

ภาคผนวก ข

เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์



THAI HEART CALIBRATION CO., LTD.

112/1 Moo 5, Phrak Sai, Muang, Samut Prakan 10280
Tel. 0-2394 2162, 0-2353 8435, 0-2757 8496 Fax: 0-2757 8507

CERTIFICATE OF CALIBRATION

Certificate No.: C0-1608001/24 Page 1 of total 4 pages

Customer WATER ANALYSIS CENTER CO., LTD.
1/94 Moo 5, T.Kanham,
A.U-thai, Ayutthaya 13210

Equipment pH Meter
Manufacturer METTLER TOLEDO Model SevenCompact S220
Serial No. B327527211 ID No. WWL 0068
Description Range : 0 - 14 pH, Resolution : 0.01 pH

Environmental Conditions Ambient Temperature: (20 ± 2) °C
Relative Humidity: (50 ± 10) %
Atmospheric Pressure: -

Calibration Location Jayhawk Laboratory (CL&GL)

Received Date 16 August 2024

Calibration Date 16 August 2024

Date of Issue 19 August 2024

Condition of Artifacts Used conditions but can be calibrated

Checked by

Aci as Technical Manager

Approved by

Representative of Managing Director

() (Krisyos K.) () (Sakda Y.)
() (Patiphan K.) () (Onnnpa P.)
() (Pongsak H.) () (Nitiphong K.)
() (Kanung C.) () (Nonthachai K.)
() (Pramong P.) () (Noppol P.)

(Dr. Ekachai Putitwong)

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REV.02 02/24/21



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Certificate No.: C0-1608001/24

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Reference Method:

- The calibration method used was CP-178 based on an in-house method.
- This certificate can be traceable to the national standards, which is realized the shown measurement units according to the International System of Units (SI Units).

Reference Standard:

Type	pH Value	Lot No.	Due Date	Traceability
pH Standard Solution	4.01	150823	Feb. 9, 2025	NIMT
	7.01	180723	Jan. 12, 2025	
	10.01	160823	Jan. 16, 2025	

Type	Serial No.	Certificate No.	Due Date	Traceability
Documenting Process Calibrator	2630521	10-2312001/23	Dec. 24, 2024	NHC
Digital Thermometer with Sensor	1709138 / 4605984-005	10-0806001/24	Jun. 7, 2025	

Remark: This certificate is traceable to the International System of Unit (SI Unit) through:

- NIMT, National Institute of Metrology (Thailand).
- THC, Thai Heart Calibration Co., Ltd.

Measurement Results:

1. Function Simulated pH Meter

Standard Applied (mV)	Nominal Value (pH)	UUC Reading		Uncertainty (± mV)
		pH	mV	
177.48	4.00	4.01	177.3	0.060
0.00	7.00	7.00	-0.1	0.060
-177.48	10.00	10.01	-177.4	0.060

UUC : Unit Under Calibration

Note : Adjust Curve to simulate pH (4,7,10)

Calibrated by Athipat

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Certificate No.: C0-1608001/24

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Measurement Results (Cont.):

2. Calibration of pH Electrode (Serial No.: 3222623)

pH Standard Solution (pH)	Measured Value		Uncertainty (± pH)
	(pH)	(mV)	
4.01	4.01	186.1	0.013
7.01	7.01	9.3	0.013
10.01	10.00	-164.5	0.013

Note : Adjust Curve to Buffer Solution pH (4,7,10)

Temperature stability of micro bath : 25 ± 0.2 °C

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



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Certificate No.: C0-1608001/24

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Reference Method:

- The calibration method used was CP-096 based on an in-house method.
- The temperature scale used was an ITS-90.
- This certificate can be traceable to the national standards, which is realized the shown measurement units according to the International System of Units (SI Units).

Reference Standard Instruments:

Type	Serial No.	Cert. No.	Due Date	Traceability
Thermometer Readout	B7C853	10-0911001/23	Nov. 8, 2024	THC
Platinum Resistance Thermometer	4854	C0A30047	Oct. 22, 2025	FLUKE
Liquid Bath	XO111019	10-2405001/23	May 25, 2025	THC

Remark: This certificate is traceable to the International System of Unit (SI Unit) through:

- THC, Thai Heart Calibration Co., Ltd.
- FLUKE, Fluke Corporation, U.S.A.

Measurement Results:

(X) Without Adjustment

Dimension of probe : Diameter 4 mm. Sensor Type : RTD (PT100)

Immersion Depth (mm.)	Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
120	22.00	22.2	-0.20	0.065
120	25.00	25.2	-0.20	0.065
120	28.00	28.2	-0.20	0.065

UUC : Unit Under Calibration

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

- End of Certificate -

Calibrated by Athipat

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Calibrated by Pongsak

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THAI HEART CALIBRATION CO., LTD.

112/1 Moo 5, Phrak Sa, Muang, Samut Prakan 10260
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THAI HEART CALIBRATION CO., LTD.

112/1 Moo 5, Phrak Sa, Muang, Samut Prakan 10260
Tel. 0 2794 2162, 0 2757 4435, 0 2757 8496 Fax. 0 2757 8507



CERTIFICATE OF CALIBRATION

Certificate No.: C0-1607004/24 Page 1 of total 2 pages

Customer: WATER ANALYSIS CENTER CO., LTD.
1/94 Moo 5, T.Kanham,
A.U-thai, Ayutthaya 13210

Equipment: Conductivity Meter
Manufacturer: EUTECH Model: CON 2700
Serial No.: 2657889 ID No.: WW1.0136
Description: -

Environmental Conditions: Ambient Temperature: (20 ± 2) °C
Relative Humidity: (50 ± 10) %
Atmospheric Pressure: -

Calibration Location: Jayhawks Laboratory (CL&GL)

Received Date: 16 July 2024

Calibration Date: 18 July 2024

Date of Issue: 18 July 2024

Condition of Artifacts: Used conditions but can be calibrated

Checked by

Act as Technical Manager

Approved by

Representative of Managing Director

() (Krisyost K.) () (Sakda Y.)
() (Patiphan K.) () (Onnapa P.)
() (Pongsak H.) () (Nitiphong K.)
() (Kanung C.) () (Nonthachai K.)
() (Pramong P.) () (Noppol P.)

(Dr. Ekachai Puttiwong)

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Certificate No.: C0-1607004/24

Page 2 of total 2 pages

Reference Method:

- The calibration method used was CP-177 based on an in-house method.
- This certificate can be traceable to the national standards, which is realized the shown measurement units according to the International System of Units (SI Units).

Reference Standard :

Material	Batch Value	Lot Number	Due Date	Traceability
Conductivity Standard Solution	147.1 µS/cm	S230330005	Nov. 9, 2024	SCP Science
	1.423 mS/cm	S231129006	May 13, 2025	SCP Science

Remark: This certificate is traceable to the International System of Unit (SI Unit) through:
- SCP Science.

Measurement Results: (Probe Serial No.: 93X219065)

Conductivity Standard Solution	Measured Value	Correction	Uncertainty (±)
147.1 µS/cm	149.0 µS/cm	-1.9 µS/cm	2.5 µS/cm
1.423 mS/cm	1.425 mS/cm	-0.002 mS/cm	0.0052 mS/cm

Note: Adjustment points: 147.1µS/cm 1.423mS/cm

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

- End of Certificate -



Master Calibration Co., Ltd.

547 Soi Ratchadaprosit, Kwang Samenuek, Khut Huaywong, Bangkok 10310

Tel : (02) 274 2978-9, (02) 2742987-8 Fax : (02) 274 2518, (02) 274 2499

Website: www.mastercalibration.com E-mail: calibration@mastercalibration.com



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Tel : (02) 274 2978-9, (02) 2742987-8 Fax : (02) 274 2518, (02) 274 2499

Website: www.mastercalibration.com E-mail: calibration@mastercalibration.com

Certificate of Calibration

TEMPERATURE
CONTROLLER ENCLOSURES



ISO 9001:2015
CALIBRATION #107

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Certificate No.: MC 2407449

Customer: Water Analysis Center Co., Ltd.
1/94 Moo 5, T.Kanham, A.U-Thai, Ayutthaya 13210.

Reference Job No.: 24-1546 Received Date: 9 July 2024
Description: Refrigerator Resolution: 0.1 °C
Manufacturer: SANDEN INTERCOOL Model: SEC-1500SBD
Serial No.: SEC1500201A-0708-00304 ID No.: WW1.0038
Marking: Additionally for the purpose of identification by this laboratory a label marked with this certificate number (MC 2407449) has been attached to the case.
Method: In-house calibration procedure MWI-T-033 this method Base on TLAS G-20-102-08 "Temperature Controlled Enclosures".
Location of Calibration: Water Analysis Center Co., Ltd.; Laboratory.
Environmental Conditions: Ambient Temperature: (25.2 to 25.4) °C
Relative Humidity: (62.1 to 63.3) %
Date of Calibration: 9 July 2024 Date of Issue: 10 July 2024

Checked by:

Chalermkit Rakphada
(Calibration Engineer)

Approved by:

Aittipong Kijjanasit
(Technical Manager)

The uncertainties are for a confidence probability of approximately 95%

This certificate is issued in accordance with the conditions of accreditation granted by the National Standardization Council of Thailand-Office of the National Standardization Council that has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of Master Calibration Co., Ltd.

[MCF-Q-077; Rev.6; Date: 22/04/2021]

Certificate No.: MC 2407449

Page 2 of 3

Reference Standard Instrument :

Description: Data Acquisition/Switch Unit Certificate No.: MC 2309074 Serial No.: MY-44012056 Due date: 7 Aug 2024 Traceable thru: MCAL
With Thermocouple Type " T " ID. No. 1471 to 1479

Traceability :

The measurement standard traceable to the international system of units (SI) through certificate as mentioned above

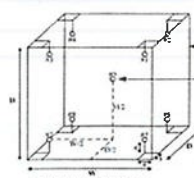
I. Calibration Procedure:

This instrument was calibration according to TLAS G-20 by comparison with calibrated thermocouple type T 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.

Temperature Uniformity - the maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady state conditions. The reference sensor should preferably be located at the geometric center of the chamber.

Temperature Stability - one-half of the greatest maximum difference of measured temperatures at any one sensor.

Overall Variation - The Difference of the maximum and minimum measured temperatures throughout observation.



Overall Ambient Temperature around the Chamber variation: 4.2 °C

Overall Line Voltage variation: 0.1 V

Chamber Size (W*H*D): 171 cm x 157 cm x 60 cm

Figure 1 - Sensor Installation Location

Checked by: Chalermkit

[MCF-Q-077; Rev.6; Date: 22/04/2021]

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Certificate No.: MC 2407449

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2. Result of calibration :

Temperature Measurement Accuracy Test

Indicating Temperature (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (±°C)
	#1	#2	#3	#4	#5	#6	#7	#8	Ref. #9	
3.0	4.2	4.0	4.0	4.0	4.0	3.7	3.8	3.5	3.5	1.0

Chamber Characterization Result

Desired Temperature (°C)	Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
4.0	3.0	3.0	0.8	0.9	2.1

The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.0$, providing a level of confidence of approximately 95 %.

This certificate will certify of the calibrated equipment only.

End of Certificate

Checked by : Chalermkiet

[MCE-Q-077 ; Rev.6 ; Date : 22/04/2021]



AUTOMATION SERVICE CO.,LTD.
CALIBRATION LABORATORY

SV 201005/2024

Cert. No. WAC-065
Page 1 of 2

CERTIFICATE OF CALIBRATION

Instrument : DO Meter Machine : -
Model : DO-31P Location : -
Serial No. : 780065
Manufacturer : TOA-DKK
Measuring Range : 0.00 ~ 20.00 mg/l

Customer : Water Analysis Center Co.,Ltd.
1/94 Moo.5 T.Kanham, A.U-Thai
Ayutthaya 13210 Thailand

Date Of Received : 11 / 01 / 2024
Date Of Calibration : 11 / 01 / 2024

Ambient Condition : Temperature 26 °C
Humidity 58 % RH

Calibrated By : P. Yooyen
(Ms. Phanee Yooyen)
Technician

Approved By : N. Rang
(Mr. Nipon Phungsomsak)
Technical Manager

Date Of Issue : 15 / 01 / 2024

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AUTOMATION SERVICE CO.,LTD.
CALIBRATION LABORATORY

Instrument : DO Meter
Model : DO-31P
Serial No. : 780065

Cert. No. WAC-065
Page 2 of 2

Calibrate Procedure

- ☐ This instrument was calibrated by comparison with standard solution (PH/ORP)
- ☐ This instrument was calibrated by comparison with scattering plate value (Turbidity)
- ☐ This instrument was calibrated by comparison with conductivity (Conductivity)
- ☒ This instrument was calibrated by comparison with Sodium sulfite anhydrous (DO)

Condition of this result of calibration
1). Reference Standard Solution

Standard	Lot No	Batch	Cert. No.	Due Date
Sodium Sulfite Power	408K1405	-	-	-

- 2). Traceability This certification is traceable to
- ☒ Kaso Chemical Co.,INC.
 - ☐ DKK Corporation

Result Of Calibration

Standard Solution (mg/l) at 25.7°C	Before Adjust		After Adjust	
	Indicator	Error	Indicator	Error
Zero	0.00	+ 0.10	0.00	-
Span	8.02	- 1.57	8.02	-

DO Electrode No. OE270AA(5) S/N 111F0029

Calibrated By : P. Yooyen
(Ms. Phanee Yooyen)
Technician



Intech Metrological Center Co.,Ltd.
89/1 Soi 82, Sukhapiban 5 Rd., O ngoen,
Saimai, Bangkok 10220, Thailand
Tel. (662) 909-8820 (Auto 10 lines) www.imcinstrument.com



Certificate of Calibration

Certificate No. : MT24-3208
Page : 1 of 2

Customer : Water Analysis Center Co.,Ltd.
Address : 1/94 M.5, Rojana Industrial Park, T.Kanham, A.U-Thai, Ayutthaya 13210

Description : Hot Air Oven	Order No. : 1152/24
Manufacturer : Memmert	Received date : Mar 22, 2024
Model : UF 280	Calibration date : Mar 22, 2024
Serial No. : B620.0814	Environment Condition :
Identification No. : WWL 0212	Temperature : (25±1-10) °C
Calibration Place : Customer Laboratory	Humidity : (50±1-30) %RH

Calibration Method : Calibration were conducted using In-house calibration procedure CP-MT-006 According to comparison with LXI Data Acquisition Switch Unit with sensor. The calibration methods based on Euramet Calibration Guide No 20 - guidelines on the Calibration of Temperature and/or Humidity Controlled Enclosures.

Reference Standard Instruments :	Instrument	Model	Serial No.	Certificate No.	Due Date
LXI Data Acquisition Switch Unit with Sensor		34972A	MY49020096	MT23-7163	Nov 30, 2024

The effect that the result relate only to the items calibrated. It was found accurate as shown on date and place of calibration only.

Traceability : This measurement are traceable to the International System of Unit (SI), through National Institute of Metrology Thailand (NIMT)

The reported expanded uncertainty of measurement was based on standard uncertainty multiplied coverage factor $k = 2$, providing a level of confidence of not less than 95%

Calibrated by : Mr.Yuttakorn Jamniansri

Approved by : (Mr. Panuwat Phukian)
Issue date : Apr 10, 2024

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Rev.03 / Feb 2024

FM-MT-013

Certificate No. : MT24-3208

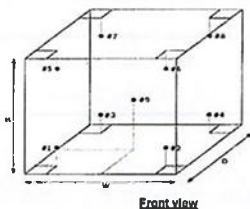
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Function : Temperature measurement
Calibration point : 104, 180 °C

Result : Without adjustment
Resolution : 0.1 °C

Calibration point (°C)	Temperature of UUC* at each position (°C)								Uncertainty of measurement (± °C)
	Ch.1	Ch.2	Ch.3	Ch.4	Ch.5	Ch.6	Ch.7	Ch.8	
104	103.494	103.533	103.871	103.988	103.590	104.081	103.843	104.217	0.45
180	179.955	179.953	180.047	179.985	179.908	180.088	180.065	180.273	0.54

Setting temperature (°C)	Indicating Temperature (°C)	Measured stability (± °C)	Measured uniformity (± °C)	Overall variation (± °C)
104.0	104.0	0.34	0.86	1.3
180.0	180.0	0.41	0.86	1.2



- #1 Lower Left Front
- #2 Lower Right Front
- #3 Lower Left Rear
- #4 Lower Right Rear
- #5 Upper Left Front
- #6 Upper Right Front
- #7 Upper Left Rear
- #8 Upper Right Rear
- #9 Geometric Center

Front view

UUC* = Unit under calibration

Uniformity = Maximum and Minimum difference of measured temperature at any probes and the measured temperature at the reference and same time.

Overall Variation = Difference of temperature value between the maximum and minimum any time.

Stability = One half of the maximum difference of measured temperatures at any one probe.

-00-

Rev.03 / Feb 2024

FM-MT-013



Certificate of Calibration

Equipment: Balance
Model: BL 210S
Serial No. (or ID.): 15808131 (WWL 0022)
Manufacturer: Sartorius
Condition: In condition

Certificate No.: C01241754
Issued Date: 05 June 2024
Job No.: WO-00030302
Page: 1 of 2

Customer: Water Analysis Center Co., Ltd.
1/94 Moo 5, Rojana Industrial Park, Rojana Road,
Tambol Kanham, Amphur U-Thai, Ayuthaya 13210 Thailand

Environment Condition: Temperature 26 °C ± 0.2 °C
Humidity 50 %RH ± 2.6 %RH

Calibration Place: Water Analysis Center Co., Ltd. (วัดน้ำสะอาด)
1/94 Moo 5, Rojana Industrial Park, Rojana Road,
Tambol Kanham, Amphur U-Thai, Ayuthaya 13210 Thailand

Calibration By: Mr. Polawed Ruernrup

Calibration Date: 05 June 2024

The Method used: In-house method, CAL-WI-47, based on UKAS Lab 14

Traceability: This certificate is traceable to the SI units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Co., Ltd. Certificate No. C02240400

Mr. Polawed Ruernrup

(Mr. Polawed Ruernrup)
Person in charge

Mr. Rungrod Jenkitrakulchai

(Mr. Rungrod Jenkitrakulchai)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated in 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.

DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Thailand 10110
Phone: +66 2838 7000 Email: info.calibration@dksh.com Website: www.dksh.com/technical-services

Delivering Growth - In Asia and Beyond.

CAL-FM-C01-14: 12 Sep 2022



Certificate No.: C01241754

Page: 2 of 2

Calibration Results:

Without Adjustment

Eccentric Error: Weight to be 1/3 or 1/2 of Maximum capacity, taken from the center of the pan as a zero reference.

Nominal Test Value (g)	Reference Points (g)				
	A	B	C	D	E
100	0.0000	-0.0001	-0.0000	-0.0002	-0.0002

Repeatability: Determination of the standard deviation of weighing balance, Readability 0.0001 (g)

Nominal test value (g)	Standard Deviation
20	0.00004
200	0.00008

Error of indication from nominal or conventional mass value, Readability 0.0001 (g)

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of indication (g)	Uncertainty (g)	k
1	1.00001	1.0000	0.0000	0.00011	2.04
2	2.00002	2.0000	0.0000	0.00011	2.04
5	5.00002	5.0000	0.0000	0.00011	2.04
10	10.00001	10.0000	0.0000	0.00011	2.04
20	20.00001	20.0000	0.0000	0.00012	2.03
50	50.00003	50.0000	0.0000	0.00013	2.02
70	70.00004	70.0000	0.0000	0.00016	2.01
100	99.99996	100.0001	0.0001	0.00017	2.01
120	119.99997	120.0002	0.0002	0.00021	2.00
150	149.99999	150.0002	0.0002	0.00024	2.00
200	199.99996	200.0004	0.0004	0.00039	2.00

The End of Certificate

