

ภาคผนวก ข

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## เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์



REV.02 02/24/21

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

REV. 02/24/21

Certificate No.: CO-1908005/22

Page 3 of total 4 pages

Measurement Results (Cont.):

2. Calibration of pH Electrode (Serial No.: 3322791)

pH Standard Solution	Measured Value		Uncertainty (± pH)
	(pH)	(mV)	
4.01	4.01	185.9	0.013
7.01	7.01	9.3	0.013
10.00	10.01	-164.9	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%.

Certificate No.: CO-1908005/22

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	10-1011001/21	Nov. 10, 2022	THC
Platinum Resistance Thermometer	5626	4854	C0A30047	Oct. 22, 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:

- 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 ( $^{\circ}\text{C}$ )	UUC Reading ( $^{\circ}\text{C}$ )	Correction ( $^{\circ}\text{C}$ )	Uncertainty ( $\pm^{\circ}\text{C}$ )
120	22.00	22.0	0.00	0.060
120	25.00	25.0	0.00	0.060
120	28.00	28.0	0.00	0.060

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.



## CERTIFICATE OF CALIBRATION

Certificate No.: CO-2007006/22

Page 1 of total 2 pages

Customer

WATER ANALYSIS CENTER CO., LTD.

30/5 Soi Vipavadee 60, Vipavadee Rangsit Road,  
Kwaeng Taladbangkhlen, Khet Laksi, Bangkok 10210

Equipment

Conductivity Meter

Manufacturer

EUTECH CON 2700

Serial No.

2657889 Model ID No. WWL 0136

Description

-

Environmental Conditions

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

Calibration Location

Jayhawks Laboratory (CL&GL)

Received Date

20 July 2022

Calibration Date

20 July 2022

Date of Issue

21 July 2022

Checked by

Approved by

Act as Technical Manager

Representative of Managing Director

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

(Dr. Ekachai Putthiwong)

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

FE-169

REV.02 02/24/21



THAI HEART CALIBRATION CO., LTD.



Certificate No.: CO-2007006/22

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	151.1 $\mu$ S/cm 1.421 mS/cm	S211008031 S220112015	Jan. 18, 2023 May 16, 2023	SCP Science

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

- SCP Science.

Measurement Results:

Conductivity Standard Solution	Measured Value	Correction	Uncertainty ( ± )
151.1 $\mu$ S/cm	150.9 $\mu$ S/cm	0.2 $\mu$ S/cm	1.5 $\mu$ S/cm
1.421 mS/cm	1.423 mS/cm	-0.002 mS/cm	0.0052 mS/cm

Note : Adjustment points: 151.1  $\mu$ S/cm 1.421 mS/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 Kitipong

REV.02 02/24/21



**AUTOMATION SERVICE CO.,LTD.**  
CALIBRATION LABORATORY



**AUTOMATION SERVICE CO.,LTD.**  
CALIBRATION LABORATORY

Automation

Automation

SV 201003/2023

Cert. No. WAC-065  
Page 1 of 2

## 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. Yooyen  
(Ms. Phanee Yooyen)  
Technician

**Approved By :**

Praji C for  
(Mr. Nipon Phungsomsak)  
Technical Manager

**Date Of Issue :**

05 / 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.

**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      1.06657.0500      K54224057      -      30 Sep 2023

- 2). 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

Certificate No.: MC 2207678

**The Reference Standard :**

Description	Certificate No.	Serial No.	Due date
Data Acquisition/Switch Unit	MC 2114432	MY44096104	20 December 2022
With Thermocouple Type " T " ID. No.2/1 to 2/9			

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

- Master Calibration Co., Ltd.

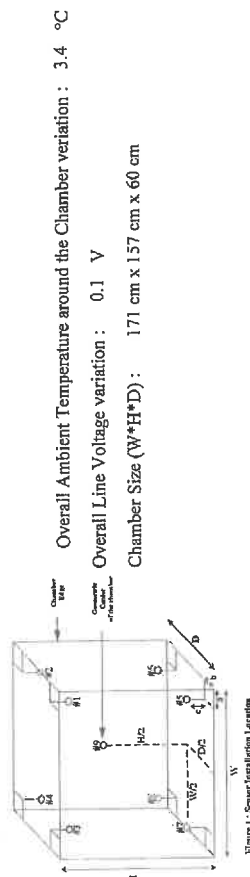
**1. Calibration Procedures:**

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.



Checked by : **Thanagorn**

**Master Calibration Co.,Ltd.**

547 Soi Ratchadavivat, Kwang Samenok, Khet Huaykwang, Bangkok 10310  
Tel : (02) 274 2978-9, (02) 2742987-8 Fax : (02) 274 2518, (02) 274 2989  
Website : www.mastercalibration.com E-mail : calibrate@mastercalibration.com



**TEMPERATURE  
CONTROLLER ENCLOSURES**

Certificate No.: MC 2207678

Page 1 of 3

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

Reference Job No. : 22-1601 Received Date : 12 July 2022  
Description : Refrigerator  
Manufacturer : SANDENINTERCOOL Model : SEC-150SBD  
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 2207678 ) 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 : ( 25.8 to 27.5 ) °C  
Relative Humidity : ( 48.8 to 52.2 ) %

Date of Calibration : 12 July 2022 Date of Issue : 19 July 2022

Checked by : **Thanagorn** Approved by : **Aittipong**  
Thanagorn Limchatcharoen Aittipong Kanjanawasit  
( 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 2207678

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
2.5	3.5	3.6	3.7	3.5	3.6	3.4	3.4	3.3	3.4
									1.1

Chamber Characterization Result

Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
2.0	2.5	1.5	0.6	3.1

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 : Thanyam

*Certificate of Calibration*



**TEMPERATURE  
CONTROLLER ENCLOSURES**

Certificate No.: MC 2203933

Page 1 of 3



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

Reference Job No. : 22-0740 Received Date : 24 March 2022

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 2203933 ) has been attached to the case.

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

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

Environmental Conditions : Ambient Temperature : ( 30.5 to 32.6 ) °C

Relative Humidity : ( 56.2 to 61.2 ) %

Date of Calibration : 24 March 2022 Date of Issue : 28 March 2022

Checked by : Thanyam

Thanyam Limchaicharoen  
( Calibration Supervisor )

Approved by : Aitipong

Aitipong Kavanawasit  
( 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 2203933

Page 2 of 3

## The Reference Standard :

Description	Certificate No.	Serial No.	Due date
Data Acquisition/Switch Unit	MC 2106035	93000641	8 August 2022
With Thermocouple Type " T " ID. No.30/1 to 30/9			

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

- Master Calibration Co., Ltd.

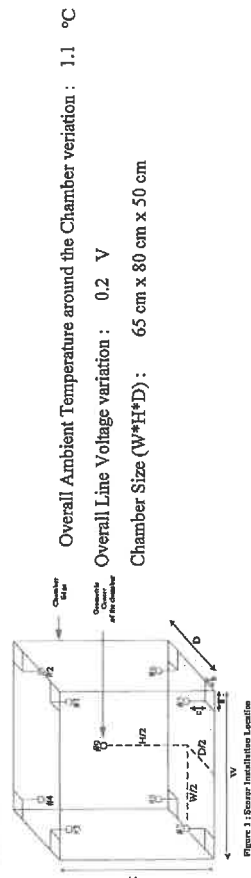
## 1. Calibration Procedure:

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.

**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.



Checked by : *Thanyam*

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

Certificate No.: MC 2203933

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	103.9	103.9	103.9	104.1	104.3	104.2	104.2	104.1	104.0	0.67
180.0	179.3	179.3	179.3	179.5	180.1	180.3	180.5	180.4	180.1	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	0.45	0.92
180.0	180.0	0.29	1.00	1.65

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 : *Thanyam*

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



## Certificate of Calibration

**Equipment:** Balance  
**Model:** BL210S  
**Serial No. (or ID.):** 15808131 (WWL 0022)  
**Manufacturer:** Sartorius  
**Condition:** In condition

**Certificate No.:** C01221885  
**Issued Date:** 08 June 2022  
**Job No.:** KSPR2208908  
**Pages:** 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 27 °C ± 0.5 °C  
 Humidity 42 %RH ± 4.7 %RH

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

**Calibration By:** Mr. Preecha Phooarsai

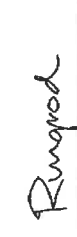
**Calibration Date:** 08 June 2022

**The Method used:** In-house method, SPCC-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 SPC RT Co., Ltd. Certificate No. C02220794

  
 (Mr. Preecha Phooarsai)

Person in charge

  
 (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 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 SPC RT Co., Ltd.

### Calibration Results:

#### Without Adjustment

Excentric 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	-0.0002

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

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

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	0.99998	1.0000	0.0000	0.000097	2.02
2	1.99999	2.0000	0.0000	0.000098	2.02
5	5.00000	5.0000	0.0000	0.000099	2.02
10	10.00002	10.0000	0.0000	0.00010	2.02
20	19.99995	20.0000	0.0000	0.00011	2.01
50	50.00002	50.0000	0.0000	0.00012	2.01
70	69.99997	70.0000	0.0000	0.00015	2.00
100	100.00007	100.0001	0.0000	0.00017	2.00
120	120.00002	120.0000	0.0000	0.00020	2.00
150	150.00009	150.0002	0.0001	0.00023	2.00
200	199.99993	200.0003	0.0004	0.00029	2.00

The End of Certificate



## High Volume Air Sampler Calibration Worksheet

Page 1 of 1

Project Site :

Location :

Date of measurement :

Worksheet No. :

High Volume ID :

High Volume Model :

High Volume SN :

Ambient Condition

Temperature (°C) :

Barometric Pressure (mmHg) :

ณ บัณฑิตวิทยาลัย

ภายในพื้นที่โครงการ

9/5/2023

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TE-3170 (TSP)

2740

-

26

756

Calibration Office

Calibrator ID :

Calibrator Model :

Calibrator SN :

Calibrate Date :

Quality Standard Slope :

Quality Standard Intercept :

WWL0103

TE-5028A

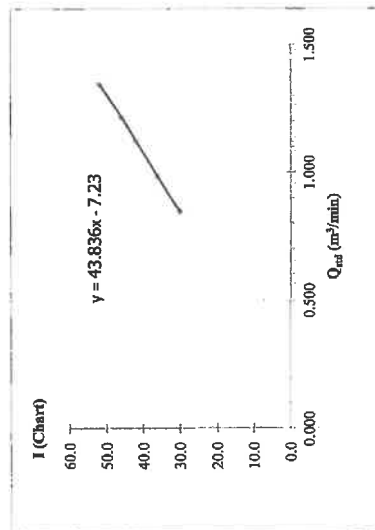
3271

11/02/2022

1.59945

-0.01874

Test No.	delta H <sub>2</sub> O (inch)	Q <sub>ad</sub> (m <sup>3</sup> /min)	I (Chart)	IC (Corrected)	Linear Regression
1	4.60	1.347	52.0	51.79	Slope : 43.66
2	3.75	1.218	46.0	45.81	Intercept : -7.201
3	3.20	1.126	42.0	41.83	Correlation Coefficient : 0.9995
4	2.45	0.986	36.0	35.85	
5	1.80	0.847	30.0	29.88	



Calibrated by :

Mr. RATTAPOL BAIKAI

Approved by :

Mr. RUNGSASIKORN KOSUM

POLAB 5.5-123

แก้ไขครั้งที่ : 1 วันที่ส่งไฟล์ : 1 ธ.ค. 2560 หน้า : 1 ของ 1

Project Site :

Location :

Date of measurement :

Worksheet No. :

High Volume ID :

High Volume Model :

High Volume SN :

Ambient Condition

Temperature (°C) :

Barometric Pressure (mmHg) :

ณ บัณฑิตวิทยาลัย

ภายในพื้นที่โครงการ

9/5/2023

-

-

TE-6070 (PM10)

2745

-

26

756

Calibration Office

Calibrator ID :

Calibrator Model :

Calibrator SN :

Calibrate Date :

Quality Standard Slope :

Quality Standard Intercept :

WWL0103

TE-5028A

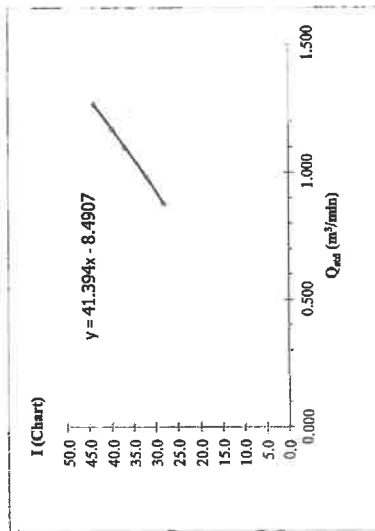
3271

11/02/2022

1.00155

-0.01185

Test No.	delta H <sub>2</sub> O (inch)	Q <sub>ad</sub> (m <sup>3</sup> /min)	I (Chart)	IC (Corrected)	Linear Regression
1	4.00	1.268	44.0	27.67	Slope : 26.03
2	3.40	1.170	40.0	25.15	Intercept : -5.339
3	3.00	1.099	37.0	23.27	Correlation Coefficient : 0.9996
4	2.40	0.985	32.0	20.12	
5	1.90	0.877	28.0	17.61	



Calibrated by :

Mr. RATTAPOL BAIKAI

Approved by :

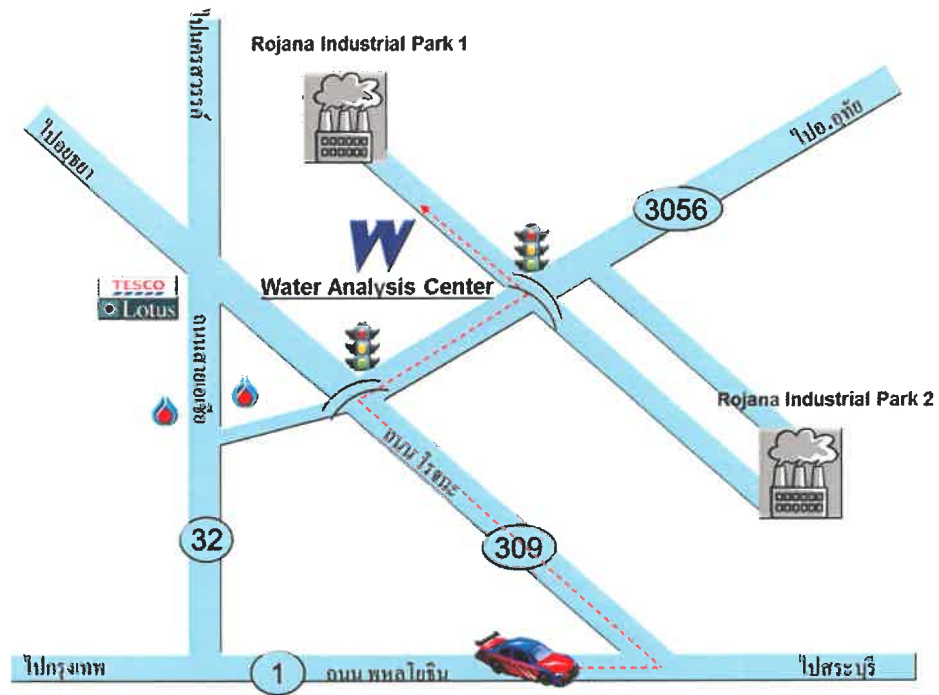
Mr. RUNGSASIKORN KOSUM

POLAB 5.5-123

แก้ไขครั้งที่ : 1 วันที่ส่งไฟล์ : 1 ธ.ค. 2560 หน้า : 1 ของ 1







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