

ภาคผนวก ช

เอกสารสอบเทียบเครื่องมือที่
ใช้ในการวิเคราะห์



THAI HEART CALIBRATION CO., LTD.
2299/12-13 Moo 4, Thepharak, Muang, Samut Prakan 10270
Tel. 0-2394-2162, 0-2757-8435, 0-2757-8496 Fax: 0-2757-8507
Website : www.thaiheartcal.com E-mail : service@thaiheartcal.com



CERTIFICATE OF CALIBRATION

Certificate No.: CO-07110177/19

Page 1 of total 3 pages

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

Equipment
pH Meter
Manufacturer
HACH
Model
senion3
ID No.
WWL 0023
Description
Range : 0 - 14 pH, Resolution : 0.01 pH

Environmental Conditions
Ambient Temperature: (23 ± 3) °C
Relative Humidity: (50 ± 15) %

Calibration Location
Received Date
7 November 2019
Calibration Date
7 November 2019

Date of Issue
9 November 2019

Checked by

Approved by:

Act as Technical Manager

Representative of Managing Director

() (Krisyosl K.) () (Sakda Y.)
() (Patiphan K.) () (Omapa P.)
() (Pongsak H.) () (Niriphong K.)
() (Kanung C.) () (Nonthachai K.)
() (Pranong P.) () (Noppol P.)

(Dr. Ekachai Puttitwong)

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

F-140

REV.03 16/08/61



THAI HEART CALIBRATION CO., LTD.
2299/12-13 Moo 4, Thepharak, Muang, Samut Prakan 10270
Tel. 0-2394-2162, 0-2757-8435, 0-2757-8496 Fax: 0-2757-8507
Website : www.thaiheartcal.com E-mail : service@thaiheartcal.com

Certificate No.: CO-07110177/19

Page 2 of total 3 pages

Reference Method:

- The calibration method used was CM-062 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 Buffer Solution	4.01	280319	Apr. 23, 2020	NIMT
pH Standard Buffer Solution	7.00	280119	Apr. 23, 2020	NIMT
pH Standard Buffer Solution	10.009	C02626	Dec. 17, 2019	HACH

Type	Model	Serial No.	Certificate No.	Due Date	Traceability
Digital Thermometer with Sensor	1523 / 5622	1709138 / 4605984-005	10-0409003/19	Sep. 3, 2020	THC

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

- NIMT, National Institute of Metrology (Thailand).
- HACH, Hach Lange GmbH.
- THC, Thai Heart Calibration Co., Ltd.

Measurement Results:

1.) Calibration of pH Electrode (Serial No.: 17195 008)

pH Standard Buffer Solution (pH)	Measured Value		Uncertainty (± pH)	Coverage Factor, k
	(pH)	(mV)		
4.01	4.00	166.6	0.016	2.00
7.00	7.01	-5.6	0.016	2.00
10.009	9.98	-174.7	0.016	2.00

Note : Adjust Curve to Buffer Solution pH (4,7,10)
Temperature stability of micro bath : 25 ± 0.2°C

The above reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor as above, providing a level of confidence approximately 95%.

Calibrated by

Omapa

REV.03 16/08/61



THAI HEART CALIBRATION CO., LTD.
2299/12-13 Moo 4, Thepharak, Muang, Samut Prakan 10270
Tel. 0-2394-2162, 0-2757-8435, 0-2757-8496 Fax.: 0-2757-8507
Website : www.thaiheartcal.com E-mail : service@thaiheartcal.com

Certificate No.: CO-0711017/19

Page 3 of total 3 pages

Reference Method:

- The calibration method used was CM-003 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	18E4877	Dec. 18, 2019	TPA
Semi-Standard Platinum Resistance Thermometer	5628	2166	TT-0063-17	Jul. 4, 2020	NIMT
Liquid Bath	XORTS-40A	XO111019	IO-0506003/19	Jun. 7, 2021	THC

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

- TPA, Technology Promotion Association (Thailand-Japan).
- NIMT, National Institute of Metrology (Thailand).
- THC, Thai Heart Calibration Co., Ltd.

ภาคผนวก ข-2

Measurement Results:

(X) Without Adjustment

Dimension of probe : Diameter 3 mm. Sensor Type : RTD (PT100)

Immersion Depth (mm.)	Standard Reading (°C)	UUC ⁽¹⁾ Reading (°C)	Correction (°C)	Uncertainty (± °C)
100	22.00	22.2	-0.20	0.15
100	25.00	25.1	-0.10	0.15
100	28.00	28.1	-0.10	0.15

UUC⁽¹⁾ : Unit Under Calibration

The above reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor $k = 2.00$, providing a level of confidence approximately 95%.

- End of Certificate -

Calibrated by Chaleem

REV 03 16/08/61

F-140



MIRACLE INTERNATIONAL TECHNOLOGY CO., LTD
214 Bangwaek Rd. Bangpai Bangkok 10160
Tel.: 0-2865-4647-8 Fax: 0-2865-4649 <http://www.mit.in.th>

CALIBRATION CERTIFICATE

Certificate No.: L1909-100

Date Issued : 10-Sep-19

Customer : Water Analysis Center Co., Ltd. (Head Office)
30/5 Soi Vibhavadeerangsi 60, Vibhavadeerangsi RD.,
Talard Bangkokhen, Laksi, Bangkok 10210

Equipment : DO Meter
Display : YSI
Manufacturer : YSI
Model : YSI 5010 BOD Probe
Serial No. : 04K17959 AC
ID No./Tag No. : WWL0027
Date Received : 06-Sep-19
Date Calibrated : 08-Sep-19
Calibrated by : Ms. Jaruchat Junthavorn

Calibration Method or Calibration Procedure Used

In-house method : CP-77 by direct measurement with standard dissolved oxygen solution at defined temperature.

This certificate is traceable to national standards, which realize the units of measurement according to the International System of Units (SI).

Result of Calibration

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

This certificate may not be reproduced other than in full except with the prior written approval of the Technical Manager, Miracle International Technology Company Limited.

Approved by :

(Mr. Tassanai Suksakon)
Technical Manager



Page 1 of 2



Calibration Report

ENCLOSURES TEMPERATURE CONTROLLED

Report No. : MC 1909145

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

Reference Job No. : 19-1904 Received Date : 15 July 2019
 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 report number (MC 1909145) has been attached to the case.
 Method : MWL-T-010 Temperature Calibration Method on Chamber
 Location of Calibration : Water Analysis Center Co., Ltd. ; Laboratory.
 Environmental Conditions : Ambient Temperature : (25.6 to 26.0) °C
 Relative Humidity : (37.0 to 44.0) %
 Date of Calibration : 15 July 2019 Date of Issue : 17 July 2019

Checked by : Thanagorn Approved by : Aitipong
 Thanagorn Limchaicharoen Aitipong Kunjawanit
 (Calibration Supervisor) (Technical Manager)

NATA Accredited Laboratory Number: 14355

Accredited for compliance with ISO/IEC 17025. The results of the tests, calibrations and/or measurements included in this document are traceable to national standards. This report may not be reproduced except with the prior written approval of the issuing laboratory.

Certificate No : L1909-100
 Environment : Ambient Temperature : (25 ± 2)°C
 Relative Humidity : (50 ± 15)%RH

STD Reading (mg/l)	UUC Reading Before (mg/l)	UUC Reading After (mg/l)	Error (mg/l)	Uncertainty (± mg/l)
8.976 @ 20.21°C	9.03	-	0.054	0.039

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. L1901-006 for HI Accuracy Thermometer Serial No. 130508842, Due 07-Jan-20
 MIT Certificate No. L1907-239, L1907-240 for Data Logger Serial No. AI74547, Due 08-Jul-20
 HANNA Certificate No. 13C81 for Zero Oxygen Solution Serial No. S0021/18, Due 14-Mar-2023

End of Certificate

Continuation of Report No. : MC 1909145

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The Reference Standard :

Description	Report No.	Serial No.	Due date
Data Acquisition/Switch Unit	MC 1907974	93000641	11 June 2020
With Thermocouple Type " T " ID. No.29/1 to 29/9			

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

National Physical Laboratory (NPL), National Measurement Institute (NMI) Australia
through the reference standards laboratory of Master Calibration Co., Ltd.

1. Calibration Procedure:

The equipment list above was calibrated an accuracy of temperature in a chamber of the Refrigerator

The calibration was performed by direct measurement of generated temperatures using the standard thermometer with nine temperature sensors. The following data was gathered during the uniformity analysis. The data was recorded in a period of sixty minutes after the specified temperature reach a steady state. The temperature scale used was based on ITS - 90.

The Refrigerator has been examined for the following feature in accordance with the requirements, for accuracy of test method MWI-T-010 "Temperature Calibration Method on Chamber" (based on ASTM Designation: E 1292-94 "Standard Specification for Gravity Convection And Forced-Ventilation Incubators" but does not necessarily comply with all methods or determinations).

They may be reported in terms of a three-dimensional region of the chamber and of the associated sensor positions:

$$\begin{aligned} - W \times H \times D &= 171 \text{ cm} \times 157 \text{ cm} \times 60 \text{ cm} \\ - a \times b \times c &= 5 \text{ cm} \times 5 \text{ cm} \times 5 \text{ cm} \end{aligned}$$

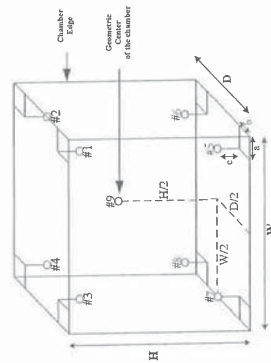


Figure 1 : Sensor Installation Location

Checked by : *Thana gorn*

[MCF-Q-048 ; Rev.4 ; Date : 01/01/2015]

Continuation of Report No. : MC 1909145

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2. Definitions :

Uniformity of temperature : 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.

Stability of temperature : One-half of the greatest maximum difference of measured temperatures at any one sensor, for at least half an hour after reaching steady state or after one achieved complete cycle of control whichever comes first. The specific check of temperature stability at specific positions or locations of working space within the chamber according to the way of use should be specified.

3. Result of calibration :

UUC* Temperature Setting (°C)	2.0
UUC* Temperature reading (°C)	2.8
Measurement location	Average of Standard Reading (°C)
Location #1	3.77
Location #2	3.66
Location #3	3.86
Location #4	3.88
Location #5	3.67
Location #6	3.69
Location #7	4.40
Location #8	4.29
Location #9	4.31
Maximum Measured Temperature	5.39 °C
Minimum Measured Temperature	2.70 °C
Uniformity of temperature	0.8 °C
Stability of temperature (±)	1.1 °C
Uncertainty of Measurement (±)	1.2 °C

Note : UUC* : Unit Under Calibration

Checked by : *Thana gorn*

[MCF-Q-048 ; Rev.4 ; Date : 01/01/2015]

Continuation of Report No. : MC 1909145

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4. Uncertainty of Measurement

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor $k = 2.28$, providing a level of confidence of approximately 95 %.

The measured values in this report refer to the time of examination. The equipment used in this examination was in a current calibration state and traceable to national standards of measurement.

End of Calibration Report

ภาคผนวก ข-5

Checked by : *Thanyaporn*

[MCF-Q-048 ; Rev4 ; Date : 01/01/2015]

W	FO.LAB 6.4-1/10	แก้ไขครั้งที่ : 0	วันที่บังคับใช้ : 1 ม.ค. 2562	หน้า : 1 ของ 4
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บันทึกการทวนสอบเครื่องมือวัด

Equipment : Heating Block I.D. No. : WWL0063
Serial No. : 1904003 Model : Mulberry, HB-44
Manufacturer : F.G.E. CO., LTD.

Environment Condition :

Temperature : _____
Humidity : _____

1. Reference Standard Instruments.

Description / Model	Code	Traceability to	Cal Due
1.1 Digital Thermometer with Thermocouple	WWL0037	-	03 July 2019
1.2			
1.3			
1.4			

2. Reference Standard Materials.

Material	Manufacturer	Lot No.	Exp. date.	Traceability to
2.1				
2.2				
2.3				
2.4				

Verification by : *ณัฏฐา*
Verification Dated : 30-12-2562
Expiration Dated : 30-04-2563

W	FO.LAB 6.4-1/10	แก้ไขครั้งที่ : 0	วันที่บังคับใช้ : 1 ม.ค. 2562	หน้า : 2 ของ 4
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I.D. No. : WWL0063

Verification result

Reference Standard Material (°C)	Reference Standard Instrument (°C)	Instrument Reading (°C)	Error (°C)	Status	
				Pass	No Pass
	150 ± 2	อุณหภูมิ 1 = 149.2	0.8	✓	
	(148.6-151.4)	อุณหภูมิ 2 = 150.2	-0.2	✓	
		อุณหภูมิ 3 = 150.8	-0.8	✓	
		อุณหภูมิ 4 = 150.6	-0.6	✓	
		อุณหภูมิ 5 = 150.8	-0.8	✓	
		อุณหภูมิ 6 = 150.6	-0.6	✓	
		อุณหภูมิ 7 = 150.9	-0.9	✓	
		อุณหภูมิ 8 = 150.4	-0.4	✓	
		อุณหภูมิ 9 = 150.8	-0.8	✓	
		อุณหภูมิ 10 = 151.0	-1.0	✓	
		อุณหภูมิ 11 = 150.8	-0.8	✓	
		อุณหภูมิ 12 = 151.0	-1.0	✓	
		อุณหภูมิ 13 = 150.4	-0.4	✓	
		อุณหภูมิ 14 = 150.8	-0.8	✓	
		อุณหภูมิ 15 = 150.8	-0.8	✓	
		อุณหภูมิ 16 = 150.6	-0.6	✓	
		อุณหภูมิ 17 = 149.9	0.1	✓	
		อุณหภูมิ 18 = 150.4	-0.4	✓	
		อุณหภูมิ 19 = 150.2	-0.2	✓	
		อุณหภูมิ 20 = 150.3	-0.3	✓	

Approved by :  Date : ๒๐-๑๒-๖2

W	FO.LAB 6.4-1/10	แก้ไขครั้งที่ : 0	วันที่บังคับใช้ : 1 ม.ค. 2562	หน้า : 3 ของ 4
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I.D. No. : WWL0063

Verification result

Reference Standard Material (°C)	Reference Standard Instrument (°C)	Instrument Reading (°C)	Error (°C)	Status	
				Pass	No Pass
	150 ± 2	อุณหภูมิ 21 = 150.0	0.0	✓	
	(148.6-151.4)	อุณหภูมิ 22 = 149.0	1.0	✓	
		อุณหภูมิ 23 = 150.2	-0.2	✓	
		อุณหภูมิ 24 = 149.8	0.2	✓	
		อุณหภูมิ 25 = 149.9	0.1	✓	
		อุณหภูมิ 26 = 150.2	-0.2	✓	
		อุณหภูมิ 27 = 150.2	-0.2	✓	
		อุณหภูมิ 28 = 150.4	-0.4	✓	
		อุณหภูมิ 29 = 150.6	-0.6	✓	
		อุณหภูมิ 30 = 150.4	-0.4	✓	
		อุณหภูมิ 31 = 150.8	-0.8	✓	
		อุณหภูมิ 32 = 150.3	-0.3	✓	
		อุณหภูมิ 33 = 150.7	-0.7	✓	
		อุณหภูมิ 34 = 150.8	-0.8	✓	
		อุณหภูมิ 35 = 150.8	-0.8	✓	
		อุณหภูมิ 36 = 150.6	-0.6	✓	
		อุณหภูมิ 37 = 150.5	-0.5	✓	
		อุณหภูมิ 38 = 150.2	-0.2	✓	
		อุณหภูมิ 39 = 150.2	-0.2	✓	
		อุณหภูมิ 40 = 149.8	0.2	✓	
		อุณหภูมิ 41 = 149.4	0.6	✓	
		อุณหภูมิ 42 = 149.5	0.5	✓	
		อุณหภูมิ 43 = 149.5	0.5	✓	
		อุณหภูมิ 44 = 150.4	-0.4	✓	

Approved by :  Date : 30-๑๒-๖2



Certificate of Calibration

Equipment: TURBIDIMETER Certificate No.: C08190148
Model: 2100N Issued Date: 4 July 2019
Serial No. (or ID.): 030500003311 (WWL 0019)
Manufacturer: HACH Job No.: KCAL1909069
Condition: In Condition 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 23 °C ± 2 °C
Humidity 50 %RH ± 15 %RH

Calibration Place: Environment Laboratory, SPC Calibration Center Co., Ltd.
1194 Soi Wachirathamsathit 57, Sukhumvit 101/1 Rd.,
Bangchak, Prakanong, Bangkok 10260 Thailand

Calibration By: Mr. Piyaapat Saidoung
Calibration Date: 4 July 2019

The Method used: In house method, SPCC-WI-23, base on Hach Manufacturer Method 8195
Traceability: This certificate is traceable to Primary standard Fromazin and StabCal accepted by United States Environmental Protection Agency (EPA) through Hach Company Certificate No. A9087 , A9087 , A9087 , A9088 , A9086

ปิยาพัฏฐ์

(Mr. Piyaapat Saidoung)
Person in charge



(Mr. Dumrong Boonsopon)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognised 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). The effect that the results relate only to the items calibrated.

This calibration certificate shall not be reproduced except in full only, without written approval from SPC Calibration Center Co., Ltd.



Certificate No.: C08190148

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Calibration Results:

Before Adjustment

Std Turbidity (NTU)	UUC Reading	Correction	Deviation	Uncertainty
0.040	0.113	-0.073	0.0	0.07
20.20	19.7	0.50	0.0	1.0
201.1	199	2.1	0.0	10
1023.0	988	35.0	1.7	50
3962.2	3823	139.2	0.9	200

After Adjustment

Std Turbidity (NTU)	UUC Reading	Correction	Deviation	Uncertainty
0.040	0.066	-0.026	0.0	0.07
20.20	20.5	-0.30	0.1	1.0
201.1	202	-0.9	0.5	10
1023.0	1024	-1.0	0.8	50
3962.2	3961	1.2	1.2	200

The End of Certificate



Inctech Metrological Center Co.Ltd.
39/1 Soi 82, Sukhapiban 5 Rd., O ngoen,
Saimai, Bangkok 10220, Thailand
Tel. (662) 909-8820 (Auto 10 lines) www.imcinstrument.com



Certificate of Calibration

Certificate No. : MT19-7468
Page : 1 of 2

Customer : Water Analysis Center Co.,Ltd.
Address : 1/94 M.5, Rojana Industrial Park, T. Kantharm A.U-Thai, Ayutthaya 13210

Description : Hot Air Oven
Manufacturer : Temaks
Model : TS8136
Serial No. : 7-1454
Identification No. : WWL0040
Calibration Place : Customer Laboratory

Order No. : 3562/19
Received date : Nov 26, 2019
Calibration date : Nov 26, 2019
Environment Condition :
Temperature : (25 \pm 10) °C
Humidity : (50 \pm 30) %RH

Calibration Method : Calibration were conducted using In-house calibration procedure CP-MT-006 According to comparison with LXI Data Acquisition Switch Unit. The calibration methods based on DKD-RS-7 guidelines for calibration of climatic chamber edition 07/2009.

Reference Standard Instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
LXI Data Acquisition Switch Unit with Sensor	34972A	MY49028922	MT18-7389	Dec 21, 2019

This result of calibration was found accurate as shown on date and place of calibration only.

Traceability : This measurement are traceable to the International System of Unit (SI), through National Institute of Metrology Thailand (NIMT)

The reported uncertainty of measurement was base on standard uncertainty multiplied by coverage factor $k = 2$, providing a level of confidence of not less than 95%

Calibrated by : Mr. Jiraphan Sreebamasarn
Issue date : Dec 25, 2019

Approved by : (Mr. Panuwat Phukian)

This calibration certificate shall not be reproduced other than in full except with the prior written approval of Inctech Metrological Center Co.,Ltd

Rev.00 / Sep 2019

FM-MT-013



Inctech Metrological Center Co.Ltd.
39/1 Soi 82, Sukhapiban 5 Rd., O ngoen,
Saimai, Bangkok 10220, Thailand
Tel. (662) 909-8820 (Auto 10 lines) www.imcinstrument.com

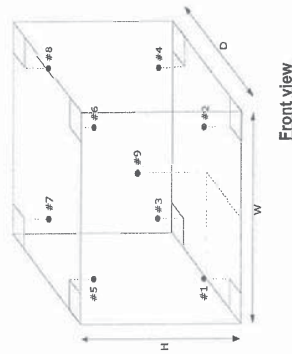


Certificate No. : MT19-7468
Page : 2 of 2

Function : Temperature measurement
Calibration point : 103, 104, 180 °C
Result : Without adjustment
Resolution : 0.1 °C

Calibration point (°C)	Temperature of UUC* at each position (°C)									Uncertainty of measurement (+/- °C)
	Ch.1	Ch.2	Ch.3	Ch.4	Ch.5	Ch.6	Ch.7	Ch.8	Ch.9	
103	102.770	102.834	102.756	102.883	102.789	102.688	102.750	102.766	102.855	0.44
104	104.269	104.169	104.492	104.369	104.027	104.426	104.373	104.483	104.210	0.44
180	180.402	180.382	180.651	180.597	180.456	180.246	180.340	180.204	180.488	0.60

Setting temperature (°C)	Indicating Temperature (°C)	Measured stability (+/- °C)	Measured uniformity (°C)	Overall variation (°C)
103.0	103.0	0.13	0.21	0.50
104.0	105.0	0.22	0.38	0.83
180.0	180.0	0.49	0.63	1.2



- #1 Lower Left Front
- #2 Lower Right Front
- #3 Lower Left Rear
- #4 Lower Right Rear
- #5 Upper Left Front
- #6 Upper Right Front
- #7 Upper Left Rear
- #8 Upper Right Rear
- #9 Geometric Center

UUC* = Unit under calibration
Uniformity = Maximum and Minimum difference of measured temperature at any probes and the measured temperature at the reference and same time.
Overall Variation = Difference of temperature value between the maximum and minimum any time.
Stability = One half of the maximum difference of measured temperatures at any one probe.

-oOo-

Rev.00 / Sep 2019

FM-MT-013



SPC CALIBRATION CENTER CO., LTD.

1194 Soi Wachirathamsatit 57 Sukhumvit 101/1 Bangchak Prakanong Bangkok 10260
Tel : +66(0) 2185-4333 Fax : +66(0) 2185-4424
website : <http://www.spc-ct.com>

Certificate of Calibration

Equipment: Balance Certificate No.: C01192930
Model: BL210S Issued Date: 05 August 2019
Serial No. (or ID.): 12909234 (WWL 0010) Job No.: KCAL1910636
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 25 °C ± 0.4 °C
Humidity 44 %RH ± 3.2 %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. Polawad Ruamirup
Calibration Date: 05 August 2019
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 Calibration Center Co., Ltd. Certificate No. C02182226


(Mr. Polawad Ruamirup)
Person in charge




(Mr. Rungrod Jenkitrakulchai)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of SPC Calibration Center Co., Ltd.



SPC CALIBRATION CENTER CO., LTD.

1194 Soi Wachirathamsatit 57 Sukhumvit 101/1 Bangchak Prakanong Bangkok 10260
Tel : +66(0) 2185-4333 Fax : +66(0) 2185-4424
website : <http://www.spc-ct.com>

Certificate No.: C01192930

Page: 2 of 2

Calibration Results: Without Adjustment

Eccentric Error: Weight to be 1/4 or 1/3 of Maximum capacity, taken from the center of the pan as a zero reference.

Nominal Test Value	Reference Points (g)				
	A	B	C	D	E
-	0.0002	0.0001	-0.0002	-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	0.00007

Departure of indication from nominal value., Readability 0.0001 (g)

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Correction of Balance (g)	Uncertainty (g)	k
1	0.99999	1.0000	0.0000	0.00012	2.08
2	1.99999	2.0000	0.0000	0.00012	2.08
5	4.99999	5.0000	0.0000	0.00012	2.07
10	10.00001	10.0000	0.0000	0.00013	2.07
20	19.99997	20.0000	0.0000	0.00013	2.06
50	49.99997	49.9999	0.0001	0.00014	2.04
70	69.99994	70.0000	-0.0001	0.00017	2.02
100	99.99998	100.0000	0.0000	0.00018	2.01
120	119.99995	120.0000	-0.0001	0.00022	2.01
150	149.99995	150.0002	-0.0003	0.00024	2.00
200	199.99990	200.0003	-0.0004	0.00030	2.00

The End of Certificate



AUTOMATION SERVICE CO.,LTD.

929,929/1 ซอยพหลโยธิน 30 ถนนพหลโยธิน แขวงจตุจักร กรุงเทพฯ 10250
929,929/1 Soi Phatnakarn 30, Pathanakarn Rd. Suanluang, Bangkok 10250
โทรศัพท์ (Tel.) 0-2319-9994 โทรสาร (FAX) 0-2319-9586 website : www.automation.co.th

SV 203025/2019

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 : 15 / 03 / 2019
Date Of Calibration : 15 / 03 / 2019

Ambient Condition : Temperature 28 °C
Humidity 57 % RH

Calibrated By :

dy

(Mr. Jongjaroen Yooyen)
Technician

Approved By :

S. Sunchai Savaraj

(Mr. Sunchai Savaraj)
Technical Manager

Date Of Issue : 15 / 03 / 2019

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 : K49156557 : - : 31 May 2019

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

Result Of Calibration

Standard Solution (mg/l) at 28.8°C	Before Adjust		After Adjust	
	Indicator	Error	Indicator	Error
Zero	0.00	+ 0.01	0.00	-
Span	7.66	+ 0.08	7.66	-

DO Electrode No. OE270AA S/N 604F0012

Calibrated By

dy

(Mr. Jongjaroen Yooyen)
Technician

W	FO.LAB 6.4-1/10	แก้ไขครั้งที่ : 0	วันที่บังคับใช้ : 1 ม.ค. 2562	หน้า : 1 ของ 3
----------	-----------------	-------------------	-------------------------------	----------------

บันทึกการทวนสอบเครื่องมือวัด

Equipment : Distillation System
 Serial No. : 7320 09 0028
 Environment Condition :
 Temperature :
 Humidity :
 ID. No. : WWL0044
 Model : Vapotec 20S
 Manufacturer : Gerhardt

1. Reference Standard Instruments.

Description / Model	Code	Traceability to	Cal Due
1.1			
1.2			
1.3			
1.4			

2. Reference Standard Materials.

Material	Manufacturer	Lot. No.	Exp. date.	Traceability to
2.1 NH ₄ Cl	Sigma-Aldrich	MKBZ40870V	31-10-2022	
2.2				
2.3				
2.4				

Verification by :
 Verification Dated : 19-08-2562
 Expiration Dated : 18-02-2563

W	FO.LAB 6.4-1/10	แก้ไขครั้งที่ : 0	วันที่บังคับใช้ : 1 ม.ค. 2562	หน้า : 2 ของ 3
----------	-----------------	-------------------	-------------------------------	----------------

ID. No. : WWL0044

Verification result

Reference Standard Material (%N, W/W)	Reference Standard Instrument (%N, W/W)	Instrument Reading (%N, W/W)	% Error (%N, W/W)	Status, ± 5%
26.19	-	25.76	98.4	Pass
26.19	-	26.22	100.1	Pass
26.19	-	26.16	99.9	Pass
26.19	-	26.27	100.3	Pass
26.19	-	25.76	98.4	Pass

Approved by :  Date : 19-08-2562



Bara Scientific Co., Ltd.
988 U Chu Liao Building Floor 7 Rama4 Road Silom
Bangkok Bangkok Thailand 10500
Tel : 02-6324300 Fax : 02-6375496-7
www.barascientific.com



Certificate of Calibration

Number of Page(s) 1 of 3

Certificate No. BSCC-UV-138/19
Equipment UV/Vis Spectrophotometer
Model UV-1800
Manufacturer Shimadzu
Serial No. A11635405598CD
ID No. WWL0082
Date of receipt 2 May 2019
Date of calibration 2 May 2019
Date of issue 8 May 2019

Customer name Water Analysis Center Co., Ltd.
Address 1/94 Moo 5, T. Kantham, A. Uthai, Ayuthaya 13210

Temperature (26.3-26.9) °C (On site)
Humidity (23.0-24.8) %RH (On site)

Equipment condition Good Operation

Calibration Location Laboratory Room Water Analysis Center

Calibration Procedure In-house method WI-UV-504-01 based on ASTM E275-01

Traceability
Wavelength Accuracy is traceable to certificate No. 67633 and 67652
Photometric Accuracy is traceable to certificate No. 67648 and 66675
Stray Light is traceable to certificate No. 67650
The above certificate are traceable to SI unit through Sarna Scientific Ltd.
(UKAS accredited calibration laboratory NO. 0659)

Calibrated by Mr. Waruth Janphung

Checked by

Approved by

Mr. Kanchit Choothep
Technical Manager

Mr. Narong Wongsirirungsale
Asst. Product Manager

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.
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Bara Scientific Co., Ltd.
988 U Chu Liao Building Floor 7 Rama4 Road Silom
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www.barascientific.com



Certificate of Calibration

Number of Page(s) 2 of 3

Certificate No. BSCC-UV-138/19

Calibration Results:

1. Wavelength Accuracy

Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty (nm)
360.89	360.81	-0.08	0.18
418.53	418.73	0.20	0.18
445.82	446.05	0.24	0.18
453.67	453.65	-0.02	0.18
459.99	459.93	-0.06	0.18
638.00	638.23	0.23	0.18
431.22	431.14	-0.08	0.18
513.39	513.46	0.07	0.18
528.87	528.87	-0.03	0.18
572.99	573.38	0.39	0.18
585.25	585.26	0.01	0.18
684.50	684.76	0.25	0.18
741.02	741.16	0.13	0.18
879.41	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	0.0000	-0.0001	-0.0001	0.0075
	0.6339	0.6315	-0.0024	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.

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

Optics

Beam Balance: *Align Lamp*

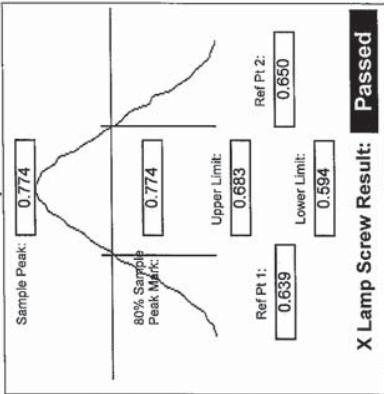
Lamp Type: Copper

Peak Selected: 324.80

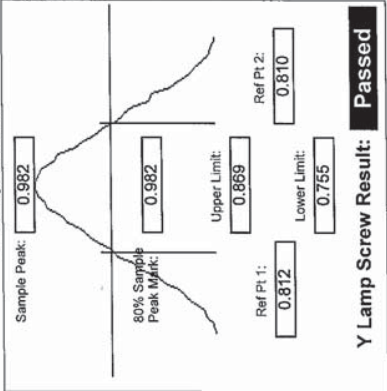
Lamp Socket Used: 3

Lamp Alignment: **Performed**

'X' Lamp Screw



'Y' Lamp Screw



Grating Squareness:

Wavelength (nm) 190 - 900 nm

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
CU First Order	324.45	324.73	325.15	Passed
λ_2 Second Order	649.23	649.55	649.97	Passed

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
Sample 2: 324.815
Sample 3: 324.815
Sample 4: 324.815
Sample 5: 324.815
Sample 6: 324.815
Sample 7: 324.815
Sample 8: 324.815
Sample 9: 324.815
Sample 10: 324.815
(Approach from end)

Mean: 324.815
Standard Deviation: 0.001

Result: **Passed**

ภาคผนวก ข-16

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	249	297	Passed
S1	156	165	191	Passed
S2	271	294	332	Passed
S3	474	506	579	Passed
S4	825	908	1008	Passed
S5	1435	1517	1754	Passed
S6	2498	2724	3053	Passed
S7	4347	4682	5313	Passed

Interlocks: **Working**

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: **Untested**

Ignition: **Working**

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:

PM6003100106

Signatures:

Thansila WAC 21-02-2019 22-Feb-2019
Date Date
Agilent

ภาคผนวก ข-17



Agilent Technologies

55 240 280 Series Atomic Adsorption Spectroscopy System Preventive Maintenance Checklist - Standard

Agilent Preventive Maintenance provides factory recommended service for your analytical systems to assure reliable operation and the accuracy of your results. Delivered by highly-trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides everything you need to reduce unplanned downtime and keep your systems operating at their peak.

Note: While non-current production AA instrument and or accessory models are not covered specifically in this document it can be used as a basic reference.

For more information about Agilent Technologies services please visit our web site using the following URL, <http://www.agilent.com/en-us/services>

Customer Information

- Customers should provide all necessary operating supplies upon request of the engineer.
- A customer representative should be available to the engineer while performing the preventive maintenance procedures.
- Any parts, not included in the Parts Lists section of this document, are not part of the recommended Preventive Maintenance service, nor are they included in the price of this service.
- If a system requires the use of additional or special procedures and/or parts for the instrument service, then these must be ordered separately and charged as a repair, which may incur additional costs.

Service Engineer's Responsibilities

- Confirm the ability of the instrument to deliver continued safe operation as established via the Agilent AA safe operation flow chart. (Refer directly to the AA 55/240/280 Preventive Maintenance Scope of Work to make this decision.)
- Only complete/printout pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information
- Complete the relevant checkboxes in the checklist using a "X" or tick mark "✓" in the checkbox. Add hand written 'additional details' if required.
- Complete Not Applicable check boxes to indicate services not delivered, as needed
- Complete the PM Service in the order of the tasks listed.
- Complete the Service Review section together with the customer

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Page 1 of 10



55 240 Series Atomic Adsorption Spectroscopy System Preventive Maintenance Checklist - Standard

System Information

Instrument System Name/LD:	Instrument Location:
AA-240TS	HA01111073
1.	2.
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.

Guidance:

- ☒ Check box if instrument configuration report is attached instead of completing the table above.

Preparation, Safe operation and Initial performance checks

- ☒ Agilent AA safe operation flow chart inspections (to determine if the PM can be performed).

NOTE: If by following the flow chart the instrument is deemed to be unsafe for continued use you MUST NOT continue PM work. Inform the customer immediately of the Agilent recommendation that use of the instrument be discontinued.

- ☒ Review the instrument logbook.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Check for required firmware updates and verify with customers if they would like it installed.
- ☐ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it.
- ☒ Discuss any specific issues with the customer prior to starting.
- ☒ Use SVD to perform a Full Wavelength Scan for Cu HCL - "As found test_1"
- ☒ Perform a Basic Cu ABS test - "As found test_2"
- ☒ Print the Details page or screen captures of the test results and attach to the end of this checklist.



55 240 Series Atomic Adsorption Spectroscopy System Preventive Maintenance Checklist - Standard

FLAME SYSTEM section

- ☐ Section NOT Applicable

Electronic components

- ☒ Review and confirm instrument configuration data in SVD
- ☒ Confirm power supply voltages using the SVD Power Supply diagnostic.
- ☒ For Dual Beam instruments - Confirm RBC frequency using the SVD RBC frequency diagnostic.

Mechanical components

- ☒ Check the burner adjuster controls for complete and free movement. If the burner adjuster needs lubrication, use Molykote 321 or mineral-based molybdenum disulphide grease.
- ☒ Run SVD tests to exercise all motor drives over the full range of their travel:
 - ☒ Monochromator drive
 - ☒ Slit drive
 - ☒ Lamp selector
 - ☒ ABA

Optics components

- ☒ Check that external optical surfaces are clean - Clean or replace as required.
- ☒ Use SVD and perform Mono Wavelength Correction.
- ☒ Use SVD and perform Slit Calibration.
- ☒ Use SVD and perform Grating Squariness Diagnostic.
- ☒ Use SVD and perform Zero Order Offset/Mono Correction.
- ☒ Use SVD and perform Wavelength Repeatability.
- ☒ Physically inspect selected HC lamps (customer to supply per their choice) and measure the % Gain for each lamp. Advise customer if lamps are showing emission degradation due to age.
- ☒ Check that the signal energy of the D2 and HC lamps track properly. Advise customer if their D2 lamp is showing emission degradation due to age.

Sample Introduction and Atomization

- ☒ Inspect the burner interlock plate to ensure that the interlock pin is secure and correct for the burner type.
- ☒ Clean the burner slot with a clean white card.
- ☒ Check the uniformity of the slot width.
- ☒ Clean the burner if required.

**55 240 280 Series Atomic Adsorption Spectroscopy
System Preventive Maintenance Checklist - Standard**

- ☒ Change the burner o-ring.
- ☒ Clean the nebulizer, spray chamber and liquid trap.
- ☒ Change all o-rings and seals in the nebulizer, nebulizer block and spray chamber.
- ☒ Check that the pressure relief bung releases readily.
- ☒ Change o-rings on the fuel and oxidant delivery barbs
- ☒ Leave the liquid trap EMPTY and verify the flame will not ignite in this state.
- ☒ Refill liquid trap and check that overflow drains freely into the drain/waste tube.
- ☒ Check the drain/waste tube for good drainage. It should not have tight bends, kinks or loops and the lower end must be above the liquid level in the waste vessel.

Gas handling components and safety interlocks

- ☒ Check and clean the igniter electrode
- ☒ Pressure test for leaks
- ☒ Leak test gasbox internal components and connections
- ☒ Check safety interlock status and operation using the SVD interlock monitoring diagnostic.

Analytical performance for Flame systems

- ☒ Ignite a flame.
- ☒ Check that you can adjust the nebulizer uptake rate from 4 to 6.5 mL per minute.
- ☒ Optimize the instrument ready to perform Cu sensitivity test.
- ☒ Create a manual method to perform a Basic Cu ABS test - "Final Performance Testing"
- ☒ Run a PM completed sensitivity test for a 5 ppm copper sample and record the results in the AA PM Performance test results and measurements table.

**55 240 280 Series Atomic Adsorption Spectroscopy
System Preventive Maintenance Checklist - Standard****FURNACE SYSTEM section**

☒ Section NOT Applicable

Electronic components

- ☐ Review and confirm instrument configuration data in SVD
- ☐ Confirm power supply voltages using the SVD Power Supply diagnostic.

Mechanical components

- ☐ Run SVD tests to exercise motor drives over the full range of their travel:
 - ☐ Monochromator drive
 - ☐ Slit drive
 - ☐ Lamp selector

Optic components

- ☐ Check that external optical surfaces are clean – Clean or replace as required.
- ☐ Use SVD and perform Mono Wavelength Correction.
- ☐ Use SVD and perform Slit Calibration.
- ☐ Use SVD and perform Grating Squaresness Diagnostic.
- ☐ Use SVD and perform Zero Order Offset/Mono Correction.
- ☐ Use SVD and perform Wavelength Repeatability.
- ☐ Physically inspect selected HC lamps (customer to supply per their choice) and measure the % Gain for each lamp. Advise customer if lamps are showing emission degradation due to age.

Gas handling, water system and workload component checks

- ☐ Inspect the GTA workload gas hoses and connections for leaks.
- ☐ Pressure test for gas leaks
- ☐ If the cooler system is accessible (stand-alone) check for correct operation and coolant/water level – this includes any temperature and pressure settings plus filter cleaning (air flow and water).
- ☐ Inspect the GTA workload water hoses and connections for leaks.
- ☐ Check all graphite components and replace if necessary.
 - ☐ Tube
 - ☐ Electrodes
 - ☐ Shroud
- ☐ Check and clean the end windows on the workload.
- ☐ Check safety interlock operation.



55 240 Series Atomic Adsorption Spectroscopy System Preventive Maintenance Checklist - Standard

Analytical performance for Furnace systems

- ☐ Optimize the instrument ready to perform Cu sensitivity test.
- Run the sensitivity test for a 25 ppb copper sample and record the results in the results table.

PSD autosampler accessory for Furnace systems

- ☐ Section NOT Applicable
- ☐ Check condition of the PSD capillary – replace if necessary
- ☐ Check condition and operation of PSD syringe – ensure it does not have air locks and bubbles.
- ☐ Change PSD rinse bottle o-ring.
- ☐ Check and clean the rinse vessel.
- ☐ Check the drain tube for good drainage. It should not have tight bends, kinks or loops and the lower end must be above the liquid level in the waste vessel.
- ☐ Ensure that the waste vessel is suitable for use with the furnace system.

Sample introduction pump system (SIPS) accessory

- ☒ Section NOT Applicable
- ☐ Re-torque screws securing the hubs, presser arms and pump rotors.
- ☐ Adjust each roller so that it rotates freely.
- ☐ Wipe clean the pump rotor rollers and pump bands with a dry clean cloth.
- ☐ Ensure that the presser arms and the surfaces near the pump are free from dirt and spills.
- ☐ Remove the pump module rear cover and check for the incursion of liquids and any signs of corrosion.
- ☐ Re-torque the nuts that fasten the motor mounting plates to the chassis.
- ☐ Check clips securing the diluents holder and replace if necessary.
- ☐ Disconnect, clean T-piece, and reassemble the tubing using the following steps.
 - ☐ Remove the T-piece by disconnecting the pump tubes, the pump bands and all other tubing.
 - ☐ Place the T-piece in an ultrasonic bath containing strong detergent 1-5% Decon 30 or similar, for approximately 5-10 minutes.
- ☐ Wash the T-piece under a tap with a strong flow of water.
- ☐ Rinse with distilled water through all of the inlets in the reverse direction to normal sample flow.
- ☐ Reassemble.

Sample preparation system (SPS 4) accessory

- ☒ Section NOT Applicable
- The Agilent SPS 4 autosampler is designed to need minimal maintenance.
- The following maintenance requirements are suggested to maintain the performance of the autosampler.
 - ☐ Cleaning the spill tray, rack location mat, end frames and chassis accessories with a damp soft cloth and diluted mild detergent.



55 240 Series Atomic Adsorption Spectroscopy System Preventive Maintenance Checklist - Standard

- ☐ Cleaning the autosampler cover panels with domestic window cleaner.
- ☐ Checking the X- axis and Z- axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes..
- ☐ Check the X- axis, Theta- axis and Z- axis FFC cables for cracks, incorrect positioning, damaged edge or damaged connectors.

NOTE: The autosampler requires no extra lubrication throughout its lifetime.

For further details refer to the SPS 4 service manual G8410-90050.

Sample preparation system (SPS 3) accessory

- ☒ Section NOT Applicable
- ☐ Check the x-axis and z-axis timing belts – Replace if there is are any cracks, splits or color deterioration and belt tension.
- ☐ Check belt tensions - adjust if required
- ☐ Check the lubrication pad for single x-axis shaft. If pad is dry or customer has observed any vibration or erratic movements of the x-axis carriage, add 1 mL of Dow Corning 200 @ Fluid, 200 CS into the well.
- ☐ Check the auto-sampler ability to find tube positions - Calibrate if required.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

Vapor generation accessory VGA (hydride generator)

- ☐ Section NOT Applicable
- ☒ Inspect VGA gas supply hose.
- ☒ Inspect/replace VGA pump tubing.
- ☒ Check low gas pressure interlock setting- adjust if required.
- ☒ Check precision orifice gas flow setting – adjust if required.
- ☒ Check gas regulator pressure to 46 psi (325 kPa) – adjust if required.
- ☒ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

UltraAA lamp accessory (external)

- ☒ Section NOT Applicable
- ☐ Check the condition of the power cable.
- ☐ Clean the exterior surfaces of the accessory with soft lint free cloth. This cloth can be dampened with warm water or a mild detergent. Do not use organic solvents or abrasive cleaning agents.

**55 240 280 Series Atomic Adsorption Spectroscopy
System Preventive Maintenance Checklist - Standard****Restore system**

- ☒ If you have altered the customer's instrumentation during the course of PM, restore to the original status to allow the customer to conduct their normal activities (e.g., reload the customer's method.)

Guidance:

If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

Service Review

- ☒ Attach available reports/printouts of all tests to this documentation.
☒ Record the PM service activity in the customer's instrument records/logbook
☒ Update/reset instrument maintenance counters as appropriate
☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
☒ Complete the Service Review Comments section below if there are additional comments
☒ Review the service and any test results with the customer.
☒ If the Instrument firmware was updated, record the details of the change in the Service Engineer's Comments box below or if necessary, in the customer's IQ records.

AA PM Performance test results and measurements table

Flame optics PMT Gain test	
For copper at 324.7 nm, 4 nA, 0.5 nm slit width	< 55 %
Flame performance test with 5 ppm copper sample	
Air /acetylene, mixing paddle removed	Abs value > 0.5
Air /acetylene, mixing paddle installed. 10 replicates	%RSD < 1.0
Furnace optics PMT Gain test	
For copper at 324.7 nm, 4 nA, 0.5 nm slit width	< 55 %
Furnace performance test with 25 ppb copper sample	
Precision %RSD	≤ 4.0
Abs value	≥ 0.15
Zeeman furnace analytical performance: 25 ppb copper sample	
Precision %RSD	≤ 4.0
Abs value	≥ 0.15

**55 240 280 Series Atomic Adsorption Spectroscopy
System Preventive Maintenance Checklist - Standard****AA consumable and parts list table**

Test Solution - Cu 5ppm solution	6610030100	50 55 140 240 280	PM supplied
Test Solution - Blank solution	5190-7001	50 55 140 240 280	PM supplied
Copper, 1000 µg/ml, 100ml	5190-8279	50 55 140 240 280	*
Kit, MK 7 O-rings, aqueous, complete set	9910083400	50 55 140 240 280	PM supplied ✓
Organic Kit	9910083500	50 55 140 240 280	PM supplied
Wire Nebulizer Cleaning	9910024700	50 55 140 240 280	consumable
Tubing/Capillary Std Neb	9910024800	50 55 140 240 280	consumable
Capillary Tube Hvac Neb (3) (organics only)	9910044000	50 55 140 240 280	consumable
Glass impact beads (5/µk)	9910025700	50 55 140 240 280	consumable
Teflon impact beads (5/µk): (organics only)	9910053300	50 55 140 240 280	consumable
Burner cleaning strip (100/µk)	9910053900	50 55 140 240 280	consumable
Window UV silica - round (right side)	2010082600	50 55 140 240 280	PM supplied
Window UV silica - rectangular (left side)	2010082500	50 55 140 240 280	PM supplied
Pad adhesive window - round	4910012700	50 55 140 240 280	PM supplied
Pad adhesive window - rectangular	4910012800	50 55 140 240 280	PM supplied
Electrode kit (1 pr) (D2)	6310003400	GTA120	PM supplied
Shroud (D2)	6310003100	GTA120	PM supplied
Zeeman electrode kit(1 pr)	6310003500	GTA120	PM supplied
Zeeman shroud	6310003600	GTA120	PM supplied
O-ring PSD rinse bottle	6910025900	PSD120	PM supplied

NOTE:

Items classified as PM supplied in the above table are included in the standard PM.
Those classified as consumable should be provided by the customer or charged to the customer if supplied by the Agilent service engineer.

- * For engineers who only service AA instruments 5190-8279 can be used as a cheaper alternative for 6610030100.

**55 240 Series Atomic Adsorption Spectroscopy
System Preventive Maintenance Checklist - Standard**

Service Engineer Comments

[Handwritten signature]

Other Important Customer Web Links

How to get information on your product: Literature Library -
<http://www.agilent.com/chem/library>
Need to know more? - www.agilent.com/chem/education
Need technical support? - www.agilent.com/chem/techsupport
Need supplies? - www.agilent.com/chem/supplies

Service Completion

Service Request number: *6530196* Date service completed: *21-Feb-2019*

Agilent Signature: *[Signature]* Customer Signature: *Thongchai*

Total no. of pages for this document: 10

Certificate of Calibration

Cer.No. : DOP 1446 Page 1/9

Certificate No. : DOP 1446 Equipment. : BSC Class II Type A2
Manufacturer. : Microtech Model. : VG-T (2x6 ft)
Serial No. : 0972 ID No. : WWL 0084
Cline. : Laboratory WATER ANALYSIS CENTER CO.,LTD
: 1/94 Moo 5 T.Kanharm, A.U-Thai, Phra nakorn sri Ayutthaya 13210

Calibration Equipments Use.

Description	Serial No.	Cer.No.	Cal Due Date
- Air Velocity			
: Anemometer Dwyer series 471B-1	: 471B-1	SPR19030163-2	: Mar 20,2020
- Inflow Velocity			
: Air Flow Hoods	: 7879	SPR19030163-4	: Mar 20,2020
- Efficiency and Integrity for HEPA Filter			
: Aerosol Photometer ATI	: 30979	A111421	: Apr 28,2020
- Ultra violet radiation			
: Digital UV radiometer 8.0	: 355	SPR19030163-1	: Mar 20,2020
- Light			
: Lux meter LX-50	: R 019426	SPR19030163-3	: Mar 20,2020

Environment Condition
Temperature : 24.39 °C ± 0.80 °C
Humidity : 73.64 %RH ± 3 %RH

Calibration Method or Calibration Procedure used : EN12469:2000,NFS 49 (Smoke Test),AS 1807.1(UV)

Calibrated Date . : 27 September 2019

Issued Date. : 27 September 2019

Calibration result

Cer.No. : DOP 1446 Page 2/9

-Air velocity downstream of HEPA filter

- Downflow velocity test
- Inflow velocity test

-Airflow Smoke Patterns Test

- Downflow Test
- View Screen Retention
- Work Opening Edge Retention
- Sash / Window Seal

-Leakage test of HEPA filter

- Maximum local penetration main filter downstream = 0.01 by PAO test
- Leakage of main filter (scanning)
- Filter media scanning of main filter
- Exhaust filter (scanning)
- Should be at least 750 lux
- Not less than 400 mW/m²

-Light Intensity

-Ultra violet radiation

Calibrated by

Signature of Chanvaro
(Mr. Punyawut Chanvaro)
Technician certified

Approved by

Signature of Kamol Kijprathuang
(Mr. Kamol Kijprathuang)
Engineering manager



Downflow velocity test

Cer.No. : DOP 1446 Page 3/9

Turn the BSC on with the anemometer inside, make air velocity measurements in the horizontal plane 50 mm. to 100 mm. above the top edge of the front aperture. Measure in 2 rows along a line 1/4 of the depth of the working space forward of the rear wall along a line the same distance behind the front windows. Start 150 mm. from the left side and with 300 mm. between the measuring spots.

Downflow velocity of HEPA filter (m/s)

Back wall					
0.40	0.45	0.48	0.49	0.47	0.44
0.35	0.36	0.38	0.37	0.37	0.36

Front window

Characteristic of downflow velocity

- Mean downflow velocity to achieve product protection : 0.25 - 0.50 m/s - All measurements should be within $\pm 20\%$ of the mean	Mean	Minimum	Maximum	$\pm 20\%$ of mean
	0.410	0.350	0.490	0.328 — 0.492
Result downflow air velocity				
Pass				

Inflow velocity test by Direct inflow measurement method DIM.

Turn the BSC on. Seal by taping the device to the center of the front opening of a biological safety cabinet.

Seal the open areas on either side of the capture hood portion of the DIM as necessary. All cabinet and exhaust blowers must be operating. Take at least five readings, and average them to determine inflow volume rate. Care should be taken not to restrict the airflow through the instrument intake area. Calculate the average inflow velocity in feet/minute (meters/second) by dividing the average

Characteristic of inflow velocity

- Mean inflow velocity to achieve operator protection ≥ 0.4 m/s	Mean	Minimum	Maximum	$\pm 20\%$ of mean
	0.900	0.90	0.90	0.720 — 1.080
Result inflow velocity				
Pass				

Airflow Smoke Patterns Test

Cer.No. : DOP 1446 Page 49

1. Downflow 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 in (10 cm) above the top of the access opening.

Result downflow Test



Pass



Failed

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 in (15 cm) above the top of the access opening.

Result view screen retention test



Pass



Failed

3. Work opening edge retention test

Smoke shall be passed along the entire perimeter of the work opening edges, approximately 1.5 in (3.8 cm) outside the cabinet. Particular attention should be paid to corners and vertical edges.

Result work opening edge retention test



Pass



Failed

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.

Result sash/window seal test



Pass



Failed

HEPA Filter Efficiency

Cer.No. : DOP 1446 Page 59

Leak Test of HEPA Filter

Instruction : The aerosol challenged through valve "Challenge" or Challenged into backside of filter and maximum local penetration main filter (downstream) = 0.01% by "PAO Test" (A substitute for DOP)

PAO Aerosol Concentration Upstream	20.00 µg/l
Concentration Upstream	100%
Leakage of Main Filter (Scanning)	0.0018%
Filter Media Scanning of Main Filter	0.0022%
Leakage of Exhaust Filter (Scanning)	0.0023%
Filter Media Scanning of Exhaust Filter	0.0023%

Pass

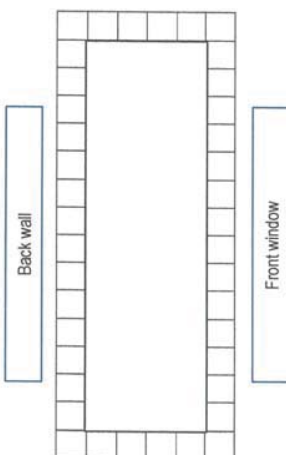
Pass

Pass

Pass

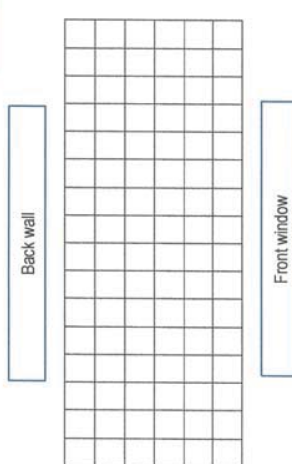
HEPA Filter Efficiency (Down Flow Filter)

Cer.No. : DOP 1446 Page 6/9



Filter frame and gasket scan data (Down flow filter)

Maximum measured penetration	0.0031	%
Minimum measured penetration	0.0001	%
Average measured penetration	0.0018	%
Result Pass or Fail		
Pass		



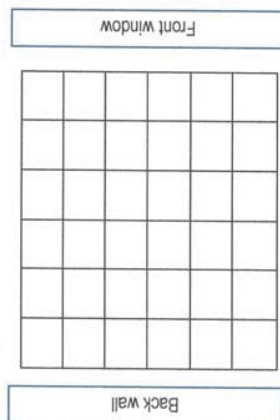
Filter media scan data(Down flow filter)

Maximum measured penetration	0.0041	%
Minimum measured penetration	0.0002	%
Average measured penetration	0.0022	%
Result Pass or Fail		
Pass		

□ : 10cm x 10 cm M : Media Leak Position MX : Maximum Media Leak Position
G : Gasket Leak Position GX : Maximum Gasket Leak Position

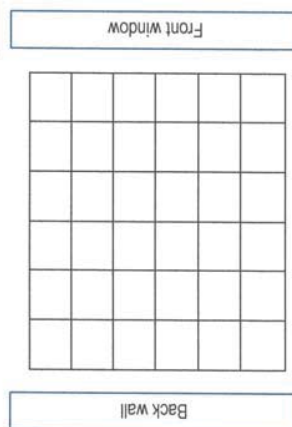
HEPA Filter Efficiency (Exhaust Filter)

Cer.No. : DOP 1446 Page 7/9



Filter frame and gasket scan data (Exhaust filter)

Maximum measured penetration	0.0034	%
Minimum measured penetration	0.0001	%
Average measured penetration	0.0023	%
Result Pass or Fail		
Pass		



Filter media scan data(Exhaust filter)

Maximum measured penetration	0.0042	%
Minimum measured penetration	0.0012	%
Average measured penetration	0.0023	%
Result Pass or Fail		
Pass		

□ : 10cm x 10 cm M : Media Leak Position MX : Maximum Media Leak Position
G : Gasket Leak Position GX : Maximum Gasket Leak Position

Lighting intensity test

Cer.No. : DOP 1446 Page 89

Lighting should be adequate for safe working within cabinet. Illumination measured at the work surface should be at least 750 lux

Lighting intensity (Lux)

Back wall			
810.0	911.0	1098.0	1109.0
853.0	853.0	853.0	787.0
Front window			
832.0	1312.0	1684.0	1700.0
1330.0	1330.0	845.0	
Average measured penetration			
1105.92 Lux			

Intensity of radiation of germicidal ultraviolet lamps

When ultraviolet lamps are tested in accordance with AS 1807-23 the irradiance at 254 nm wavelength shall be not less than 400 mW/m² at the work for surface.

Ultraviolet intensity (mW/m²)

Back wall			
630.0	1150.0	1950.0	2020.0
1420.0	1420.0	730.0	730.0
Front window			
540.0	680.0	1010.0	1100.0
790.0	790.0	590.0	
Average measured penetration			
1050.83 mW/m ²			

Total result testing laminar flow biohazard Class II

Cer.No. : DOP 1446 Page 99

1. Air velocity of HEPA filter at

- Mean downflow velocity : Between 0.25-0.50 m/s
- Mean inflow velocity : Average \geq 0.4 m/s

2. Airflow Smoke Patterns Test

- Downflow Test
- View screen retention test
- Work opening edge retention test
- Sash/window seal test

3. HEPA Filter Efficiency

- Leakage of Main Filter (Scanning)
- Media Scanning of Main Filter
- Leakage of Exhaust Filter (Scanning)
- Media Scanning of Exhaust Filter

Maximum local penetration filter = 0.01% by * PAO Test * (A substitute for DOP)

4. Lighting intensity at

- Illumination measured at the work surface should be at least 750 lux

5. Intensity of radiation of Ultraviolet at

- Irradiance at 254 nm wavelength shall be not less than 400 mW/m² at the work for surface.

Calibrated by

:  (Mr. Punyawat Chanvaro)

Technician certified

: 

Approved by

: (Mr. Kamol Kijprathuang)

Engineering manager

End of Certificate.



BECTHAI BANGKOK EQUIPMENT & CHEMICAL CO., LTD.
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E-mail: bkk@becthai.com Website: www.becthai.com



NSG-TIS-17025
CALIBRATION 031

Certificate No.: CAL-19-867

Page : 1 of 3

CERTIFICATE OF CALIBRATION

Equipment : CHAMBER (Incubator)
Manufacturer : MEMMERT
Model : IN 260
Serial No. : D619.0170
ID No. : N/A
Customer : Water Analysis Center Co., Ltd
: 1/94 Moo 5, Kanham, U-Thai,
Phra Nakhon Si Ayutthaya 13210
Location : Becthai Laboratory
Date of Receipt : 8 November 2019
Date of Calibration : 11 November 2019
Date of Issue : 11 November 2019
Ambient Temperature : (30±10) °C
Relative Humidity : (60±20) %
Condition As-Received : New Item

Calibrated by

A. Boonmee
.....
(Mr. Anusit Boonmee)
Calibration Engineer

Approved by

Jintana Sangthajaroenlap
.....
(Ms. Jintana Sangthajaroenlap)
Calibration Manager

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

This certificate may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory. Indicated values are valid for the state of the Chamber at the time of calibration only.



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NSG-TIS-17025
CALIBRATION 031

Certificate No.: CAL-19-867

Page : 2 of 3

CALIBRATION REPORT

Conditions of calibration

1. Reference standard instrument :

Instrument	Model	Serial No.	Module S/N	Certificate No.	Due date
LXI Data Acquisition / Switch Unit	34972A	MY57003286	MY58060140	QR19-1036	10 June 2020
With Sensors	RTD	P1 to P9 / TC 101-109			

2. Traceability : This certification is traceable to the International System of Unit maintained at :

- Quality Reborn Copany Limited, Accredited Calibration Laboratory No. 0292.

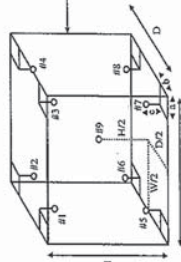
3. Method of calibration : The calibration procedure was carried out according to CPM-CAL-08 based on TLAS G-20-1/02-08(E):

Guidelines for Calibration and Checks of Temperature Controlled Enclosures. The temperature scale in use is ITS-90.

4. Result of calibration :

(✓) without adjustment

() after adjustment



Sensor Installation Details:

a = 10 cm.
b = 10 cm.
c = 10 cm.

Position of working standard

Chamber Size (mm)			Capacity
Width	Depth	High	Liter
640	500	800	256

Event	Environment		AC Line
	°C	%RH	Volt
Beginning of Calibration	23.1	55.6	226.5
End of Calibration	22.9	59.4	226.8
Minimum	22.7	55.2	225.3
Maximum	23.2	59.4	227.1



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ISO/IEC 17025
 CALIBRATION LAB

Certificate No.: CAL-19-867

Page : 3 of 3

CALIBRATION REPORT

Reporting of temperature distribution in UUC*

Calibration Point (°C)	Reference Standard Reading at each position (°C)								Uncertainty of Measurement ±(°C)
	P1	P2	P3	P4	P5	P6	P7	P8	P9 (Ref.)
35.0	35.67	35.59	35.57	35.46	35.35	35.44	35.32	35.29	35.41
									0.98

Reporting of UUC* performance.

Temperature Setting (°C)	Indicating Temperature (°C)				Stability ± (°C)	Overall Variation (°C)
	Minimum	Maximum	Average	Uniformity (°C)		
35.0	35.0	35.0	35.0	0.28	0.11	0.54

Note :

1. UUC* : Unit Under Calibration
2. 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.
3. Stability : One-half of the greatest maximum difference of measured temperatures at any one sensor.
4. Overall Variation : The difference of the maximum and the minimum measured temperatures throughout observation time.

- End of Report -



Master Calibration Co., Ltd.
 547 Soi Ratchadaniyeu, Kweng Samsenok, Khet Huaykwang, Bangkok 10310
 Tel : (02) 274 2978-9 (02) 274 2987-8 Fax : (02) 274 2518, (02) 274 2989
 http://www.mastercalibration.com

Calibration Report



WATER BATH

Report No. : MC 1900241

Page 1 of 4

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

Reference Job No. : 19-0049
Description : Water Bath
Manufacturer : Memmert
Serial No. : 1402.1385
Model : WB 14
ID. No. : WWL 0088
Marking : Additionally for the purpose of identification by this laboratory a label marked with this report number (MC 1900241) has been attached to the case.
Method : MWI-T-008 Temperature Calibration Method on Water Bath
Location of Calibration : Water Analysis Center Co., Ltd. ; LABORATORY.
Environmental Conditions : Ambient Temperature : (30.5 to 31.8) °C
 Relative Humidity : (50.0 to 54.0) %
Date of Calibration : 11 January 2019
Date of Issue : 14 January 2019

Checked by : Panruthai Janwong
 Panruthai Janwong
 (Calibration Supervisor)
Approved by : Aittipong Kanjanawasit
 Aittipong Kanjanawasit
 (Technical Manager)

NATA Accredited Laboratory Number: 14355

Accredited for compliance with ISO/IEC 17025. The results of the tests, calibrations and/or measurements included in this document are traceable to national standards. This report may not be reproduced except with the prior written approval of the issuing laboratory.

[MCF-Q-048 : Rev.4 : Date : 01/01/2015]

Continuation of Report No. : MC 1900241

Page 2 of 4

The Reference Standard :

Description	Report No.	Serial No.	Due date
Data Acquisition/Switch Unit	MC 1802558	MY44020009	4 March 2019
With Thermocouple Type "T" ID. No.25/1 to 25/9			

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

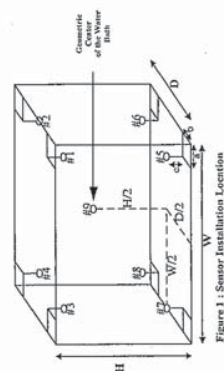
National Physical Laboratory (NPL), National Measurement Institute (NMI) Australia
through the reference standards laboratory of Master Calibration Co., Ltd.

1. Calibration Procedure:

The equipment list above was calibrated an accuracy of temperature in a chamber of the bath.

The calibration was performed by direct measurement of generated temperatures using the standard thermometer with nine temperature sensors and cover the bath. The following data was gathered during the uniformity analysis. The data was recorded in a period of sixty minutes after the specified temperature reach a steady state. The temperature scale used was based on ITS - 90.

The water bath has been examined for the following feature in accordance with the requirements, for accuracy of test method MWI-T-008 "Temperature Calibration Method on Water Bath" (based on ASTM Designation: E 715-80 "Standard Specification for Gravity Convection And Forced-Circulation Water Baths" but does not necessarily comply with all methods or determinations).



They may be reported in terms of a three-dimensional region of the chamber and of the associated sensor positions:

$$\begin{aligned} - W \times H \times D &= 35 \text{ cm} \times 18 \text{ cm} \times 33 \text{ cm} \\ - a \times b \times c &= 5 \text{ cm} \times 5 \text{ cm} \times 5 \text{ cm} \end{aligned}$$

Checked by : *Pattana*

[MCF-Q-048 ; Rev.4 ; Date : 01/01/2015]

Continuation of Report No. : MC 1900241

Page 3 of 4

2. Definitions :

Uniformity of temperature : 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.

Stability of temperature : One-half of the greatest maximum difference of measured temperatures at any one sensor, for at least half an hour after reaching steady state or after one achieved complete cycle of control whichever comes first. The specific check of temperature stability at specific positions or locations of working space within the chamber according to the way of use should be specified.

3. Result of calibration :

UUC* Temperature Setting (°C)	44.9
UUC* Temperature reading (°C)	44.9
Average of Standard Reading (°C)	
Measurement location	
Upper Right Front (1)	44.8
Upper Right Back (2)	44.7
Upper Left Front (3)	44.7
Upper Left Back (4)	44.5
Lower Right Front (5)	44.5
Lower Right Back (6)	44.5
Lower Left Front (7)	44.4
Lower Left Back (8)	44.3
Center (9)	44.5
Maximum Measured Temperature	45.3 °C
Minimum Measured Temperature	43.8 °C
Uniformity of temperature	0.86 °C
Stability of temperature (±)	0.58 °C
Uncertainty of Measurement (±)	0.21 °C

Note : UUC* : Unit Under Calibration

Checked by : *Pattana*

[MCF-Q-048 ; Rev.4 ; Date : 01/01/2015]



MCAL
MASTER CALIBRATION CO.,LTD.

547 Soi Ratchaditwit, Kwang Sansenok, Khet Huaykwang, Bangkok 10310
Tel : (02) 274 2978-9, (02) 274 2987-8 Fax : (02) 274 2518, (02) 274 2989
<http://www.mastercalibration.com>

Continuation of Report No. : MC 1900241

Page 4 of 4

4. 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 %.

The measured values in this report refer to the time of examination. The equipment used in this examination was in a current calibration state and traceable to national standards of measurement.

End of Calibration Report

Checked by :

Pantjai

[MCF-Q-048 ; Rev.4 ; Date : 01/01/2015]