	14. ฝาปิดกับเลนส์ Electrode (Dust Protection Hood)	☐	☐	
☐	☐	15. ขาจับอิเล็กโทรด (Stand)	☐	☐	
		Turbidimeter			
☐	☐	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	☐	☐	
☐	☐	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่นเกิน 3.0)	☐	☐	
		Automatic titrator			
☐	☐	18. สภาพ Piston Burettes	☐	☐	
☐	☐	19. Function Rinsing and Dosing	☐	☐	
☐	☐	20. ระบบท่อสายยาและอุปกรณ์ประกอบ	☐	☐	

เพิ่มเติมข้อแนะนำ :

Miss.Kaewkan Suradech
Service Engineer