



ภาคผนวก ง
เอกสารสอบเทียบเครื่องมือตรวจวัด

เอกสารสอบเทียบเครื่องมือตรวจวัด



THAI HEART CALIBRATION CO., LTD.
112/1 Moo 5, Phraek Sai, Muang, Samut Prakan 10280
Tel. 0 2394 2162, 0 2757 8435, 0 2757 8496 Fax. 0 2757 8507



CERTIFICATE OF CALIBRATION

Certificate No.: C0-1908005/22 Page 1 of total 4 pages

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

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

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

Calibration Location Jayhawks Laboratory (CL&GL)

Received Date 19 August 2022

Calibration Date 19 August 2022

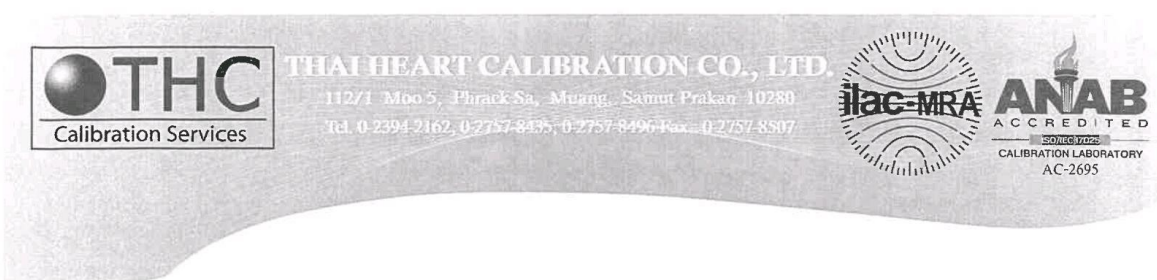
Date of Issue 22 August 2022

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FE-169

REV.02 02/24/21

เอกสารสอบเทียบเครื่องมือตรวจวัด



Certificate No.: C0-1908005/22

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 | Jan. 22, 2023 | NIMT |
| | 7.01 | 020221 | Jan. 18, 2023 | |
| | 10.00 | 091020 | Feb. 7, 2023 | |

| Type | Model | Serial No. | Certificate No. | Due Date | Traceability |
|---------------------------------|-------------|-----------------------|-----------------|--------------|--------------|
| Documenting Process Calibrator | 753 | 3101007 | 10-0804001/22 | Apr. 7, 2023 | THC |
| Digital Thermometer with Sensor | 1523 / 5622 | 1709138 / 4605984-005 | 10-1006004/22 | Jun. 9, 2023 | |

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)

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



Certificate No.: C0-1908005/22

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Measurement Results (Cont.):

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

| pH Standard Solution (pH) | 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%.

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Certificate No.: C0-1908005/22

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 Comporation, U.S.A.

Measurement Results: (X) Without Adjustment

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

| Immersion Depth (mm.) | Standard Reading (°C) | UUC Reading (°C) | Correction (°C) | Uncertainty (± °C) |
|-----------------------|-----------------------|------------------|-----------------|--------------------|
| 120 | 22.00 | 22.0 | 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 -

FE-169

เอกสารสอบเทียบเครื่องมือตรวจวัด



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112/1 Moo 5, Phrak Sai, Muang, Samut Prakan 10280
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CERTIFICATE OF CALIBRATION

Certificate No.: C0-2007006/22 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 | Model | CON 2700 |
| Serial No. | 2657889 | ID No. | WWL 0136 |
| Description | - | | |

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 20 July 2022

Calibration Date 20 July 2022

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FE-169

REV.02 02/24/21

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Certificate No.: C0-2007006/22

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 $\mu\text{S/cm}$ | S211008031 | Jan. 18, 2023 | SCP Science |
| | 1.421 mS/cm | S220112015 | May 16, 2023 | |

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 (\pm) |
|--------------------------------|------------------------|----------------------|-----------------------|
| 151.1 $\mu\text{S/cm}$ | 150.9 $\mu\text{S/cm}$ | 0.2 $\mu\text{S/cm}$ | 1.5 $\mu\text{S/cm}$ |
| 1.421 mS/cm | 1.423 mS/cm | -0.002 mS/cm | 0.0052 mS/cm |

Note : Adjustment points: 151.1 $\mu\text{S/cm}$ 1.421mS/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 -

FE-169

เอกสารสอบเทียบเครื่องมือตรวจวัด



AUTOMATION SERVICE CO.,LTD.
CALIBRATION LABORATORY

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

Cert. No. WAC-065
Page 2 of 2

Calibrate Procedure

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

Condition of this result of calibration

1). Reference Standard Solution

| <u>Standard</u> | <u>Lot No</u> | <u>Batch.</u> | <u>Cert. No.</u> | <u>Due Date</u> |
|----------------------|---------------|---------------|------------------|-----------------|
| Sodium Sulfite Power | 1.06657.0500 | K54224057 | - | 30 Sep 2023 |

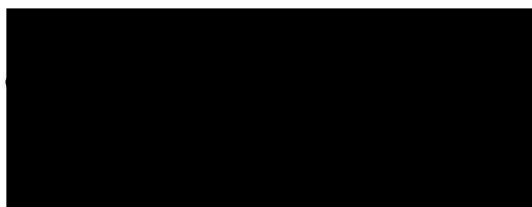
2). Traceability This certification is traceable to

- ☒ 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 | + 0.05 | 0.00 | - |
| Span | 8.25 | 7.13 | - 1.12 | 8.25 | - |

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



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Master Calibration Co.,Ltd.

547 Soi Ratchadanivat, Kwaeng Samsennok, 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

Certificate of Calibration

**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-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 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

The uncertainties are for a confidence probability of approximately 95%

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

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

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Certificate No.: MC 2207678

Page 2 of 3

The Reference Standard :

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

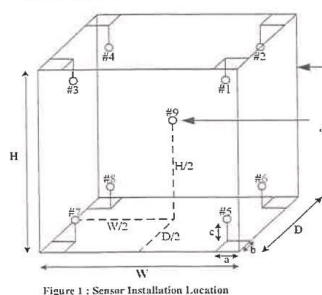
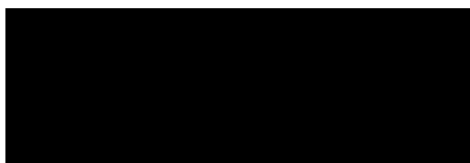


Figure 1 : Sensor Installation Location

Overall Ambient Temperature around the Chamber variation : 3.4 °C

Overall Line Voltage variation : 0.1 V

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



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

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

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



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

เอกสารสอบเทียบเครื่องมือตรวจวัด



Master Calibration Co., Ltd.

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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
TLAS 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

The uncertainties are for a confidence probability of approximately 95%

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

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

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

Certificate No.: MC 2203933

Page 2 of 3

The Reference Standard :

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

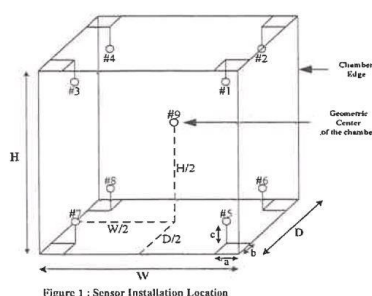


Figure 1 : Sensor Installation Location

Overall Ambient Temperature around the Chamber variation : 1.1 °C

Overall Line Voltage variation : 0.2 V

Chamber Size (W*H*D) : 65 cm x 80 cm x 50 cm

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

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

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



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

เอกสารสอบเทียบเครื่องมือตรวจวัด

Business Unit

SPC Calibration Center



Part of DKSH Group



Certificate of Calibration

| | | | |
|-----------------------------|---------------------|-------------------------|--------------|
| Equipment: | Balance | Certificate No.: | C01221685 |
| Model: | BL210S | Issued Date: | 08 June 2022 |
| Serial No. (or ID.): | 15808131 (WWL 0022) | Job No.: | KSPR2206906 |
| Manufacturer: | Sartorius | Page: | 1 of 2 |
| Condition: | In condition | | |

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

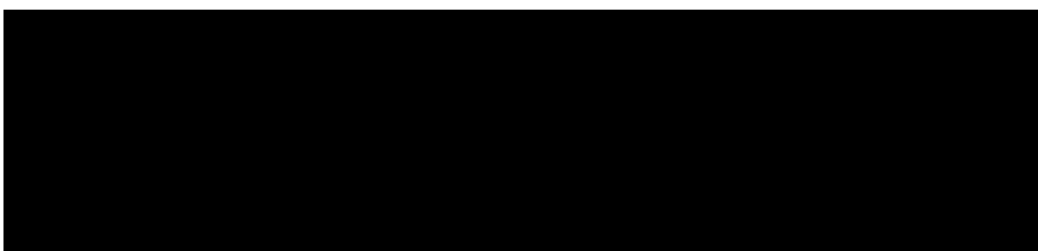
Calibration Place: Water Analysis Center Co., Ltd. (ห้องเครื่องชั่ง)
1/94 Moo 5, Rojana Industrial Park, Rojana Road,
Tambol Kanham, Amphur U-Thai, Ayutthaya 13210 Thailand

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



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.

บริษัท เอสพีซี อาร์ที จำกัด
SPC RT CO., LTD.
สาขาที่ 00003 1194 ซอยวิจิตรบรรณศาลิ 57 ถนนสุขุมวิท 101/1 แขวงบางซื่อ เขตพญาไท กรุงเทพมหานคร 10260
Branch 00003 1194 Soi Wichaithammasathai 57 Sukhumvit 101/1 Road, Bangchak, Phraekhaeng, Bangkok 10260 Thailand
Tel: 0 2185 4333 Ext. 3300-3308 Fax: 0 2185 4424 E-mail: info.spc@spc-rt.com Website: www.spc-rt.com

SPCC-FM-C01-12: 05 Apr 2022

เอกสารสอบเทียบเครื่องมือตรวจวัด

Business Unit

SPC Calibration Center



Part of DKSH Group

Certificate No.: C01221685

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 | 100 | (g) |
| Reference Points (g) | | | | | |
| A | B | C | D | E | |
| - | 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

บริษัท เอสพีซี อาร์ที จำกัด

SPC RT CO., LTD.




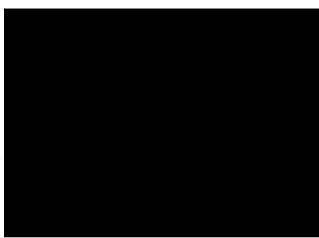
สาขาที่ 00003 1194 ซอยวิชัยธรรมศาสตร์ 57 ถนนสุขุมวิท 101/1 แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260

Branch 00003 1194 Soi Wachirathammasithi 57, Sukhumvit 101/1 Road, Bangchak, Phraekhanong, Bangkok 10260 Thailand

Tel: 0 2185 4333 Ext. 3300-3308 Fax: 0 2185 4424 E-mail: info.spc@spc-rt.com Website: www.spc-rt.com

SPCC-FM-C01-12: 05 Apr 2022

เอกสารสอบเทียบเครื่องมือตรวจวัด

| | | | |
|--|--|---|---|
|  Bara Scientific Solution of Success | Bara Scientific Co., Ltd. 968 U Chu Liang Building Floor7 Rama4 Road Silom Bangrak Bangkok Thailand 10500 Tel : 02-6324300 Fax : 02-6375496-7 www.barascientific.com |  ILAC-MRA |  NSC-TISI-TIS 17025 CALIBRATION 0209 |
| <h1>Certificate of Calibration</h1> | | | |
| | | Number of Page(s) | 1 of 3 |
| Certificate No. | BSCC-UV-149/22 | | |
| Equipment | UV/Vis Spectrophotometer | | |
| Model | UV-1800 | | |
| Manufacturer | Shimadzu | | |
| Serial No. | A11635405598CD | | |
| ID No. | WWL0082 | | |
| Date of receipt | 29 April 2022 | | |
| Date of calibration | 29 April 2022 | | |
| Date of issue | 6 May 2022 | | |
| Customer name | Water Analysis Center Co., Ltd. | | |
| Address | 1/94 Moo 5 , T.Kantham, A.Uthai, Ayutthaya 13210 | | |
| Temperature | (29.9-31.8) °C (On site) | | |
| Humidity | (48.7-52.6) %RH (On site) | | |
| Equipment condition | Good Operation | | |
| Calibration Location | Laboratory Room Water Analysis Center | | |
| Calibration Procedure | In-house method WI-UV-702-01 based on ASTM E275-01 | | |
| Traceability | Wavelength Accuracy is traceable to certificate No. 95917 and 95918 Photometric Accuracy is traceable to certificate No. 95924 and 95937 Stray Light is traceable to certificate No. 95908 The above certificate are traceable to SI unit through Starna Scientific Ltd. (UKAS accredited calibration laboratory NO. 0659) | | |
| Calibrated by | Mr.Waruth Janphung | | |
|  | | | |
| <small>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.</small> | | | |

FM-UV-708-02 Rev.01 (23/01/63)

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Bara Scientific Co., Ltd.
968 U Chu Liang Building Floor7 Rama4 Road
Silom Bangrak Bangkok Thailand 10500
Tel : 02-6324300 Fax : 02-6375496-7
www.barascientific.com



Certificate of Calibration

Certificate No. **BSCC-UV-149/22**

Number of Page(s)

2 of 3

Calibration Results:

1.Wavelength Accuracy

| Certified Wavelength (nm) | UUC (nm) | Error (nm) | Uncertainty (\pm nm) |
|---------------------------|----------|------------|-------------------------|
| 360.89 | 360.86 | -0.03 | 0.18 |
| 418.53 | 418.72 | 0.19 | 0.18 |
| 445.82 | 446.51 | 0.69 | 0.18 |
| 453.67 | 453.56 | -0.11 | 0.18 |
| 459.99 | 459.81 | -0.18 | 0.18 |
| 638.00 | 638.17 | 0.17 | 0.18 |
| 431.22 | 431.52 | 0.30 | 0.18 |
| 513.39 | 513.60 | 0.21 | 0.18 |
| 528.90 | 528.80 | -0.10 | 0.18 |
| 572.99 | 576.13 | 3.14 | 0.18 |
| 585.25 | 585.30 | 0.04 | 0.18 |
| 684.50 | 684.68 | 0.18 | 0.18 |
| 741.02 | 741.22 | 0.20 | 0.18 |
| 879.41 | 879.30 | -0.11 | 0.18 |

2.Photometric Accuracy (UV)


| Wavelength (nm) | Certified Absorbance (A) | UUC (A) | Error (A) | Uncertainty (\pm A) |
|-----------------|--------------------------|---------|-----------|------------------------|
| 235 | CNR | CNR | CNR | CNR |
| | CNR | CNR | CNR | CNR |
| 257 | CNR | CNR | CNR | CNR |
| | CNR | CNR | CNR | CNR |
| 313 | CNR | CNR | CNR | CNR |
| | CNR | CNR | CNR | CNR |
| 350 | 0.0000 | 0.0000 | 0.0000 | 0.0075 |
| | 0.6429 | 0.6404 | -0.0025 | 0.0075 |

*CNR = Customer not request



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FM-UV-708-02 Rev.01 (23/01/63)

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Bara Scientific Co., Ltd.
968 U Chu Liang Building Floor7 Rama4 Road
Silom Bangrak Bangkok Thailand 10500
Tel : 02-6324300 Fax : 02-6375496-7
www.barascientific.com

Certificate of Calibration

Certificate No. BSCC-UV-149/22 **Number of Page(s)** 3 of 3

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 |
| | 0.5783 | 0.5806 | 0.0023 | 0.0042 |
| | 0.7628 | 0.7650 | 0.0022 | 0.0042 |
| | 1.0206 | 1.0245 | 0.0039 | 0.0042 |
| 440.0 | 0.0000 | 0.0000 | 0.0000 | 0.0042 |
| | 0.5621 | 0.5635 | 0.0014 | 0.0042 |
| | 0.7455 | 0.7466 | 0.0011 | 0.0042 |
| | 0.9985 | 1.0007 | 0.0022 | 0.0042 |
| 465.0 | 0.0000 | 0.0000 | 0.0000 | 0.0042 |
| | 0.5227 | 0.5240 | 0.0013 | 0.0042 |
| | 0.6880 | 0.6895 | 0.0015 | 0.0042 |
| | 0.9487 | 0.9508 | 0.0021 | 0.0042 |
| 546.1 | 0.0000 | 0.0000 | 0.0000 | 0.0042 |
| | 0.5207 | 0.5205 | -0.0002 | 0.0042 |
| | 0.6973 | 0.6966 | -0.0007 | 0.0042 |
| | 0.9959 | 0.9955 | -0.0004 | 0.0042 |
| 590.0 | 0.0000 | 0.0000 | 0.0000 | 0.0042 |
| | 0.5544 | 0.5536 | -0.0008 | 0.0042 |
| | 0.7253 | 0.7240 | -0.0013 | 0.0042 |
| | 1.0942 | 1.0924 | -0.0018 | 0.0042 |
| 635.0 | 0.0000 | 0.0000 | 0.0000 | 0.0042 |
| | 0.5616 | 0.5609 | -0.0007 | 0.0042 |
| | 0.6927 | 0.6915 | -0.0012 | 0.0042 |
| | 1.0881 | 1.0869 | -0.0012 | 0.0042 |

*CNR = Customer not request

4. Stray Light*

| Standard cut-off wavelength (nm) | Unit Under Calibration(UUC) | | |
|----------------------------------|-----------------------------|-------------------|----------------|
| | Wavelength (nm) | Transmission (%T) | Absorbance (A) |
| 200.96±0.11nm | 199.31 | 0.9668 | 2.0147 |

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 base 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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FM-UV-708-02 Rev.01 (23/01/63)

เอกสารสอบเทียบเครื่องมือตรวจวัด



บริษัท ไทยยูนิค จำกัด

THAI UNIQUE CO., LTD.

80-82 ถนนประชาธิปไตย แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200

80-82 Prachathipatai Rd., Bangkhunphrom, Pranakorn, Bangkok 10200

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

PREVENTATIVE MAINTENANCE (PM) CHECK LIST

FOR ATOMIC ABSORPTION SPECTROMETER

Model & Serial Number: AA 240FS & AA 09117073

Customer : ว. อิมปีโอเดรเวทท์ จก.

Date: 10 กพ 22

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

เอกสารสอบเทียบเครื่องมือตรวจวัด



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Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thawatt@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 = 9.5 mL/min
- ☒ Test Photometric noise, STDV = 0.0003 Abs (should be ≤ 0.00050 Abs)
- ☒ Flame, Test high solids nebulizer setting use

-Air/acet Cu 5 ppm = 0.77 Abs, and Precision

(%RSD)= 0.4 % (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 ≥ 0.15 Abs and $\leq 4.0\%$ RSD)

เอกสารสอบเทียบเครื่องมือตรวจวัด

SVD Results Report

VARIAN

Report ID.1 **Diagnostic Start Time:** 10/2/2022 11:56:32 **Diagnostic End Time:** 10/2/2022 12:36:59
Customer: Water Analysis Center Co., Ltd. **Service Engineer:** Suriya Nacharoen
Address: Ayuthaya **Contact Details:** Kanitsaya

Instrument Configuration

Configuration:

| | |
|---|--|
| Serial Number: AA0911M073 | 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: 29533.551 | D2 Run Hours: 4026.533 |
| Zero Wavelength Offset: -18.735 | D2 Serial Number: not set ! |
| Mono Correction: -0.360 | D2 Install Date: 1/1/1970 |
| Flame Hours: 7417.833 | D2 Original Intensity: 1.000 |
| | D2 Last Intensity: 678.000 |

Frequency:

| | |
|------------------------------------|---|
| Averaging Period: 30.0 | |
| Datapoint Count: 20 | |
| Upper Limit: 51.00 | Highest Measured Frequency: 50.00 |
| Average Frequency: 50.00 | |
| Lower Limit: 49.00 | Lowest Measured Frequency: 50.00 |

Result: **Passed**

Report Generated At: 10/2/2022 12:39:54

1

SVD Results Report **SVD**

เอกสารสอบเทียบเครื่องมือตรวจวัด

Power Supply:

Averaging Period: 30.0

Datapoint Count: 20

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

Report Generated At: 10/2/2022 12:39:55

2

SVD Results Report



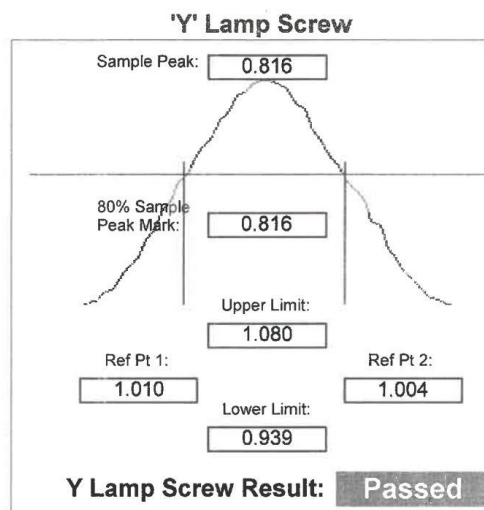
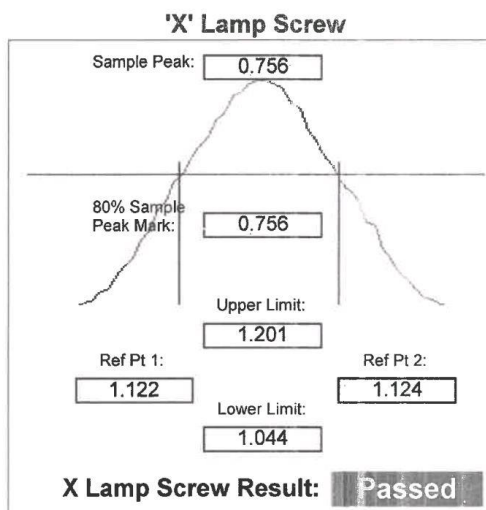
เอกสารสอบเทียบเครื่องมือตรวจวัด

Optics

Beam Balance:

Lamp Type: Copper
Lamp Socket Used: 3

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



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 | Passed |
| First Order | 324.45 | 324.74 | 325.15 | Passed |
| Second Order | 649.23 | 649.56 | 649.97 | Passed |

Report Generated At: 10/2/2022 12:39:55

3

SVD Results Report



เอกสารสอบเทียบเครื่องมือตรวจวัด

Wavelength Repeatability:

| | | | |
|--------------------------------------|--|---------------------------|-----------------|
| Lamp Used: Copper | | Lamp Current(mA): 4 | |
| Peak Used(nm): 324.750 | | Slit Width(nm): 0.2 | |
| Connected to Socket: 3 | | Slit Height: Normal | |
| Lamp Alignment: <div>Performed</div> | | | |
| Lower Limit(nm) 324.759 | | 324.879 | Upper Limit(nm) |
| (Approach from Zero Order) | | (Approach from end) | |
| Sample 1: 324.819 | | Sample 2: 324.811 | |
| Sample 3: 324.819 | | Sample 4: 324.811 | |
| Sample 5: 324.815 | | Sample 6: 324.811 | |
| Sample 7: 324.819 | | Sample 8: 324.815 | |
| Sample 9: 324.819 | | Sample 10: 324.819 | |
| Mean: 324.816 | | Standard Deviation: 0.004 | |
| Result: <div>Passed</div> | | | |

เอกสารสอบเทียบเครื่องมือตรวจวัด

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 | 156 | 165 | 191 | Passed |
| S2 | 271 | 293 | 332 | Passed |
| S3 | 474 | 504 | 579 | Passed |
| S4 | 825 | 904 | 1008 | Passed |
| S5 | 1435 | 1510 | 1754 | Passed |
| S6 | 2498 | 2711 | 3053 | Passed |
| S7 | 4347 | 4658 | 5313 | Passed |

Interlocks:

| | | | |
|-------------------------------|----------|---------------------|---------|
| Burner Fitted: | Working | Flame Detect: | Working |
| N2O Burner Fitted: | Working | GCU Active: | Working |
| Flame Shield Closed: | Working | Oxidant Pressure: | Working |
| Gas Control Fitted: | Untested | Oxidant Changeover: | Working |
| Pressure Release Bung Fitted: | Working | Ignition: | Working |
| Liquid Trap Fitted: | Working | | |

Report Generated At: 10/2/2022 12:39:55

5

SVD Results Report



เอกสารสอบเทียบเครื่องมือตรวจวัด

Auto Lamp Recognition:

Lamp 1: Uncoded Lamp/Not Connected

Lamp 2: Uncoded Lamp/Not Connected

Lamp 3: 14 - Copper (Cu)

Lamp 4: Uncoded Lamp/Not Connected

Lamp 5: Not Supported

Lamp 6: Not Supported

Lamp 7: Not Supported

Lamp 8: Not Supported

Result: **Passed**

GTA Temperature Monitoring:

Not Performed

Notes:

C2202SU09_1
PM 10 Feb 2022

Signatures:



Report Generated At: 10/2/2022 12:39:55

6

SVD Results Report



เอกสารสอบเทียบเครื่องมือตรวจวัด



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

PREVENTATIVE MAINTENANCE (PM) CHECK LIST

FOR ATOMIC ABSORPTION SPECTROMETER

Model & Serial Number: 240Z AA & M918230004

Customer : ศูนย์วิเคราะห์น้ำ จก.

Date: 29 เม.ย. 22

Safety

- ☐ Flame, Inspect/replace o-ring nebulizer, spray chamber and burner N/A
- ☐ Flame, Clean nebulizer, spray chamber and burner N/A
- ☐ Flame, Check liquid trap interlock, burner interlock, pressure relief bung interlock and shield interlock N/A
- ☒ Furnace, Clean work head, electrode and shroud
- ☒ Furnace, Clean PSD and PSD tray
- ☒ 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 = 324.7 nm
- ☒ Check that PMT % Gain the copper at 324.8 nm, 4 mA, 0.5 nm slit width, Gain = 49.7 (should be $\leq 64\%$ or $\leq 380V$)
- ☐ Flame, Check D2 lamp is work N/A

เอกสารสอบเทียบเครื่องมือตรวจวัด



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Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thawatt@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**

**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 = _____ mL/min
- ☒ Test Photometric noise, STDV = 0.0001 Abs (should be ≤ 0.00050 Abs)
- ☐ Flame, Test high solids nebulizer setting use
- Air/acet Cu 5 ppm = _____ Abs, and Precision
- (%RSD)= _____ % (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 = 0.22 Abs, and
- Precision (%RSD)= 2.4 % (should be ≥ 0.15 Abs and $\leq 4.0\%$ RSD)

N/A

N/A

เอกสารสอบเทียบเครื่องมือตรวจวัด



MEGAFIL CO., LTD.

99/183 Moo 3 Tambon Bang Rak Noi Amphur Mueang Nonthaburi 11000
Tel. 0-2528-6081-2 Fax. 0-2528-6083, 0-2525-7034
www.megafil.co.th E-mail : megafil.group@gmail.com

BSC Certification Test Report

Page 1 of 6

Certificate No. : M01075/22

Customer Name : LABORATORY WATER ANALYSIS CENTER COMPANY LIMITED

Customer Address : 1/94 Moo 5 T.Kanharm, 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 : 23/09/2022

Due Date : 23/09/2023 *or after HEPA filters are replaced or unit is moved*

Test by : Mr. Piyapong Pusua

Approved by :

Issued Date :

This calibration certificate documents the traceability to 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.

Megafil Co.,Ltd.

MG-FM-7.8-001, R00 (01/07/19)

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MEGAFIL CO., LTD.

99/183 Moo 3 Tambon Bang Rak Noi Amphur Mueang Nonthaburi 11000
Tel. 0-2528-6081-2 Fax. 0-2528-6083, 0-2525-7034
www.megafil.co.th E-mail : megafil.group@gmail.com

Page 2 of 6

Certificate No. : M01075/22

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 | 100mm |

Measurement Data.

| | | | |
|------|------|------|------|
| 0.36 | 0.42 | 0.43 | 0.41 |
| 0.40 | 0.34 | 0.34 | 0.33 |

Average velocity 0.38 m/s (75 FPM.) **Velocity range** 0.25-0.50 m/s (49-98 FPM.)

Uniformity(EN: +/-20%avg.) 0.30 - 0.46 m/s (60 - 90 FPM.)

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

Downflow volume (Q) 802 CFM.

Result Summary ☒ **Pass** ☐ **Fail**

Equipment used : Thermo Anemometer **Model** 425 **S/N :** 02623979 **Calibration date :** 14/07/2022

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Certificate No. : M01075/22

2. Inflow velocity test.

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

| | | | | |
|------|------|------|------|------|
| 0.53 | 0.47 | 0.48 | 0.50 | 0.51 |
| 0.57 | 0.46 | 0.52 | 0.53 | 0.50 |
| 0.54 | 0.57 | 0.55 | 0.52 | 0.53 |
| 0.53 | 0.51 | 0.57 | 0.54 | 0.51 |
| 0.51 | 0.48 | 0.53 | 0.55 | 0.56 |

Average Inflow velocity 0.44 m/s (86 FPM.) Velocity range ≥0.40 m/s (≥79 FPM.)

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

Inflow volume(Q) 344 CFM

Result Summary ☒ Pass ☐ Fail

Adjustments Required ☐ Fan Speed ☐ Damper

Equipment used : Thermo Anemometer Model 425 S/N : 02623979 Calibration date : 14/07/2022

3. HEPA filter leak test.

Measurement Data

| HEPA Filter | PAO Upstream Conc.(calculated) | Specification | Measured leak penetration |
|---------------------|--------------------------------|---------------|---------------------------|
| Supply HEPA Filter | <u>18</u> µg/l. | <0.003% | <0.003% |
| Exhaust HEPA Filter | <u>18</u> µg/l. | <0.003% | <0.003% |

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Certificate No. : M01075/22

Leak location

Supply HEPA Filter

Back



Exhaust HEPA Filter

Back



Result Summary

☒ Pass

☐ Fail

Equipment used : Aerosol Photometer Model 2I S/N : 26468 Calibration date 14/07/2022

Equipment used : Smoke Generator Model TDA-6D S/N : 26530

4. Airflow smoke patterns test

Measurement Information

1. 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
2. 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.
3. 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.
4. 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.

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Certificate No. : M01075/22

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 เนื่องจากตู้ไม่มีฟังก์ชันนี้

6. Illumination Test (Lighting) : Option

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

Lux

| | | | |
|-----|------|------|-----|
| 620 | 965 | 938 | 561 |
| 867 | 1446 | 1492 | 768 |

Remark :

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Certificate No. : M01075/22

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/m² when measures at work floor surface.

mW/m²

| | | | |
|-----|------|------|-----|
| 720 | 1510 | 1540 | 760 |
| 470 | 980 | 990 | 450 |

Remark :

-o0o-

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เอกสารสอบเทียบเครื่องมือตรวจวัด



Ref No. : 0303/17008

CERTIFICATE OF TESTING LABORATORY ACCREDITATION

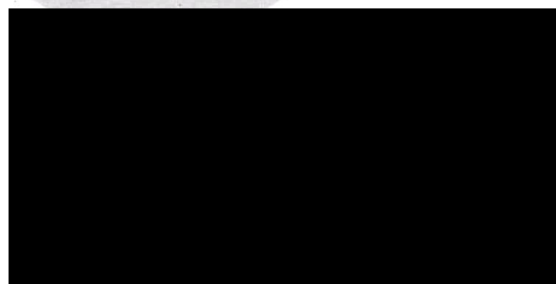
This is to certify that

*Laboratory of Water Analysis Center Co., Ltd.
1/94 Moo 5, Tambon Kanharm, Amphoe U-Thai,
Changwat Phra Nakhon Si Ayutthaya 13210*

has successfully undergone assessment according to ISO/IEC 17025 : 2017
and under the Bureau of Laboratory Accreditation, Department of Science Service
for the requirements, regulations and criteria for the competence of testing laboratories

LABORATORY ACCREDITATION
Accreditation Number TESTING - 0029
BLA-DSS

The scope of accreditation is as annexed hereto



Bureau of Laboratory Accreditation, Department of Science Service,
Ministry of Higher Education, Science, Research and Innovation

เอกสารสอบเทียบเครื่องมือตรวจวัด

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Accreditation Number : Testing - 0029

Laboratory Status : ☒ Permanent ☐ Site ☐ Temporary ☐ Mobile

| Item Number | Test Material / Product | Test Item / Range of Testing | Test Method / Technique Used |
|-------------|-------------------------|--|---|
| 1 | Bottled drinking water | - Chloride 6 mg/L to 1 000 mg/L - Total hardness (Calculated as CaCO ₃) 5 mg/L to 2 000 mg/L - Total solids dried at 103 °C to 105 °C 25 mg/L to 4 000 mg/L | Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 rd ed., 2017, part 4500-Cl ⁻ B Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 rd ed., 2017, part 2340 C Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 rd ed., 2017, part 2540 B |

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| Item Number | Test Material / Product | Test Item / Range of Testing | Test Method / Technique Used |
|--------------|-------------------------|--|--|
| 1 (cont.) | Bottled drinking water | - Manganese 0.05 mg/L to 5 mg/L - Iron 0.10 mg/L to 5 mg/L - Cadmium 1 µg/L to 5 µg/L - Lead 10 µg/L to 50 µg/L - pH 6.0 to 8.0 | Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 rd ed., 2017, part 3111 B, 3030 E Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 rd ed., 2017, part 3113 B, 3030 E In - house method : TM 001 based on Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 rd ed., 2017, part 4500-H ⁺ B |

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| Item Number | Test Material / Product | Test Item / Range of Testing | Test Method / Technique Used |
|-------------|-------------------------|---|---|
| 2 | Water | <p>- pH 6.0 to 10.0</p> <p>- Total suspended solids dried at 103 °C to 105 °C 10 mg/L to 1 000 mg/L</p> <p>- Total dissolved solids dried at 180 °C 25 mg/L to 4 000 mg/L</p> | <p>In - house method : TM 001 based on Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 4500-H⁺ B</p> <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 2540 D</p> <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 2540 C</p> |

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| Item Number | Test Material / Product | Test Item / Range of Testing | Test Method / Technique Used |
|--------------|-------------------------|--|---|
| 2 (cont.) | Water | - Cadmium 0.02 mg/L to 0.9 mg/L - Copper 0.05 mg/L to 5 mg/L - Zinc 0.05 mg/L to 5 mg/L - Chromium 0.05 mg/L to 5 mg/L - Nickel 0.10 mg/L to 4 mg/L - Manganese 0.05 mg/L to 5 mg/L - Lead 0.10 mg/L to 2 mg/L - Iron 0.10 mg/L to 5 mg/L | Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 rd ed., 2017, part 3111 B, 3030 E |

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| Item Number | Test Material / Product | Test Item / Range of Testing | Test Method / Technique Used |
|--------------|-------------------------|--|--|
| 2 (cont.) | Water | <p>- Water soluble silica (Calculated as SiO₂) 1.1 mg/L to 26 mg/L</p> <p>- Chloride 6 mg/L to 1 000 mg/L</p> <p>- Total hardness (Calculated as CaCO₃) 5 mg/L to 2 000 mg/L</p> | <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 4500-SiO₂ C</p> <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 4500-Cl⁻ B</p> <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 2340 C</p> |

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| Item Number | Test Material / Product | Test Item / Range of Testing | Test Method / Technique Used |
|--------------|-------------------------|------------------------------|---|
| 2 (cont.) | Water | - BOD 2 mg/L to 500 mg/L | In - house method : TM 041 based on Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 rd ed., 2017, part 5210 B |
| | | - BOD 2 mg/L to 500 mg/L | In - house method : TM 013 based on Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 rd ed., 2017, part 5210 B, part 4500-O C |
| | | - COD 40 mg/L to 200 mg/L | Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 rd ed., 2017, part 5220 C |

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| Item Number | Test Material / Product | Test Item / Range of Testing | Test Method / Technique Used |
|--------------|-------------------------|---|---|
| 2 (cont.) | Water | - Total Kjeldahl Nitrogen 5 mg/L to 200 mg/L - Oil and grease 2 mg/L to 100 mg/L - Total solids dried at 103 °C to 105 °C 25 mg/L to 4 000 mg/L | Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 rd ed., 2017, part 4500-NH ₃ C, part 4500-N _{org} B Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 rd ed., 2017, part 5520 D Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 rd ed., 2017, part 2540 B |

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| Item Number | Test Material / Product | Test Item / Range of Testing | Test Method / Technique Used |
|--------------|-------------------------|---|---|
| 2 (cont.) | Water | <ul style="list-style-type: none"> - Selenium 5 µg/L to 50 µg/L - Arsenic 5 µg/L to 50 µg/L - Barium 0.5 mg/L to 5 mg/L - Cadmium 1 µg/L to 5 µg/L - Lead 10 µg/L to 50 µg/L | <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 3114 C</p> <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 3111 D, 3030 E</p> <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 3113 B, 3030 E</p> |

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| Item Number | Test Material / Product | Test Item / Range of Testing | Test Method / Technique Used |
|-------------|-------------------------|---|---|
| 3 | Wastewater | <p>- pH 4.0 to 10.0</p> <p>- Total suspended solids dried at 103 °C to 105 °C 10 mg/L to 1 000 mg/L</p> <p>- Total dissolved solids dried at 180 °C 50 mg/L to 4 000 mg/L</p> | <p>In - house method : TM 001 based on Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 4500 - H⁺ B</p> <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 2540 D</p> <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 2540 C</p> |

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| Item Number | Test Material / Product | Test Item / Range of Testing | Test Method / Technique Used |
|--------------|-------------------------|--|---|
| 3 (cont.) | Wastewater | <ul style="list-style-type: none"> - Cadmium 0.02 mg/L to 0.9 mg/L - Copper 0.05 mg/L to 5 mg/L - Zinc 0.05 mg/L to 5 mg/L - Chromium 0.05 mg/L to 5 mg/L - Nickel 0.10 mg/L to 4 mg/L - Manganese 0.05 mg/L to 5 mg/L - Lead 0.10 mg/L to 2 mg/L - Iron 0.10 mg/L to 5 mg/L | Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 rd ed., 2017, part 3111 B, 3030 E |

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| Item Number | Test Material / Product | Test Item / Range of Testing | Test Method / Technique Used |
|--------------|-------------------------|---|--|
| 3 (cont.) | Wastewater | <p>- Total hardness (Calculated as CaCO_3) 5 mg/L to 2 000 mg/L</p> <p>- BOD 4 mg/L to 7 000 mg/L</p> <p>- BOD 4 mg/L to 7 000 mg/L</p> | <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 2340 C</p> <p>In - house method : TM 041 based on Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 5210 B</p> <p>In - house method : TM 013 based on Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 5210 B, part 4500-O C</p> |

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| Item Number | Test Material / Product | Test Item / Range of Testing | Test Method / Technique Used |
|--------------|-------------------------|---|--|
| 3 (cont.) | Wastewater | - COD 40 mg/L to 3 000 mg/L | Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 rd ed., 2017, part 5220 C |
| | | - Total Kjeldahl Nitrogen 5 mg/L to 200 mg/L | Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 rd ed., 2017, part 4500-NH ₃ C, 4500-N _{org} B |
| | | - Oil and grease 2 mg/L to 1 000 mg/L | Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 rd ed., 2017, part 5520 D |

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| Item Number | Test Material / Product | Test Item / Range of Testing | Test Method / Technique Used |
|--------------|-------------------------|--|---|
| 3 (cont.) | Wastewater | <ul style="list-style-type: none"> - Total solids dried at 103 °C to 105 °C 25 mg/L to 4 000 mg/L - Selenium 5 µg/L to 50 µg/L - Arsenic 5 µg/L to 50 µg/L - Barium 0.5 mg/L to 5 mg/L | <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 2540 B</p> <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 3114 C</p> <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23rd ed., 2017, part 3111 D, 3030 E</p> |

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Scope of Testing Laboratory Accreditation

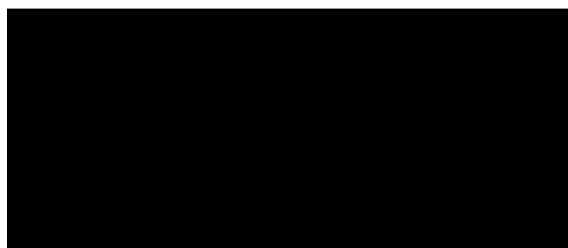
Laboratory Name : Laboratory of Water Analysis Center Co., Ltd.

Address : 1/94 Moo 5, Tambon Kanharm, Amphoe U-Thai,
Changwat Phra Nakhon Si Ayutthaya 13210

Accreditation Number : Testing - 0029

Laboratory Status : ☐ Permanent ☒ Site ☐ Temporary ☐ Mobile

| Item Number | Test Material / Product | Test Item / Range of Testing | Test Method / Technique Used |
|-------------|-------------------------|---|--|
| 4 | Environmental noise | - Sound level Equivalent sound level $L_{eq,T}$ 30 dB (A) to 120 dB (A) Maximum sound level L_{max} 30 dB (A) to 120 dB (A) | In - house method : TM 201 based on ISO 1996-2 : 2017 |



Initial Issue Date 23rd September 2008

Issue Number 13

Bureau of Laboratory Accreditation, Department of Science Service, Ministry of Higher Education, Science, Research and Innovation