

ภาคผนวก ช

เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์

Certificate No.: MC 2307702

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The Reference Standard Instrument :

Description	Certificate No.	Serial No.	Due date	Traceable thru
Data Acquisition/Switch Unit	MC 2303173	MYA1010916	9 Mar 2024	MCAL
With Thermocouple Type " T " ID. No.17/1 to 17/9				

Traceability :

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

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.

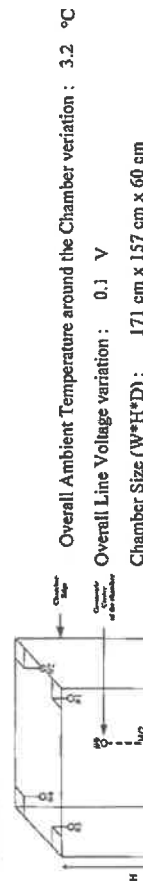


Figure 1: Sensor Installation Location

Checked by: *Thanayon*

Certificate of Calibration

TEMPERATURE CONTROLLER ENCLOSURES



NSC-TL705 17005
CALIBRATION 0183

Certificate No.: MC 2307702

Page 1 of 3

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

Reference Job No.	: 23-1577	Received Date	: 11 July 2023
Description	: Refrigerator		
Manufacturer	: SANDEN/INTERCOOL	Model	: SEC-1500SBD
Serial No.	: SECI500201A-0708-00304	ID. No.	: WWL0038
Marking	: Additionally for the purpose of identification by this laboratory a label marked with this certificate number (MC 2307702) has been attached to the case.		
Method	: In-House calibration procedure MWL-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 : (25.3 to 25.9) °C

Date of Calibration : 11 July 2023
Relative Humidity : (65.2 to 67.9) %
Date of Issue : 12 July 2023

Checked by : <i>Thanayon</i> Thanayon Linnacharoen (Calibration Supervisor)	Approved by : <i>Aitipong</i> Aitipong Kanjanavasi (Technical Manager)
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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 2307702

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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
2.5	4.4	4.2	4.2	4.2	4.0	3.9	4.1	4.0	3.8
									0.86

Chamber Characterization Result

Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
2.0	2.5	1.50	1.01	3.3

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 certificate will certify of the calibrated equipment only.

End of Certificate

Checked by : *Thanayon*

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



CERTIFICATE OF CALIBRATION

Page 1 of total 2 pages

Certificate No.: C0-1907007/23

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

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

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

Calibration Location: Jayhawks Laboratory (CL&GL)

Received Date: 19 July 2023

Calibration Date: 19 July 2023

Date of Issue: 20 July 2023

Condition of Artifacts: Used conditions but can be calibrated

Checked by: *[Signature]*

Approved by: *[Signature]*

Act as Technical Manager

Representative of Managing Director

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

(Dr. Ekachai Puttittwong)

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REV.02 02/24/21



Certificate No.: CO-190700723

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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	147.8 $\mu\text{S/cm}$	S220611005	Dec. 6, 2023	SCP Science
	1.425 mS/cm	S220812006	May 31, 2024	

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 ($\pm$)
147.8 $\mu\text{S/cm}$	147.5 $\mu\text{S/cm}$	0.3 $\mu\text{S/cm}$	2.5 $\mu\text{S/cm}$
1.425 mS/cm	1.427 mS/cm	-0.002 mS/cm	0.0051 mS/cm

Note: Adjustment points: 147.8 $\mu\text{S/cm}$ 1.425mS/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 -

Calibrated by Onnapa
REV.02 02/24/21

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CERTIFICATE OF CALIBRATION

Certificate No.: CO-180800523

Page 1 of total 4 pages

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

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

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

Calibration Location
Received Date
18 August 2023
Calibration Date
18 August 2023
Date of Issue
21 August 2023

Condition of Artifacts
Used conditions but can be calibrated

Checked by

Approved by

Act as Technical Manager

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 Puttitwong)

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FE-169

REV.02 02/24/21

Certificate No.: C0-1808005/23

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	030822	Feb. 9, 2024	NIMT
	7.01	300522	Feb. 9, 2024	
	10.01	230822	Feb. 7, 2024	

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Type	Model	Serial No.	Certificate No.	Due Date	Traceability
Documenting Process Calibrator	754	2630521	10-2412001/22	Dec. 23, 2023	THC
Digital Thermometer with Sensor	1523 / 5622	1709138 / 4605984-005	10-0806001/23	Jun. 8, 2024	

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	Nominal Value	UUC Reading		Uncertainty
(mV)	(pH)	pH	mV	(± 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)

FB-169

Calibrated by Kittipong
REV.02 02/24/21

Certificate No.: C0-1808005/23

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Measurement Results (Cont.):

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

pH Standard Solution	Measured Value		Uncertainty (± pH)
	(pH)	(mV)	
4.01	4.01	180.0	0.013
7.01	7.00	4.0	0.013
10.01	10.01	-172.0	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%.

FB-169

Calibrated by Kittipong
REV.02 02/24/21



Certificate No.: C0-1808005/23

Page 4 of total 4 pages

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	10-0911001/22	Nov. 9, 2023	THC
Platinum Resistance Thermometer	5626	4854	CQA30047	Oct. 22, 2023	FLUKE
Liquid Bath	XORTS-40A	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)	UTUC 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 Pongsak
REV.02 02/24/21

FE-169

CERTIFICATE OF CALIBRATION

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

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

Date Of Received : 05 / 01 / 2023
Date Of Calibration : 05 / 01 / 2023

Ambient Condition : Temperature 25 °C
 Humidity 50 % RH

Calibrated By:

P. Yooen
(Ms. Phanee Yooen)
Technician

Approved By :

Prasit (for)
(Mr. Nipon Phungsomsak)
Technical Manager

Date Of Issue :

09 / 01 / 2023

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.



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

- Reference Standard Solution

Standard	Lot No	Batch	Cert. No.	Due Date
Sodium Sulfite Power	1.06657.0500	K54224057	-	30 Sep 2023

- Traceability This certification is traceable to
☒ Merck KGaA 64271 Darmstadt
☐ DKK Corporation

Result Of Calibration

Standard Solution (mg/l) at 24.1°C	Before Adjust		After Adjust	
	Indicator	Error	Indicator	Error
Zero	0.00	+ 0.05	0.00	-
Span	8.25	- 1.12	8.25	-

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

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



Master Calibration Co., Ltd.
547 Soi Ratchaditnol, Kwang Sanemot, Khet Huaykwang, Bangkok 10310
Tel : (02) 274 2978-9, (02) 274 2987-8 Fax : (02) 274 2318, (02) 274 2989
Website : www.mastercalibration.com E-mail : calibrate@mastercalibration.com

Certificate of Calibration

TEMPERATURE
CONTROLLER ENCLOSURES



Certificate No.: MC 2303684

Page 1 of 3



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

Reference Job No. : 23-0729 Received Date : 23 March 2023
Description : Oven
Manufacturer : Memmert Model : UF260
Serial No. : B620.0814 ID. No. : WWL0212
Marking : Additionally for the purpose of identification by this laboratory a label marked with this certificate number (MC 2303684) 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 : (27.1 to 29.3) °C
Relative Humidity : (38.0 to 72.2) %
Date of Calibration : 23 March 2023 Date of Issue : 24 March 2023

Checked by : Thangorn Approved by : Aitipong
Thanagorn Linchacharoen Aitipong Kallanjawisit
(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

Certificate No.: MC 2303684

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The Reference Standard :

Description	Certificate No.	Serial No.	Due date
Data Acquisition/Switch Unit With Thermocouple Type "T" ID. No.171/ 179	MC 2303173	MY41010916	9 March 2024

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.

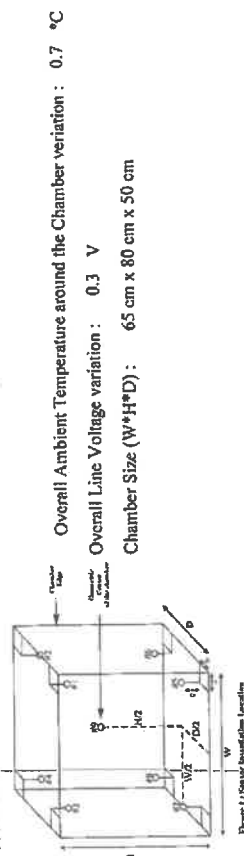


Figure 1-2 Measured Uncertainty Locations

Certificate No.: MC 2303684

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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	
104	103.7	103.9	103.6	103.8	103.7	104.2	104.1	104.2	104.3	0.58
180	179.4	179.8	179.4	179.7	179.4	179.9	179.8	180.2	180.0	1.3

Chamber Characterization Result

Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
104	104	0.32	0.84	1.2
180	180	0.4	0.9	1.3

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



Certificate of Calibration



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

Certificate No.: C01223710
Issued Date: 07 December 2022
Job No.: KSPR2215481
Page: 1 of 2

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

Environment Condition: Temperature 25 °C ± 0.9 °C
Humidity 48 %RH ± 4.9 %RH

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

Calibration By: Mr. Pradit Siriboot
Calibration Date: 07 December 2022
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. C02221864

Signature

(Mr. Pradit Siriboot)
Person in charge

(Mr. Rungrod Jenkitrakulchai)
Authorized signatory

This certificate is issued for the units of measurement according to the International System of Units (SI). It provides traceability of measurement to International or national standards or other recognized national standards 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.

ฉบับนี้ออกให้เพื่อเป็นหลักฐานการวัด
DKSH Technology Limited
2533 หมู่ 5 ถนนพหลโยธิน แขวงพญาไท กรุงเทพมหานคร 10600



Certificate No.: C01223710 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	Reference Points (g)				
	A	B	C	D	E
-	0.0001	0.0001	0.0001	-0.0002	-0.0001

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

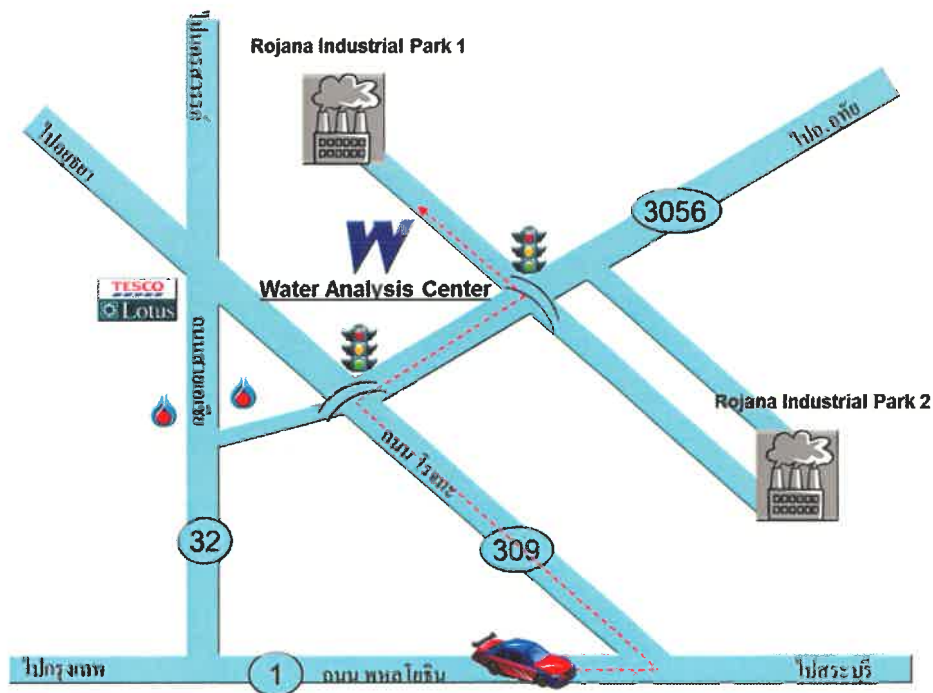
Nominal test value (g)	Standard Deviation
20	0.00007
200	0.00007

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	0.00012	2.08
2	2.00001	2.0000	0.0000	0.00012	2.08
5	5.00003	5.0000	0.0000	0.00012	2.07
10	10.00002	10.0000	0.0000	0.00013	2.07
20	20.00001	20.0000	0.0000	0.00013	2.06
50	50.00003	50.0000	0.0000	0.00014	2.04
70	70.00004	70.0001	0.0001	0.00017	2.02
100	100.00002	100.0001	0.0001	0.00018	2.01
120	120.00003	120.0001	0.0001	0.00022	2.01
150	150.00005	150.0003	0.0003	0.00024	2.00
200	200.00006	200.0004	0.0003	0.00030	2.00

The End of Certificate

ฉบับนี้ออกให้เพื่อเป็นหลักฐานการวัด
DKSH Technology Limited
2533 หมู่ 5 ถนนพหลโยธิน แขวงพญาไท กรุงเทพมหานคร 10600



บริษัท ศูนย์วิเคราะห์น้ำ จำกัด

1/94 หมู่ที่ 5 ต.คานหาม อ.อุทัย จ.พระนครศรีอยุธยา 13210

โทรศัพท์ 035-800593, 081-9917119 โทรสาร 035-800594

Email : wac@wacthai.com Website : www.wacthai.com