

ภาคผนวก ข

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## เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์



## CERTIFICATE OF CALIBRATION



Certificate No.: CO-2008004/21 Page 1 of total 4 pages

**Customer**  
WATER ANALYSIS CENTER CO., LTD.  
30/5 Soi Vipavadee 60, Vipavadee 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  
( Dr. Ekachai Puttithong )  
( ) ( Krisyosol K. ) ( ) ( Sakda Y. )  
( ) ( Patiphan K. ) ( ) ( Onnapa P. )  
( ) ( Pongsak H. ) ( ) ( Nitiphong K. )  
( ) ( Kanung C. ) ( ) ( Nonthachai K. )  
( ) ( Pramong P. ) ( ) ( Noppol P. )

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

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	IO-0804001/21	Apr. 7, 2022	THC
Digital Thermometer with Sensor	1523 / 5622	1709138 / 4605984-005	IO-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 Kitiipong

REV.02 02/24/21

FE-169





THAI HEART CALIBRATION CO., LTD.  
112/1 Moo 9, Phraek Sai, Muang Samut Prakan, 10930  
Tel: 02-946-2162, 02-957-8435, 02-957-8966 Fax: 02-957-8507



## 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 Taladbangkhen, Khet Laksi, 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**

**Approved by**

Act as Technical Manager

Representative of Managing Director

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

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FE-169

REV.02 02/24/21

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 (Labron 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

825/92/1 Soi Petanaka 30, Petanaka Rd., Suanluang, Suanluang, Bangkok 10250  
Head Office: Tel. 02-312-8934 ext.1 Fax. 02-312-8961 E-mail : ats@automation.co.th  
Payong Branch : 1/15 Huiyong Rd., A. Muang, Rayong 21150 Tel. 039-892-152 Fax. 039-892-345  
Lamphun Branch : 122/5 M.4, T. San Kiang, A. Muang, Lamphun 51000 Tel/Fax. 053-561-876  
Website : www.automation.co.th

SV 212001/2021

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

Ambient Condition : Temperature 24 °C  
Humidity 47 % RH

Calibrated By :

(Ms. Phanee Yooyen )  
Technician

Approved By :

(Mr. Nipon Phongsomsak )  
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.

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 K52300357 - 31 Mar 2022

- 2). Traceability This certification is traceable to  
☒ Merck 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(S) S/N 111F0029

Calibrated By

( Ms. Phanee Yooyen )  
Technician

Certificate No.: MC 2107214

**The Reference Standard :**

Description	Certificate No.	Serial No.	Due date
Data Acquisition/Switch Unit	MC 2009600	MY44095818	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.

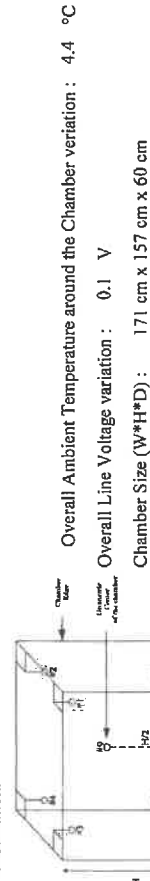


Figure 1 : Sensor Installation Location

Checked by : *Thangorn*

*Certificate of Calibration*



**TEMPERATURE  
CONTROLLER ENCLOSURES**

Certificate No.: MC 2107214

Page 1 of 3

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

Reference Job No. : 21-1565 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 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 : ( 26.3 ) °C

Relative Humidity : ( 56.4 to 59.3 ) %

Date of Calibration : 13 July 2021 Date of Issue : 14 July 2021

Checked by : *Thangorn* Approved by : *Aittipong*  
Thangorn Limchaicharoen Aittipong Kanlanawast  
( 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

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	
2.6	4.0	4.0	4.1	4.0	3.9	3.8	3.7	3.8	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 : Thanagorn

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



## 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, Ayuthaya 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 :

Thanagorn

Thanagorn Linchaicharoen

( Calibration Supervisor )

Approved by :

Aittipong

Aittipong Kailjanakasit

( 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 except with the prior written approval of the issuing laboratory.

[MCF-Q-077 ; Rev.5 ; Date : 15/07/2014]



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.

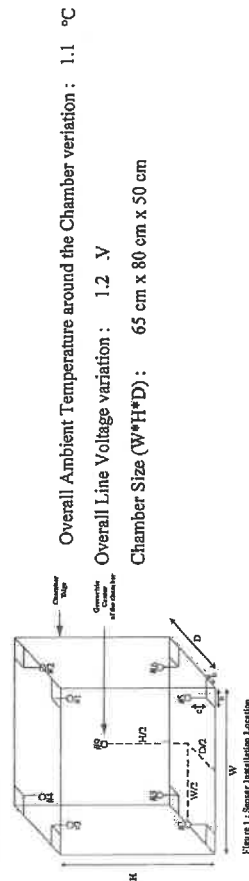
### 1. Calibration Procedure:

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.

*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 : *Thanyaporn*

[MCF-Q-077 ; Rev.5 ; Date : 15/07/2014]

Continuation of Report No. : MC 2103787

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	103.9	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 : *Thanyaporn*

[MCF-Q-077 ; Rev.5 ; Date : 15/07/2014]

Continuation of Report No. : MC 2103787

**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.

**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.

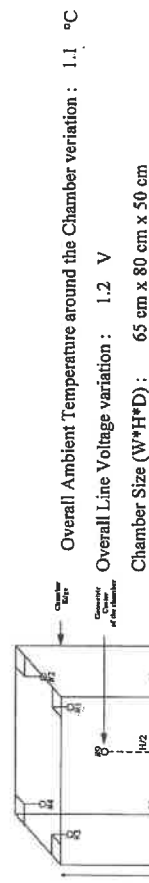


Figure 1 : Sensor Installation Location

Checked by : *Thangorn*

**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, Ayuthaya 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 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 : ( 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*  
Thanagorn Limchaicharoen Aittipong Kasijana Vastit  
(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.



## Certificate of Calibration

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

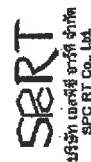
Certificate No.: C01211841  
Issued Date: 24 June 2021  
Job No.: KSPR2107989  
Page: 1 of 2

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 27 °C ± 0.3 °C  
Humidity 40 %RH ± 1.7 %RH

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

Calibration By: Mr. Phakapol Dominin  
Calibration Date: 10 June 2021  
The Method used: In house method, SPCC-WI-47, base 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. C02210017



(Mr. Rungrod Jankitkulchai)  
Authorized signatory

Person In charge

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 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.

SPC RT Co., Ltd.  
1194 Moo 5, Rojana Industrial Park, Rojana Road,  
Tambol Kanham, Amphur U-Thai, Ayutthaya 13210 Thailand  
Tel: 0 288 4333 Ext. 3300-3308 Fax: 0 288 4333 E-mail: info@spcrt.com Website: www.spcrt.com

[MCF-Q-077; Rev.5; Date: 15/07/2014]

SPCC-FM-C01-10; 23 Nov 2020

Continuation of Report No. : MC 2103787

### 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	103.9	104.2	104.3	104.3	104.3	104.0
180.0	179.1	179.1	179.0	179.2	180.4	180.5	180.6	180.6	180.2
									0.67
									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: Thanagorn





Bara Scientific Co., Ltd.  
968 U Chu Liang Building Floor7 Ramak Road  
Siam Bangkok Bangkok Thailand 10500  
Tel : 02-6324300 Fax : 02-6376498-7  
www.barascientific.com



# Certificate of Calibration

Certificate No.

BSCC-JV-135/21

Number of Page(s)

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Calibration Results:

## 1. Wavelength Accuracy

Wavelength (nm)	Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty (±A)
360.89	360.82	360.82	-0.07	0.18
418.53	418.71	418.71	0.18	0.18
446.32	446.38	446.38	0.06	0.18
453.67	453.58	453.58	-0.09	0.18
459.99	459.80	459.80	-0.19	0.18
638.00	638.10	638.10	0.10	0.18
431.38	431.38	431.38	0.16	0.18
513.39	513.57	513.57	0.18	0.18
528.90	528.82	528.82	-0.08	0.18
572.99	572.58	572.58	-0.41	0.18
585.25	585.37	585.37	0.12	0.18
684.50	684.65	684.65	0.15	0.18
741.02	741.14	741.14	0.12	0.18
879.41	879.29	879.29	-0.12	0.18

2. Photometric Accuracy (UV)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
235	CNR	CNR	CNR	CNR
257	CNR	CNR	CNR	CNR
313	CNR	CNR	CNR	CNR
350	CNR	CNR	CNR	CNR
	0.0000	0.0000	0.0000	0.0075
	0.6358	0.6310	-0.0048	0.0075

\*CNR = Customer not request

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.  
Advertising the report / Certificate and publicity of the results are prohibited and also shall not be reproduced except in full, without written approval of the Bara Scientific Co., Ltd.



Bara Scientific Co., Ltd.  
968 U Chu Liang Building Floor7 Ramak Road  
Siam Bangkok Bangkok Thailand 10500  
Tel : 02-6324300 Fax : 02-6376498-7  
www.barascientific.com



# Certificate of Calibration

Certificate No.

BSCC-JV-135/21

Number of Page(s)

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Calibration Results:

## 3. Photometric Accuracy (Visible)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
420.0	0.0000	0.0000	0.0000	0.0042
	0.5473	0.5511	0.0038	0.0042
	0.7625	0.7655	0.0030	0.0042
	1.0484	1.0525	0.0041	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.5369	0.5401	0.0032	0.0042
	0.7446	0.7464	0.0018	0.0042
	1.0235	1.0259	0.0024	0.0042
465.0	0.0000	0.0000	0.0000	0.0042
	0.4873	0.4906	0.0033	0.0042
	0.6868	0.6892	0.0014	0.0042
	0.9433	0.9453	0.0020	0.0042
546.1	0.0000	0.0000	0.0000	0.0042
	0.5009	0.5027	0.0018	0.0042
	0.6952	0.6950	-0.0002	0.0042
	0.9568	0.9556	-0.0012	0.0042
590.0	0.0000	0.0000	0.0000	0.0042
	0.5292	0.5303	0.0011	0.0042
	0.7228	0.7218	-0.0010	0.0042
	0.9893	0.9874	-0.0019	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	0.5140	0.5151	0.0011	0.0042
	0.6902	0.6889	-0.0013	0.0042
	0.9539	0.9519	-0.0020	0.0042

\*CNR = Customer not request

## 4. Stray Light\*

Standard	Wavelength (nm)	Transmission (%)	Absorbance (A)
cut-off wavelength (nm)	200.40	0.9524	2.0215
200.97±0.1nm			

The Stray light transmission reference is less than 1.0%T and Stray light absorbance reference is greater than 2.00A

\*Stray Light not NSC-ONSC Accredited.

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

\*\*\*End of Certificate\*\*\*

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.  
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80-82 Prachathipaisai Rd., Bangkhunphrom, Pranakorn, Bangkok 10200

Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thawan@thaiunique.com, Website : www.thaiunique.com

PREVENTATIVE MAINTENANCE (PM) CHECK LIST

FOR ATOMIC ABSORPTION SPECTROMETER

Model & Serial Number: 240 FS AA X 17918230004  
Customer: Water Analyis Center Co., Ltd  
Date: 17 Apr 2021

Safety

- ☒ Flame, Inspect/replace o-ring nebulizer, spray chamber and burner
- ☒ Flame, Clean nebulizer, spray chamber and burner
- ☒ Flame, Check liquid trap interlock, burner interlock, pressure relief/bung interlock and shield interlock

☐ Furnace, Clean work head, electrode and shroud N/A

☐ Furnace, Clean PSD and PSD tray N/A

☐ Furnace, Check water pressure N/A

☒ Check drain tube

☒ Check exhaust system

☒ Check gas pressure sensor interlock

☒ Check and all gas hoses for SpectraAA

☒ Clean computer control

Optics

☒ Inspect/Replace that external optics surfaces

☒ Check Wavelength Accuracy the copper line at 323.0-326.0 nm = 324.6 nm

☒ Check that PMT % Gain the copper at 324.8 nm, 4 mA, 0.5 nm slit width, Gain = 22 % (should be  $\leq 64\%$  or  $\leq 380V$ )

☒ Flame, Check D2 lamp is work



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Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thawan@thaiunique.com, Website : www.thaiunique.com

Electronics

- ☒ Check power supply voltage
- ☒ Check cables and connectors
- ☒ Check/Clean all boards in the instrument
- ☐ Furnace, Check camera and align\*\* N/A

\*\*Option for Graphite Zeeman only

Mechanism

- ☒ Flame, Check the burner adjuster
- ☐ Furnace, Check PSD accessories N/A

Analytical performance

☒ Clear the sample compartment

☒ Flame, Check uptake rate form 7.2-10.6 mL per minute = 10.4 mL/min

☒ Test Photometric noise, STDV = 0.0002 Abs (should be  $\leq 0.00050$  Abs)

☒ Flame, Test high solids nebulizer setting use

-Air/acet Cu 5 ppm = 0.76 Abs, and Precision (%RSD) = 0.5 % (should be  $> 0.55$  Abs and  $< 0.5\%$  RSD)

or

-N20/Acet Cu 5 ppm = \_\_\_\_\_ Abs, and Precision

(%RSD) = \_\_\_\_\_ % (should be  $> 0.3$  Abs and  $< 0.5\%$  RSD)

☐ Furnace, Characteristic mass and sensitivity Cu 25 ppb = \_\_\_\_\_ Abs, and N/A

Precision (%RSD) = \_\_\_\_\_ % (should be  $\geq 0.15$  Abs and  $\leq 4.0\%$  RSD)

SIGN :

Engineer

Singia Nakhon

(Signature)

Customer : Koat

(Signature)

## VARIAN

**Customer:** Water Analysis Center Co., Ltd.

**Contact Details:** Kanitsara

**Configuration:**

**Turret Type: Automatic**

**Number Of Lamps: 4**

**Mono Type: Automatic**

**Gasbox Tyne: Y Gas Box**

**Former Adjuster: False**

**Main Frequency: 50**

Firmware Version: 2.12

**multiliner Tyne: Normal/good**

Print Version: 191

.....

## D2 Run Hours: 4626.033

D2 Run Hours: 4626.033

**D2 Serial Number: not set!**

D2 Install Date: 1/1/1970

**D2 Original Intensity: 1 000**

**D2 | 20+ Intensity: 100 000**

**Averaging Period: 30.0**

**Datapoint Count: 20**

**Highest Measured Frequency:**

50.00

00'05

**Lowest Measured Frequency:**

50.00

### Result.

Report Generated At: 4/7/2021 12:07:04 PM

2

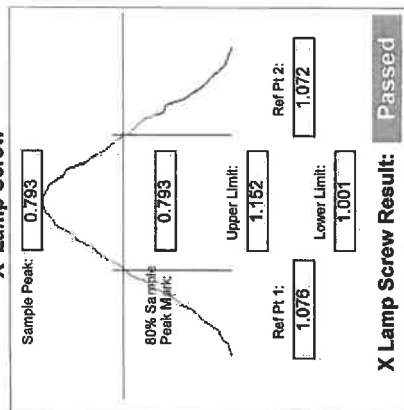
### SVD Results Report

## Beam Balance:

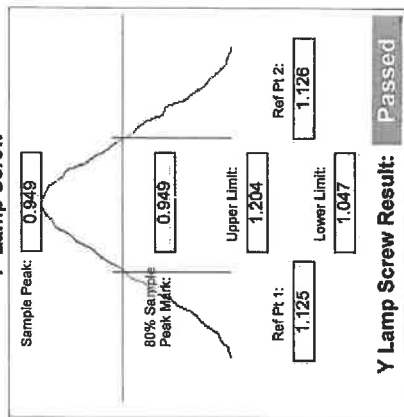
Lamp Type: Copper  
Lamp Socket Used: 3

Peak Selected: 324.80  
Lamp Alignment: **Performed**

## X' Lamp Screw



## Y' Lamp Screw



## Grating Squareness:

Lamp Element(s): Copper

Lamp Turret Position: 3

Lamp Current(mA): 4.00

Slit Width(nm): 0.5

1st Order Wavelength(nm): 324.80

Lamp Alignment: **Performed**

	Lower Limit (nm)	Actual (nm)	Upper Limit (nm)	Result:
Zero Order	-0.10	0.00	0.10	<b>Passed</b>
First Order	324.45	324.62	325.15	<b>Passed</b>
Second Order	649.23	649.54	649.97	<b>Passed</b>

## Wavelength Repeatability:

Lamp Used: Copper  
Peak Used(nm): 324.750  
Connected to Socket: 3  
Lamp Current(mA): 4  
Slit Width(nm): 0.2  
Slit Height: Normal

Lamp Alignment: **Performed**

Lower Limit(nm) 324.551  
Upper Limit(nm) 324.671

(Approach from Zero Order)

Sample 1: 324.611

Sample 2: 324.611

Sample 3: 324.611

Sample 4: 324.611

Sample 5: 324.615

Sample 6: 324.611

Sample 7: 324.615

Sample 8: 324.611

Sample 9: 324.615

Sample 10: 324.611

Mean: 324.613  
Standard Deviation: 0.002

Result: **Passed**



Mechanical

Wavelength Drive:

Passed

Slit Drive:

Passed

Turret Drive:

Passed

Auto Burner Adjuster Drive:

Untested

Miscellaneous

Signal Processing Linearity:

Calculate Mode: New Calc Mode

	Lower Limit	Actual	Upper Limit	Result:
S0	114	258	297	Passed
S1	156	186	191	Passed
S2	271	300	332	Passed
S3	474	516	579	Passed
S4	825	933	1008	Passed
S5	1435	1555	1754	Passed
S6	2498	2802	3053	Passed
S7	4347	4795	5313	Passed

Interlocks:

Burner Fitted:	Working
N2O Burner Fitted:	Working
Flame Shield Closed:	Working
Gas Control Fitted:	Untested
Pressure Release Bung Fitted:	Working
Liquid Trap Fitted:	Working

Flame Detect:	Working
GCU Active:	Working
Oxidant Pressure:	Working
Oxidant Changeover:	Working
Ignition:	Working

Auto Lamp Recognition:

- Lamp 1: 42 - Potassium (K)
- Lamp 2: 53 - Sodium (Na)
- Lamp 3: 14 - Copper (Cu)
- Lamp 4: 37 - Nickel (Ni)
- Lamp 5: Not Supported
- Lamp 6: Not Supported
- Lamp 7: Not Supported
- Lamp 8: Not Supported

Result: Passed

GTA Temperature Monitoring:

Not Performed

Notes:

C2104SU29 PM 1/2

Signatures:

Water Analysis Center Co., Ltd Date

Suriya Nacharoen

Date



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Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thuwat@thaiunique.com, Website : www.thaiunique.com

PREVENTATIVE MAINTENANCE (PM) CHECK LIST  
FOR ATOMIC ABSORPTION SPECTROMETER

Model & Serial Number: AA 240FS & AA0911M073  
Customer : Water Analysis Center Co., Ltd.  
Date: 04 Feb 2021

Safety

- ☒ Flame, Inspect/replace o-ring nebulizer, spray chamber and burner
- ☒ Flame, Clean nebulizer, spray chamber and burner
- ☒ Flame, Check liquid trap interlock, burner interlock, pressure relief bung interlock and shield interlock
- ☐ Furnace, Clean work head, electrode and shroud N/A
- ☐ Furnace, Clean PSD and PSD tray N/A
- ☐ Furnace, Check water pressure N/A
- ☒ Check drain tube
- ☒ Check exhaust system
- ☒ Check gas pressure sensor interlock
- ☒ Check and all gas hoses for SpectrAA
- ☒ Clean computer control

Optics

- ☒ Inspect/Replace that external optics surfaces
- ☒ Check Wavelength Accuracy the copper line at 323.0-326.0 nm = 324.8 nm
- ☒ Check that PMT % Gain the copper at 324.8 nm, 4 mA, 0.5 nm slit width, Gain = 56 % (should be  $\leq 64\%$  or  $\leq 380V$ )
- ☒ Flame, Check D2 lamp is work



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Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thuwat@thaiunique.com, Website : www.thaiunique.com

Electronics

- ☒ Check power supply voltage
- ☒ Check cables and connectors
- ☒ Check/Clean all boards in the instrument
- ☐ Furnace, Check camera and align\*\* N/A

\*\*Option for Graphite Zeeman only

Mechanisms

- ☒ Flame, Check the burner adjuster
- ☐ Furnace, Check PSD accessories N/A

Analytical performance


- ☒ Clear the sample compartment
  - ☒ Flame, Check uptake rate form 7.2-10.6 mL per minute = 9.8 mL/min
  - ☒ Test Photometric noise, STDV = 0.00001 Abs (should be  $\leq 0.00050$  Abs)
  - ☒ Flame, Test high solids nebulizer setting use
    - Air/acet Cu 5 ppm = 0.75 Abs, and Precision (%RSD) = 0.5 % (should be  $> 0.55$  Abs and  $< 0.5\%$  RSD)
- or
- N20/Acet Cu 5 ppm = Abs, and Precision (%RSD) = % (should be  $> 0.3$  Abs and  $< 0.5\%$  RSD)
  - ☐ Furnace, Characteristic mass and sensitivity Cu 25 ppb = Abs, and Precision (%RSD) = % (should be  $\geq 0.15$  Abs and  $\leq 4.0\%$  RSD)

SIGN :

Engineer (Signature) (Signature)

Customer : (Signature) (Signature)

# SVD Results Report



**VARIAN**

Report ID: 3    Diagnostic Start Time: 05-Dec-20 10:36:29 AM    Diagnostic End Time: 04-Feb-21 11:58:44 AM

Customer: Water Analysis Center Co., Ltd.    Service Engineer: SuriyaNacharoen

Address: Prana khron si ayuthaya    Contact Details: K\_Kanlisara

Instrument Configuration

## Configuration:

Serial Number: AA091M073

Turret Type: Automatic

Instrument Model: Varian AA140/240/280

Number Of Lamps: 4

Flame Instrument: True

Mono Type: Automatic

Furnace Instrument: True

Gasbox Type: Y' Gas Box

Zeeman Present: False

Auto Burner Adjuster: False

Internal Zeeman: False

Mains Frequency: 50

Internal UltraAA: False

Firmware Version: 2.12

Optics Type: Double Beam

Photomultiplier Type: Normal(900nm)

D2 BG Correction Fitted: True

PWB Version: 181

Boot Block Version: 2.02

## EEPROM Data:

Instrument Run Hours: 20613.650

D2 Run Hours: 2906.000

Zero Wavelength Offset: -18.731

D2 Serial Number: not set !

Mono Correction: -0.370

D2 Install Date: 01-Jan-70

Flame Hours: 4025.000

D2 Original Intensity: 1.000

D2 Last Intensity: 661.000

## Frequency:

Averaging Period: 30.0

Datapoint Count: 20

Upper Limit: 51.00

Highest Measured Frequency: 50.00

Average Frequency: 50.00

Lowest Measured Frequency: 50.00

Lower Limit: 49.00

Result: Passed

## Power Supply:

Averaging Period: 30.0  
Datapoint Count: 20

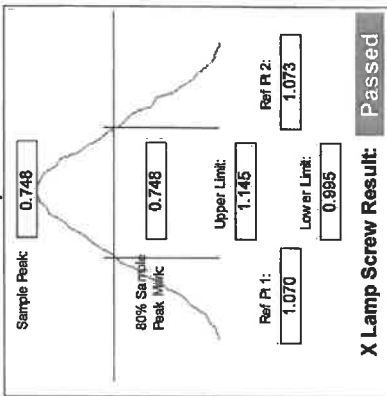
	Lower Limit (V)	Actual (V)	Upper Limit (V)	Result
12.00V Rail	10.80	12.20	13.20	Passed
-12.00V Rail	-13.20	-12.00	-10.80	Passed
5.00V Rail	4.50	5.10	5.50	Passed
310.00V Rail	279.00	318.00	341.00	Passed

Beam Balance:

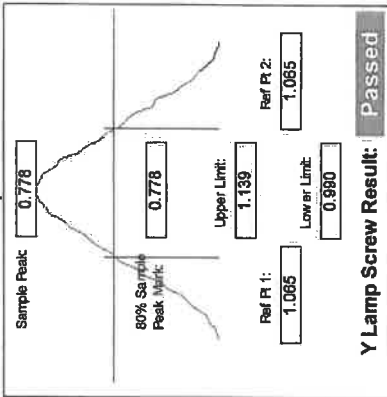
Lamp Type: Copper  
Lamp Socket Used: 3

Peak Selected: 324.80  
Lamp Alignment: **Performed**

'X' Lamp Screw



'Y' Lamp Screw



Grating Squareness:

Lamp Element(s): Copper  
Lamp Turret Position: 3  
Lamp Current(mA): 4.00  
Slit Width(nm): 0.5  
1st Order Wavelength(nm): 324.80  
Lamp Alignment: **Performed**

	Lower Limit (nm)	Actual (nm)	Upper Limit (nm)	Result:
Zero Order	-0.10	0.00	0.10	<b>Passed</b>
First Order	324.45	324.73	325.15	<b>Passed</b>
Second Order	649.23	649.55	649.97	<b>Passed</b>

Wavelength Repeatability:

Lamp Used: Copper  
Peak Used(nm): 324.750  
Connected to Socket: 3  
Lamp Current(mA): 4  
Slit Width(nm): 0.2  
Slit Height: Normal

Lamp Alignment: **Performed**

Lower Limit(nm) 324.751  
Upper Limit(nm) 324.871  
(Approach from Zero Order)  
Sample 1: 324.811  
(Approach from end)  
Sample 2: 324.807  
Sample 3: 324.811  
Sample 4: 324.811  
Sample 5: 324.815  
Sample 6: 324.811  
Sample 7: 324.815  
Sample 8: 324.811  
Sample 9: 324.815  
Sample 10: 324.815

Mean: 324.812  
Standard Deviation: 0.003

Result: **Passed**

Mechanical

Wavelength Drive:

Passed

Slit Drive:

Passed

Turret Drive:

Passed

Auto Burner Adjuster Drive:

Untested

Miscellaneous

Signal Processing Linearity:

Calculate Mode: New Calc Mode				
	Lower Limit	Actual	Upper Limit	Result
S0	114	248	297	Passed
S1	158	185	191	Passed
S2	271	294	332	Passed
S3	474	508	579	Passed
S4	825	908	1008	Passed
S5	1435	1516	1754	Passed
S6	2498	2723	3053	Passed
S7	4347	4681	5313	Passed

Interlocks:

Burner Fitted:

Working

N2O Burner Fitted:

Working

Flame Shield Closed:

Working

Gas Control Fitted:

Untested

Pressure Release Bung Fitted:

Working

Liquid Trap Fitted:

Working

Flame Detect:

Working

GCU Active:

Working

Oxidant Pressure:

Working

Oxidant Changeover:

Working

Ignition:

Working

Auto Lamp Recognition:

Lamp 1: 50 - Selenium (Se)

Lamp 5: Not Supported

Lamp 2: 3 - Arsenic (As)

Lamp 6: Not Supported

Lamp 3: 14 - Copper (Cu)

Lamp 7: Not Supported

Lamp 4: 42 - Potassium (K)

Lamp 8: Not Supported

Result: Passed

GTA Temperature Monitoring:

Not Performed

Notes:

C2102SU11 PM1/2

Signatures:

Water Analysis Center Co., Ltd.

Date

04 Feb 21

Suriya Nacharoen

## BSC Certification Test Report

Page 1 of 6

Certificate No. : M0979/21

Customer Name : LABORATORY WATER ANALYSIS CENTER COMPANY LIMITED

Customer Address : 1/94 Moo 5 T.Kanbarn, A.U.-Thai,  
Phra Nakhon Si Ayutthaya 13210

Equipment : Biological Safety Cabinet Class II Type A2

Manufacturer : Microtech

Model : V6-T

Serial No : 0972

ID No. : WWL0084


Were in accordance with ☒ EN 12469 ☐ NSF 49 ☐ Manufacturer's specification

Test Date : 23/09/2021

Due Date : 23/09/2022 or after HEPA filters are replaced or unit is moved

Test by : Mr. Puwadol Keawkia

Approved by :

  
(Mr. Kridsada Thinhuaetoei)  
Authorized Signatory

Issued Date : 24/09/2021

This calibration certificate documents the traceability in national standards, which realize the unit of measurement according to the International System of Units (SI).

This certificate may not be reproduced other than in full except with the prior written approval of the Megafil Company Limited.

Page 2 of 6

Certificate No. : M0979/21

Procedure Used : European Standard EN12469 : 2000 has the status of British Standard,

Biotechnology Performance criteria for microbiological safety cabinets.

: NSF International Standard / American National Standard NSF / ANSI 49-2008

Biosafety Cabinet : Design, Construction, Performance and Field Certification.

: Australian Standard : AS 1807.23-2000 Determination of intensity of radiation from germicidal ultraviolet lamps.

: Manufacturer's specification.

### 1. Downflow velocity test.

#### Measurement Information

No. of Rows	No. of Readings	Grid Spacing Front-Back	Grid Spacing Side-Side	Probe height Above sash
2	8	1/4, 3/4	1/8, 3/8	100 mm.

#### Measurement Data.

0.34	0.37	0.36	0.35
0.32	0.33	0.32	0.34

Average velocity 0.34 m/s ( 67 FPM.) Velocity range 0.25-0.50 m/s ( 49-98 FPM.)

Uniformity( EN: +-20% avg. 0.27-0.41 m/s ( 54-80 FPM.)

Supply filter dimension 24 x 72 (inch x inch) Supply filter area 10.69 SQ.FT

Downflow volume (Q) 716 CFM.

Result Summary ☒ Pass ☐ Fail

Equipment used : Thermo Anemometer Model 425 S/N : 03004786 Calibration date : 23/02/2021

Certificate No. : M0979/21

2. Inflow velocity test.

Select method : ☐ DIM ☒ Exhaust velocity. ☐ MFG's Specifications

0.57	0.59	0.56	0.61	0.63
0.58	0.6	0.56	0.59	0.58
0.61	0.57	0.56	0.54	0.56
0.59	0.56	0.62	0.59	0.62
0.59	0.57	0.63	0.59	0.58

Average Inflow velocity 0.50 m/s (98 FPM.) Velocity range 20.40 m/s ( 279 FPM.)

Inflow dimension 8 x 72 (inch x inch) Inflow area 4.00 SQ.FT

Inflow volume(Q) 392 CFM

Result Summary ☒ Pass ☐ Fail

Adjustments Required ☐ Fan Speed ☐ Damper

Equipment used : Thermo Anemometer Model 425 S/N : 03004786 Calibration date 23/02/2021

3. HEPA filter leak test.

Measurement Data

HEPA Filter	PAO Upstream Conc.(calculated)	Specification	Measured leak penetration
Supply HEPA Filter	18 µg/L	<0.003%	<0.003%
Exhaust HEPA Filter	18 µg/L	<0.003%	<0.003%

Certificate No. : M0979/21

Leak location

Supply HEPA Filter

Back



Exhaust HEPA Filter

Back



Result Summary ☒ Pass ☐ Fail

Equipment used : Aerosol Photometer Model TDA-2H S/N : 21683 Calibration date 24/02/2021

Equipment used : Smoke Generator Model TDA-6C S/N : 21623

4. Airflow smoke patterns test

Measurement Information

- Downflow Pattern test : Smoke shall be passed from one end of the cabinet to the other, along the centerline of the work surface, at a height of 4 inch (10 cm) above the top of the access opening
- View screen retention test : Smoke shall be passed from one end of the cabinet to the other, 1.0 in (2.5 cm) behind the view screen, at a height 6.0 inch (15 cm) above the top of the access opening.
- Work opening edge retention test : Smoke shall be passed along the entire perimeter of the work opening. Particular attention should be paid to corners and vertical edges.
- Sash/window seal test : Smoke shall be passed up the inside of the window 2 in (5 cm) from the sides and along the top of the work area.

Certificate No. : M0979/21

Result Summary

Downflow Pattern test	<input checked="" type="checkbox"/> Accept	<input type="checkbox"/> Non-Conforming
View screen retention test	<input checked="" type="checkbox"/> Accept	<input type="checkbox"/> Non-Conforming
Work opening edge retention test	<input checked="" type="checkbox"/> Accept	<input type="checkbox"/> Non-Conforming
Sash/window seal test	<input checked="" type="checkbox"/> Accept	<input type="checkbox"/> Non-Conforming

5. Site Installation

Sash Alarm.	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input checked="" type="checkbox"/> N/A
Interlock System.	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input checked="" type="checkbox"/> N/A
Exhaust System Performance	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input checked="" type="checkbox"/> N/A

Remark / Recommendation

ระบบ Site installation ไม่มีการตรวจสอบ เนื่องจากผู้ไม่พึงประสงค์

6. Illumination Test (Lighting) : Option

Lighting should be adequate for safe working within the cabinet. Illumination measured at the work surface.

Lux

632	1000	997	630
947	1456	1449	921

Remark :

Page 5 of 6

Certificate No. : M0979/21

7. Ultraviolet Lamp Test (UV) : Option

Ultraviolet radiation where UV Lamp are fitted, the intensity of radiation at a wavelength of 254 nm. Shall be not less than 400 mW/m<sup>2</sup> when measures at work floor surface.

mW/m<sup>2</sup>

740	1580	1570	750
480	1040	1020	480

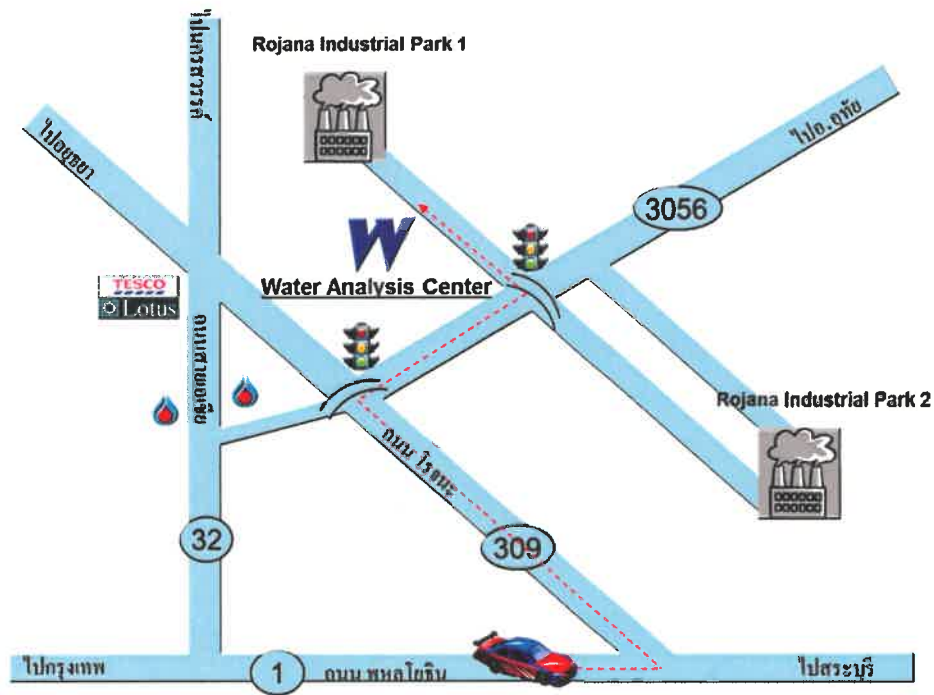
Remark :

-000-

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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](mailto:wac@wacthai.com) Website : [www.wacthai.com](http://www.wacthai.com)