

เอกสารเทียบเครื่องมือที่ใช้ในการวิเคราะห์



THAI HEART CALIBRATION CO., LTD.
112/1 Moo 5, Phraek Sa, Muang, Samut Prakan 10780
Tel: 0-2394-2162, 0-2757-8435, 0-2757-8436 Fax: 0-2757-8507



CERTIFICATE OF CALIBRATION

Certificate No.: CO-2008004/21

Page 1 of total 4 pages

Customer
WATER ANALYSIS CENTER CO., LTD.
30/5 Soi Viphavadee 60, Viphavadee Rangsit Road,
Kwaeng Taladbangkhen, Khet Laksi, Bangkok 10210

Equipment
pH Meter
Manufacturer
METTLER TOLEDO
Model
SevenCompact
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
Jayhawks Laboratory (CL&GL)
Received Date
20 August 2021
Calibration Date
20 August 2021

Date of Issue
23 August 2021

Checked by

Approved by

Act as Technical Manager

Representative of Managing Director

() (Krisvot K.) () (Sakda V.)
() (Patiphan K.) () (Onnape P.)
() (Pongsak H.) () (Nitiphong K.)
() (Kanung C.) () (Nonthachai K.)
() (Pramong P.) () (Noppol P.)

(Dr. Ekachai Puttitwong)

This calibration certificate shall not be reproduced other than in full except with the prior written approval of the Thai Heart Calibration Co., Ltd.

REV.02 02/24/21

ภาคผนวก ข-1



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Certificate No.: CO-2008004/21

Page 2 of total 4 pages

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	081020	Feb. 1, 2022	NIMT
	7.01	020221	Dec. 25, 2021	
	10.00	091020	Jan. 19, 2022	

Type	Model	Serial No.	Certificate No.	Due Date	Traceability
Documenting Process Calibrator	753	3101007	10-0804001/21	Apr. 7, 2022	THC
Digital Thermometer with Sensor	1523 / 5622	1709138 / 4605984-005	10-1006001/21	Jun. 10, 2022	

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	177.4	0.060
0.00	7.00	7.00	0.0	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 Kittipong

Certificate No.: CO-2008004/21

Measurement Results (Cont.):

2. Calibration of pH Electrode

pH Standard Solution	Measured Value		Uncertainty (± pH)
	(pH)	(mV)	
4.01	4.00	187.0	0.013
7.01	7.00	11.1	0.013
10.00	10.02	-161.6	0.013

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

Temperature stability of micro bath: $25 \pm 0.2^\circ\text{C}$

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%.

ภาคผนวก ข-2

Certificate No.: CO-2008004/21

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	Model	Serial No.	Cert. No.	Due Date	Traceability
Thermometer Readout	1529-R	B7C853	20E3985	Nov. 9, 2021	TPA
Platinum Resistance Thermometer	5626	4853	C0A30046	Oct. 28, 2023	FLUKE
Liquid Bath	XORTS-40A	XO111019	10-0306002/21	Jun. 3, 2023	THC

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

- TPA, Technology Promotion Association (Thailand-Japan).
- FLUKE, Fluke Corporation, U.S.A.
- THC, Thai Heart Calibration Co., Ltd.

Measurement Results: (X) Without Adjustment

Measurement Results:			Sensor Type : RTD (PT100)	
Dimension of probe : Diameter 4 mm.				
Immersion Depth (mm.)	Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
120	22.00	22.0	0.00	0.058
120	25.00	25.0	0.00	0.058
120	28.00	28.0	0.00	0.058

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 -



THAI HEART CALIBRATION CO., LTD.

112/1 Moo 8, Phraek Sai, Muang, Samut Prakan 10280
Tel. 0-2394-2162 0-2252-8435 0-2757-8896 Fax. 0-2757-8897



CERTIFICATE OF CALIBRATION

Certificate No.: CO-2107005/21 Page 1 of total 2 pages

Customer
WATER ANALYSIS CENTER CO., LTD.
30/5 Soi Viphavadee 60, Viphavadee Rangsit Road,
Kwaeng Taladbangkhien, Khet Laksei, Bangkok 10210

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

Environmental Conditions Ambient Temperature: $(20 \pm 2)^\circ\text{C}$
Relative Humidity: $(50 \pm 10)\%$
Atmospheric Pressure: -

Calibration Location Jayhawks Laboratory (CL&GL)
Received Date 21 July 2021
Calibration Date 21 July 2021

Date of Issue 22 July 2021

Checked by

Act as Technical Manager

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

Approved by

Representative of Managing Director

(Dr. Ekachai Puttitwong)

Certificate No: AD2012-017-0001

Environment: Ambient Temperature: $(25 \pm 2)^\circ\text{C}$
Relative Humidity: $(50 \pm 15)\%\text{RH}$

STD Reading (mg/l)	UUC Reading Before (mg/l)	UUC Reading After (mg/l)	Error (mg/l)	Uncertainty ($\pm$ mg/l)
9.046	9.07	-	0.024	0.013

STD = Standard
UUC = Unit Under Calibration

Description of UUC: Range 0.00 to 60.00 mg/l
Resolution 0.01 mg/l

Measurement Standards Used & Traceability:

The International System of Units (SI) through

MIT Certificate No. L2002-756.L2002-757 for Data Logger (Lutron Temperature & Humid & Baro) Serial No. B014887. Due 28-Feb-21

MIT Certificate No. L2001-629 for Hi Accuracy Thermometer Serial No. 130508834. Due 07-Jan-21

End of Certificate

Page 2 of 2

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

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	1.06657.0500	K52300357	-	31 Mar 2022

- 2). Traceability This certification is traceable to
☒ Merk KGaA 64271 Darmstadt
☐ DKK Corporation

Result Of Calibration

Standard Solution (mg/l) at 26.0°C	Before Adjust		After Adjust	
	Indicator	Error	Indicator	Error
Zero	0.00	+0.10	0.00	-
Span	7.99	+0.22	7.99	-

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

Calibrated By P.

(Ms. Phance Yooyen)
Technician

929/029/1 Soi Putrakarn 30, Putrakarn Rd., Suanluang, Bangkok 10250
Head Office : Tel. 02-319-8934 ext.1 Fax 02-318-4361 E-mail : atsc@automation.co.th
Rayong Branch : 17/51 Muayprang Rd., A. Muang, Rayong 21150 Tel. 038-692-152 Fax 038-692-345
Lamphun Branch : 122/5 M.4, T. Lam Klang, A. Muang, Lamphun 51000 Tel/Fax 053-591-976
website : www.automation.co.th

SV 212001/2021

CERTIFICATE OF CALIBRATION

Instrument : DO Meter
Model : DO-31P
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
Ayuthaya 13210 Thailand

Date Of Received : 03 / 12 / 2021
Date Of Calibration : 03 / 12 / 2021

Ambient Condition : Temperature 24 °C
Humidity 47 % RH

Calibrated By :

P.
(Ms. Phance Yooyen)
Technician

Approved By :

N. Phung
(Mr. Nipon Phungsomsak)
Technical Manager

Date Of Issue : 03 / 12 / 2021

This Certificate may not be reproduced other than in full, except with the prior written approval of the head of the industrial instruments calibration center.

Certificate of Calibration

TEMPERATURE CONTROLLER ENCLOSURES

Certificate No.: MC 2107214

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

Reference Job No. : 21-1565 Received Date : 13 July 2021
Description : Refrigerator
Manufacturer : SANDENINTERCOOL Model : SEC-1500SBD
Serial No. : SEC1500201A-0708-00304 ID. No. : WWL0038
Marking : Additionally for the purpose of identification by this laboratory a label marked with this certificate number (MC 2107214) has been attached to the case.
Method : In-House calibration procedure MWI-T-033 this method is reference to TLAS G-20 "Temperature Controlled Enclosures".
Location of Calibration : Water Analysis Center Co., Ltd. : Laboratory.
Environmental Conditions : Ambient Temperature : (26.3) °C
Relative Humidity : (56.4 to 59.3) %
Date of Calibration : 13 July 2021 Date of Issue : 14 July 2021

Checked by : Thanagorn Approved by : Aittipong
Thanagorn Limchaicharoen Aittipong Kanjanakitsit
(Calibration Supervisor) (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.

Certificate No.: MC 2107214

The Reference Standard :

Description : Data Acquisition/Switch Unit
Certificate No. : MC 2009600
Serial No. : MY44095818
Due date : 8 August 2021
With Thermocouple Type " T " ID. No. 6/1 to 6/9

This certificate is traceable to the international system of units maintained at:

- Master Calibration Co., Ltd. And Quality Reborn Co., Ltd.

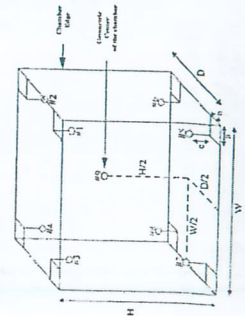
1. Calibration Procedure:

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 : 4.4 °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 : Thanagorn

Certificate No.: MC 2107214

Page 3 of 3

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	
2.6	4.0	4.0	4.1	4.0	3.9	3.8	3.7	3.8	3.4	1.2

Chamber Characterization Result

Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
2.0	2.6	2.7	1.4	5.8

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

This report will certify of the calibrated equipment only.

End of Certificate

Checked by : Thangorn



TEMPERATURE
CONTROLLER ENCLOSURES

Report No.: MC 2103787

Page 1 of 3

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

Reference Job No. : 21-0710 Received Date : 25 March 2021
Description : Oven
Manufacturer : Memmert Model : UF260
Serial No. : B620.0814 ID. No. : N/A
Marking : Additionally for the purpose of identification by this laboratory a label marked with this report number (MC 2103787) has been attached to the case.

Method : In-House calibration procedure MVI-T-033 this method is reference to TLAS G-20 "Temperature Controlled Enclosures".

Location of Calibration : Water Analysis Center Co., Ltd. ; Laboratory.

Environmental Conditions : Ambient Temperature : (31.8 to 35.3) °C

Relative Humidity : (44.7 to 55.9) %

Date of Calibration : 25 March 2021 Date of Issue : 26 March 2021

Checked by : Thangorn Approved by : Aittipong
Thangorn Limchaitaroen Aittipong Kaipana Vasiit
(Calibration Supervisor) (Technical Manager)

The uncertainties are for a confidence probability of approximately 95%

This certificate is issued in accordance with the condition of accreditation granted by the Thai Laboratory Accreditation Scheme which 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 expect with the prior written approval of the issuing laboratory.

Continuation of Report No. : MC2103787

Page 2 of 3

The Reference Standard :

Description
Data Acquisition/Switch Unit
With Thermocouple Type "T" ID. No.17/1 to 17/9

Report No. MC 2016027
Serial No. MY41010916
Due date 10 January 2022

This certificate is traceable to the international system of units maintained at:

- Master Calibration Co., Ltd.

1. 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.

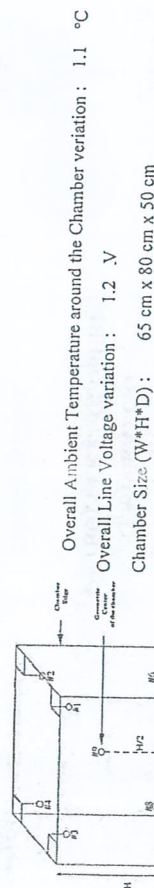


Figure 1 : Sensor Installation Location

Checked by : Thanagon

Continuation of Report No. : MC2103787

Page 3 of 3

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	
104.0	103.7	103.7	103.7	103.7	104.2	104.3	104.3	104.3	104.0	0.67
180.0	179.1	179.1	179.0	179.2	180.4	180.5	180.6	180.6	180.2	0.99

Chamber Characterization Result

Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
104.0	104.0	0.27	0.44	1.0
180.0	180.0	0.29	1.31	1.9

3. Uncertainty of Measurement

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

This report will certify of the calibrated equipment only.

End of Calibration Report

Checked by : Thanagon

Calibration Report

TEMPERATURE
CONTROLLER ENCLOSURES



Report No. : MC 2103787

Page 1 of 3

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

Reference Job No. : 21-0710 Received Date : 25 March 2021
Description : Oven
Manufacturer : Memmert Model : UF260
Serial No. : B620.0814 ID No. : N/A
Marking : Additionally for the purpose of identification by this laboratory a label marked with this report number (MC 2103787) has been attached to the case.
Method : In-House calibration procedure MWI-T-033 this method is reference to TLAS G-20 "Temperature Controlled Enclosures".

Location of Calibration : Water Analysis Center Co., Ltd. ; Laboratory.
Environmental Conditions : Ambient Temperature : (31.8 to 35.3) °C
Relative Humidity : (44.7 to 55.9) %
Date of Calibration : 25 March 2021 Date of Issue : 26 March 2021

Checked by : Thangorn Approved by : Aittipong
Thangorn Limchicharoen Aittipong Karjunawakisit
(Calibration Supervisor) (Technical Manager)

The uncertainties are for a confidence probability of approximately 95%

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Continuation of Report No. : MC 2103787

Page 2 of 3

The Reference Standard :
Description : Report No. : Serial No. : Due date :
Data Acquisition/Switch Unit : MC 2016027 MY41010916 10 January 2022
With Thermocouple Type "T" ID. No. 17/1 to 17/9

This certificate is traceable to the international system of units maintained at:

- Master Calibration Co., Ltd.

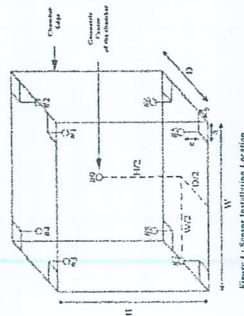
1. Calibration Procedure:

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.

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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 : 1.1 °C
Overall Line Voltage variation : 1.2 V
Chamber Size (W*H*D) : 65 cm x 80 cm x 50 cm

Checked by : Thangorn