

ภาคผนวก จ



เอกสารสอบเทียบเครื่องมือวิเคราะห์



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert.No.: 24CH17

Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Water Proof
Model : pHTestr 30
Serial No. : 3066320
ID No. : -
Condition As-Received: Used Item
Received Date : 05 January 2024
Calibration Date : 09 January 2024
Reference : 2401-0077DN-3
Submitted by : Environment Research & Technology Company Limited.
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,
Toongsonghong, Laksi, Bangkok 10210

Ambient Temperature : (25 \pm 2.5) °C
Relative Humidity : (50 \pm 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with standard
voltage calibrator and direct measurement
with certified reference material (CRM)

Calibrated by : Walalak Sirithean

Approved by :

Approved Signatory

(☒) Saithip Meangmai
() Warakorn Lernagatrakul
() Ponpan Paipim

Issue Date : 10 January 2024

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0062385



Cert.No.: 24CH17

Page.: 2 of 2

Condition of this calibration result

1. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.008	CPA chem	940102	27 Nov 2025
pH 6.986	CPA chem	931959	01 Oct 2024
pH 9.997	CPA chem	940106	02 Nov 2024

2. This certificate is valid only to the item calibrated on date and place of calibration.

Calibration Results

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4,7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement (\pm)	Coverage factor k
pH Electrode S/N.: 3066320	4.008	4.01	N/A	0.0071	2.00
	6.986	7.00	N/A	0.0093	2.00
	9.997	10.00	N/A	0.0095	2.00

- Remark**
- pH meter does not have voltage mode.
 - Can not connect the BNC because the plug does not match with the socket.
 - N/A = Not Available

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

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Saithyp

a 1196385



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert. No.: 24TM93

Page : 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven

Manufacturer : Memmert

Model : UF 110

Serial No. : B414.0652

ID No. : ERTC-L-In.-098

Submitted by : Environment Research & Technology Company Limited.
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,
Toongsonghong, Laksi,
Bangkok 10210

Location : Laboratory (ERTC)

Received Order : 03 January 2024

Calibration Date : 03 January 2024

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Tawatchai Pama

Approved by :

Approved Signatory

() Pornthippa Tameyakul

(☒) Ponpan Paipim

() Suwit Imjai

Issue Date : 16 January 2024

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0062472



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2401-0001ON-3
Procedure Used :-

Cert. No.: 24TM93
Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

<u>Instrument</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Traceable</u>	<u>Due Date</u>
1) Data Acquisition	MY57013823	23LM66	TPA	25 Mar 2024

2. This certificate is valid only to the item calibrated on date and place of calibration.

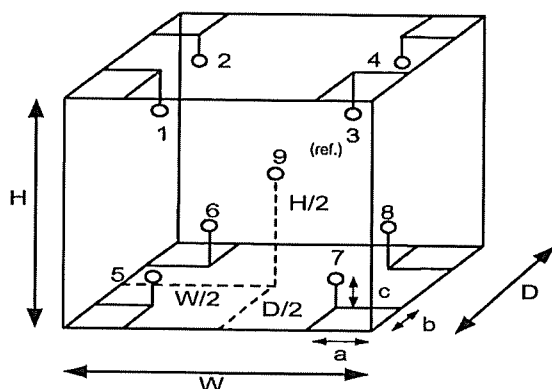
3. This certification is traceable to the International System of Unit.

Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Environment during calibration		
	Beginning	Finished
Temp. (°C)	30	30
REL.Humid. (%)	53	53
AC Supply (Volt)	226	225

Ref. Std. ID No.: @ Calibration Point		
Position :	(104) °C	(180) °C
1	21-17RTD-01	22-17TC-01
2	21-17RTD-02	23-17TC-02
3	17RTD-03	19-17TC-03
4	23-17RTD-10	19-17TC-04
5	17RTD-05	19-17TC-05
6	17RTD-06	19-17TC-06
7	17RTD-07	19-17TC-07
8	23-17RTD-08	19-17TC-08
9 (ref.)	23-17RTD-09	19-17TC-09

Probe Installation Details :

a = 5.0 cm
 b = 5.0 cm
 c = 5.0 cm

Dimension of Chamber :

D = 0.40 m
 W = 0.56 m
 H = 0.48 m
 Capacity = 0.11 m³

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Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2401-0001ON-3
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 24TM93

Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor <i>k</i>
104.0	104.0	104.0	0.075	1.2	2.4	2
180.0	180.0	180.0	0.41	3.4	3.9	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (±°C)
	Position									
	1	2	3	4	5	6	7	8	9 (ref.)	
104.0	105.068	102.783	103.239	103.695	104.855	103.867	102.799	103.295	103.959	0.42
180.0	179.954	177.587	177.414	178.118	181.087	179.869	179.584	178.045	180.704	1.3

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

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.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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

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Mettler-Toledo (Thailand) Ltd.
846/4 - 846/5 Lasalle Rd., Bangna Tai Sub-District
Bangna District, Bangkok 10260
+662 723 0382
MT-TH.ServiceSupport@mt.com



Accuracy Calibration Certificate

Customer

Company: Environment Research & Technology Co., Ltd.
Address: 25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Rd., Toongsonghong
City: Laksi Contact: Ramita Taengthai
Zip / Postal: 10210
State / Province: Bangkok
Order Number: 0 5 3 2 9 6 3 6 1 1

Weighing Device

Manufacturer: Mettler Toledo Instrument Type: Weighing Instrument
Model: MS204S/01 Asset Number: ERTC-L-IN-088
Serial No.: B334691537 Terminal Model: N/A
Building: N/A Terminal Serial No.: N/A
Floor: 5 Terminal Asset No.: N/A
Room: 504

Range	Max. Capacity	Readability (d)
1	220 g	0.0001 g

Procedure

Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)
METTLER TOLEDO Work Instruction: CP/W002/20
This calibration certificate contains measurements for As Found calibration. No As Left calibration was performed because the device was not modified after As Found calibration. Therefore, results for As Left correspond to As Found.
The sensitivity/span of the weighing instrument was adjusted before calibration with a built-in weight.
In accordance with EURAMET cg-18 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific calibration conditions.

	Temperature		Humidity	
As Found	Start: 27.5 °C	End: 26.9 °C	Start: 44.1 %	End: 44.8 %

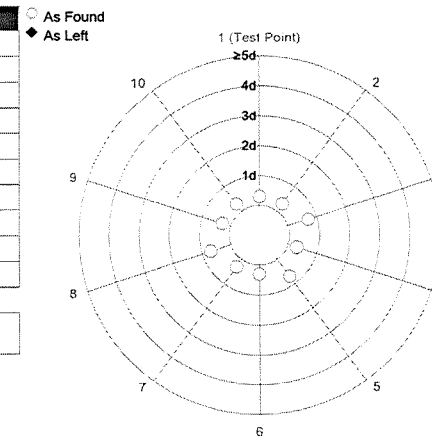
As Found Calibration Date: 15-Jan-2024 Calibrator: Nithit Jongkrod
As Left Calibration Date: N/A
Issue Date: 15-Jan-2024
Approved Signatory: Technical Manager / Head of Calibration Center

Measurement Results

Repeatability

Test Load: 100 g

	As Found	As Left
1	100.0000 g	N/A
2	100.0000 g	N/A
3	99.9999 g	N/A
4	100.0000 g	N/A
5	99.9999 g	N/A
6	100.0000 g	N/A
7	100.0000 g	N/A
8	99.9999 g	N/A
9	100.0000 g	N/A
10	100.0000 g	N/A
Standard Deviation	0.00005 g	N/A

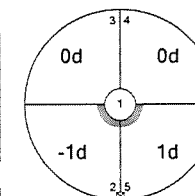


The "d" in the graph represents the readability of the range/interval in which the test was performed.
The results of this graph are based upon the absolute values of the differences from the mean value.

Eccentricity

Test Load: 100 g

Position	As Found	As Left
1	100.0000 g	N/A
2	99.9999 g	N/A
3	100.0000 g	N/A
4	100.0000 g	N/A
5	100.0001 g	N/A
Maximum Deviation	0.0001 g	N/A



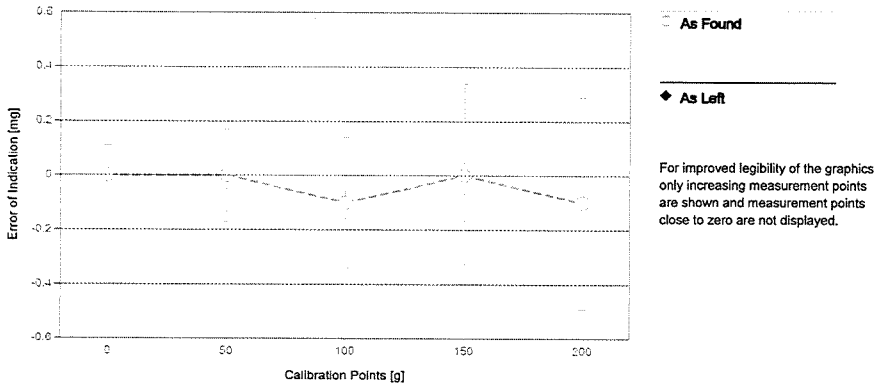
As Found

The "d" in the graph represents the readability of the range/interval in which the test was performed.

Error of Indication

As Found

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.0000 g	0.11 mg	2
2	0.0500 g	0.0500 g	0.0000 g	0.13 mg	2
3	0.1000 g	0.1000 g	0.0000 g	0.13 mg	2
4	0.5000 g	0.5000 g	0.0000 g	0.13 mg	2
5	1.0000 g	1.0000 g	0.0000 g	0.13 mg	2
6	5.0000 g	5.0000 g	0.0000 g	0.13 mg	2
7	10.0000 g	10.0000 g	0.0000 g	0.14 mg	2
8	50.0000 g	50.0000 g	0.0000 g	0.17 mg	2
9	100.0001 g	100.0000 g	-0.0001 g	0.24 mg	2
10	150.0001 g	150.0001 g	0.0000 g	0.34 mg	2
11	200.0000 g	199.9999 g	-0.0001 g	0.39 mg	2



The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor k – which can be larger than 2 according to EURAMET cg-18. The value of the measurand lies within the assigned range of values with a probability of approximately 95%.

The user is responsible for maintaining environmental conditions and the settings of the weighing instrument when it was calibrated. The results of this calibration certificate relate only to the calibrated item.

Test Equipment

All weights used for metrological testing are traceable to national or international standards. The weights were calibrated and certified by an accredited calibration laboratory.

Weight Set 1: OIML E2

Weight Set No.: WS52 Date of Issue: 22-Nov-2022
Certificate Number: 182272 Calibration Due Date: 21-May-2024

Thermo Hygrometer

Equipment No.: IN302 Date of Issue: 11-Oct-2023
Certificate Number: SG-H-00656/66 Calibration Due Date: 08-Oct-2024

Remarks

FACT adjustment functionality activated
Equipment condition: Good
Next calibration according to customer's procedure
Calibration data not decide by calibration laboratory

End of Accredited Section

The information below and any attachments to this calibration certificate are not part of the accredited calibration.

Measurement Uncertainty of the Weighing Instrument in Use

Stated is the expanded uncertainty with k=2 in use. The formula shall be used for the estimation of the uncertainty under consideration of the errors of indication. The value R represents the net load indication in the unit of measure of the device.

Temperature coefficient for the evaluation of the measurement uncertainty in use: 1.5 · 10⁻⁶ / K

Temperature range on site for the evaluation of the measurement uncertainty in use: 3 K

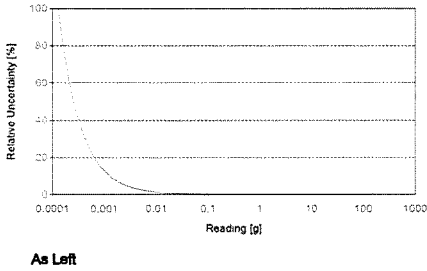
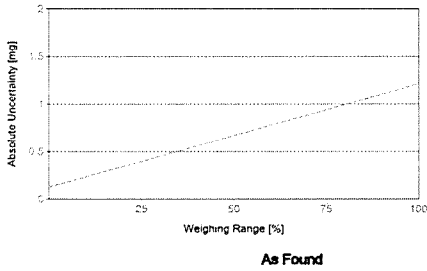
Linearization of Uncertainty Equation

	Range		As Found	As Left
	d	Max		
1	0.0001 g	220 g	U ₁ = 0.13 mg + 0.00494 mg/g · R	N/A

To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

Absolute and Relative Measurement Uncertainty In Use for Various Net Indications (Examples)

Net Indication	As Found		As Left	
0.0220 g	0.13 mg	0.59%	N/A	N/A
0.2200 g	0.13 mg	0.060%	N/A	N/A
2.2000 g	0.14 mg	0.0064%	N/A	N/A
22.0000 g	0.24 mg	0.0011%	N/A	N/A
220.0000 g	1.2 mg	0.00055%	N/A	N/A



GWP®
Certificate



As Found



As Left



The weighing device meets the given process requirements.

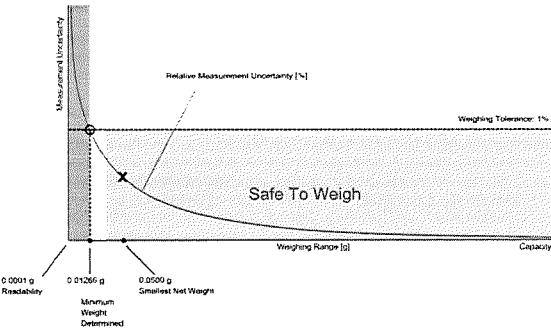
The weighing device meets the given process requirements.

Tests Performed: ☒ As Found ☐ As Left ☒ No adjustments/modifications made. As Left results correspond to As Found.

Process Requirements

Weighing Tolerance: 1% | Smallest Net Weight: 0.0500 g | Safety Factor: 2

Safe Weighing Range



While the values in this graph reflect the actual calibration results, the measurement uncertainty curves are simply a visual representation. This graph reflects As Left testing, unless only As Found was performed.

Minimum Weight

As Found Minimum Weight Table

Minimum weights for different weighing tolerances and safety factors					
Tolerance	Safety Factor				
	1	2	3	5	10
0.1%	0.12712 g	0.25551 g	0.38518 g	0.64847 g	1.33062 g
0.2%	0.06340 g	0.12712 g	0.19115 g	0.32018 g	0.64847 g
0.5%	0.02532 g	0.05070 g	0.07612 g	0.12712 g	0.25551 g
1%	0.01266 g	0.02532 g	0.03800 g	0.06340 g	0.12712 g
2%	0.00633 g	0.01266 g	0.01899 g	0.03166 g	0.06340 g
5%	0.00253 g	0.00506 g	0.00759 g	0.01266 g	0.02532 g



Pass: The determined minimum weight meets the requirement for the smallest net weight.

As Left Minimum Weight Table

Minimum weights for different weighing tolerances and safety factors					
Tolerance	Safety Factor				
	1	2	3	5	10
0.1%	0.12712 g	0.25551 g	0.38518 g	0.64847 g	1.33062 g
0.2%	0.06340 g	0.12712 g	0.19115 g	0.32018 g	0.64847 g
0.5%	0.02532 g	0.05070 g	0.07612 g	0.12712 g	0.25551 g
1%	0.01266 g	0.02532 g	0.03800 g	0.06340 g	0.12712 g
2%	0.00633 g	0.01266 g	0.01899 g	0.03166 g	0.06340 g
5%	0.00253 g	0.00506 g	0.00759 g	0.01266 g	0.02532 g



Pass: The determined minimum weight meets the requirement for the smallest net weight.

At these net minimum weight values, the measurement uncertainty of the weighing device is equal to or less than 1/1 (no safety factor), 1/2, 1/3, 1/5, or 1/10 of the required tolerance. The values are calculated with $k = 2$ and based on the linear formula of the measurement uncertainty of the weighing device in use.

The safety factor for As Found is always 1. This implies no safety factor. As Found testing looks at the behavior of the instrument from the past until test occurred. For the past, it is necessary to know that the tolerance was met, but not the safety factor. The safety factor is a proactive measure to apply for future measurements.

Notes on minimum weight values in above table:

1. If "N/A" is shown above, no appropriate value could be calculated.
2. METTLER TOLEDO is not responsible for the definition of the process requirements.

Measurement Results

Results Summary

	Repeatability	Eccentricity	Error of Indication
As Found	✓	✓	✓
As Left	✓	✓	✓

✓ = Passed

✗ = Failed

f = Safety Factor not met

Repeatability

Test Load: 100 g

Tolerance	Control Limit	As Found		As Left	
		Std. Deviation	Result	Std. Deviation	Result
0.1%	N/A	0.00005 g*	N/A	0.00005 g*	N/A
0.2%	0.00005 g		✓		f
0.5%	0.00013 g		✓		✓
1%	0.00025 g		✓		✓
2%	0.00050 g		✓		✓
5%	0.00125 g		✓		✓

*The calculated standard deviation value is below the rounding error of the balance. The 0.41*d rule is used for the assessment of this repeatability test and the calculation of the minimum weight.

The weighing tolerance is met if the standard deviation is less than or equal to the corresponding control limit.

Eccentricity

Test Load: 100 g

Tolerance	Control Limit	As Found		As Left	
		Deviation	Result	Deviation	Result
0.1%	0.0500 g	0.0001 g	✓	0.0001 g	✓
0.2%	0.1000 g		✓		✓
0.5%	0.2500 g		✓		✓
1%	0.5000 g		✓		✓
2%	1.0000 g		✓		✓
5%	2.5000 g		✓		✓

The weighing tolerance is met if the deviation is less than or equal to the corresponding control limit.

Error of Indication

As Found

		Control limits for various weighing tolerances					
Reference Value	Error	0.1%	0.2%	0.5%	1%	2%	5%
0.0000 g	0.0000 g	N/A	N/A	N/A	N/A	N/A	N/A
50.0000 g	0.0000 g	0.0250 g	0.0500 g	0.1250 g	0.2500 g	0.5000 g	1.2500 g
100.0001 g	-0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0001 g	0.0000 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
200.0000 g	-0.0001 g	0.1000 g	0.2000 g	0.5000 g	1.0000 g	2.0000 g	5.0000 g
Result		✓	✓	✓	✓	✓	✓

As Left

		Control limits for various weighing tolerances					
Reference Value	Error	0.1%	0.2%	0.5%	1%	2%	5%
0.0000 g	0.0000 g	N/A	N/A	N/A	N/A	N/A	N/A
50.0000 g	0.0000 g	0.0250 g	0.0500 g	0.1250 g	0.2500 g	0.5000 g	1.2500 g
100.0001 g	-0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0001 g	0.0000 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
200.0000 g	-0.0001 g	0.1000 g	0.2000 g	0.5000 g	1.0000 g	2.0000 g	5.0000 g
Result		✓	✓	✓	✓	✓	✓

The weighing tolerance is met if the error (of indication) for each test point is less than or equal to the corresponding control limit for that particular weighing tolerance. Results at or close to the zero point cannot be assessed.



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2401-0001ON-2
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 24TM92
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Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor <i>k</i>
104	104	104	0.10	1.8	2.1	2
180	180	180	0.27	4.4	5.0	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (±°C)
	Position									
	1	2	3	4	5	6	7	8	9 (ref.)	
104	104.379	103.463	103.443	103.893	104.213	103.223	105.222	104.297	103.494	0.77
180	179.045	177.562	181.299	179.300	180.773	177.931	182.136	178.131	178.019	1.6

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

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.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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

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**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

Calibration Cert. # 3884.01
ISO/IEC 17025

Certificate of Calibration

Certificate No. : MT23-7846

Page : 1 of 2

Customer : Environment Research & Technogy Co., Ltd.
Address : 25/114 Moo 6 Soi Chinaket1, Ngamwongwan Road, Toongsonghong, Laksi, Bangkok 10210

Description : Incubator
Manufacturer : Accuplus
Model : Smart i250
Serial No. : 2059-0218-0002
Identification No. : ERTC-L-IN-143
Calibration Place : Customer Laboratory

Order No. : 3936/23
Received date : Dec 12, 2023
Calibration date : Dec 12, 2023
Environment Condition :
Temperature : (25+/-10) °C
Humidity : (50+/-30) %RH

Calibration Method : Calibration were conducted using In-house calibration procedure *CP-MT-006* According to comparison with LXI Data Acquisition Switch Unit with sensor. The calibration methods based on Euramet Calibration Guide No.20 - guidelines on the Calibration of Temperature and/or Humidity Controlled Enclosures.

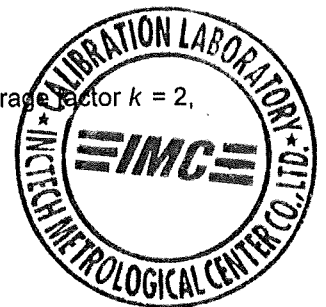
Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
LXI Data Acquisition Switch Unit with Sensor	34972A	MY57003222	MT23-5938	Oct 05, 2024

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 based on standard uncertainty multiplied by coverage factor $k = 2$, providing a level of confidence of not less than 95%



Calibrated by : Mr.Yuttakorn Jamneansri
Issue date : Jan 09, 2024

Approved by : _____
(Mr.Panuwat Phuklan)

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

**Intech 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

Calibration Cert. # 3884.01
ISO/IEC 17025

Certificate No. : MT23-7846

Page : 2 of 2

Function : Temperature measurement

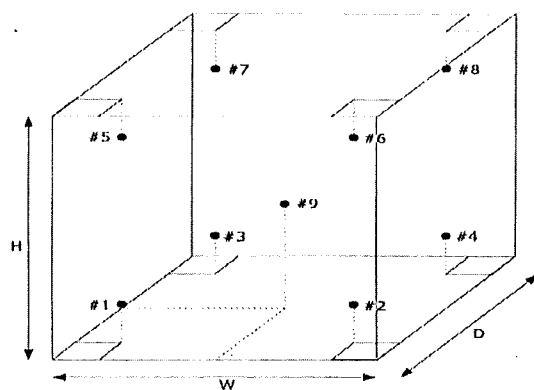
Result : Without adjustment

Calibration point : 20 °C

Resolution : 0.1 °C

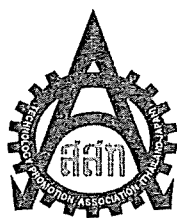
Calibration point (°C)	Temperature of UUC* at each position (°C)									Uncertainty of measurement (+/- °C)
	Ch.1	Ch.2	Ch.3	Ch.4	Ch.5	Ch.6	Ch.7	Ch.8	Ch.9	
20	20.542	20.166	20.504	20.211	20.551	20.501	20.477	20.728	19.867	0.46

Setting temperature (°C)	Indicating Temperature (°C)	Measured stability (+/- °C)	Measured uniformity (°C)	Overall variation (°C)
20.0	20 to 20.3	0.25	1.0	1.3



- #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

Front view**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.



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3 : EQUIPMENT CALIBRATION AND TESTING SERVICES


534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250

TEL. 0-2717-3000 FAX. 0-2719-9484

Cert.No.: 23TW254

Page.: 1 of 2

Certificate of Testing

Equipment :	DO Meter
Manufacturer :	YSI
Model :	5000-115
Serial No. :	17H104220
ID No. :	ERTC-L-In.137
Received Date :	29 November 2023
Test Date :	30 November 2023
Reference :	2311-0939DN-1
Submitted by :	Environment Research & Technology Company Limited. 25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road, Toongsonghong, Laksi, Bangkok 10210
Laboratory Condition :	Temperature (25 ± 5) °C Humidity (50 ± 20) %
Test Procedure :	In - house method : CP-CH9 by Comparison Technique with Azide Modification Method
Tested by :	Walalak Sirithean 
Approved by :	<hr/> <div>Approved Signatory</div>
<input checked="" type="checkbox"/> Saithip Meangmai <input type="checkbox"/> Warakorn Lernagtrakul <input type="checkbox"/> Ponpan Paipim	
Issue Date :	4 December 2023



Cert.No.: 23TW254

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

This certification is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center, Technology Promotion Association (Thailand-Japan).

<u>Instruments</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Burette	-	130BU10	23CG1172	22 Mar 2025
2) Balance	1124013382	140RC006	23MM18	20 Feb 2024

2. Standard Material :-

<u>Material</u>	<u>Manufacturer</u>	<u>Lot.No.</u>	<u>Assay</u>
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 17J100003

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.18	8.17	0.0055

This report was certified only for the instrument we tested. It is allowable to use for study the system efficiency, The environmental impact control and present to organization it may concerned. Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced other in full, without written approval of the laboratory

-o0o-


a 1192571

CALIBRATION REPORT

Issued By B.T.METROLOGY CO.,LTD.
Date of Issue 3 January 2024

Cert. Number
BTC-T-01/67
Page 1 of 4 pages

B.T.METROLOGY CO.,LTD.
17/166 Soi Prachachun 14 (PEA Village)
Tungsonghong Laksi, Bangkok 10210

Approved Signatory

P.Prasitmate

Customer : Environment research & Technogy Co., Ltd.
Address : 25/114 Moo6 Soi Chinaket1, Ngamwongwan Road, Toongsonghong, Laksi, Bangkok 10210
Date of Received : 29 December 2023
Instrument – Description : COD REACTOR
Id. Number : ERTC-L-In-112
Manufacturer : Hanna
Model Number : HI 8398000-02
Serial Number : G0059491

Calibration Procedure : Indicate temperature of Unit Under Test (UUC) was compared to temperature Obtained from reference standards at calibration point .

Measurement Method : The thermocouples shall be placed with in the chamber in accordance with the appendix A and the temp. readings of the thermocouples could be found in the appendix A.

Cal. Inform. : Cal. (☒) Only () Adjusted

Location of Calibration : At Customer Location

Environmental Conditions :

Temperature is $27 \pm 3^{\circ}\text{C}$

Relative Humidity is $60 \pm 10\%$ Rh

Comments


The temperature scale in use is the International Temperature Scale of 1990 (ITS-90).
The Uncertainties of report based on a standard uncertainty Multiplied by a coverage factor $k=2$,
Providing level of confidence approximately 95%
All Tests pass standard tolerance.

Tractability Information

Reference Standards Description	Serial Number	Certificate Number	Cal. Date	Due Date.
STD Thermometer with Probe, PRT	08000079/12058	PSL-T 0872/66	6-7/June /2023	6-7/June /2024
Equipment Description	Serial Number	Certificate Number	Cal. Date	Dule Date.
Data logger With Probe (RTD : 01-25)	MY49020096	BTC-T-001-66	1/February/2023	1/February/2024

This certification is traceable to SI Unit through the reference standard laboratory of In-house B.T.Metrology Calibration Lab.
The used to perform this calibration is Traceable to National Institute of Metrology (Thailand), NIMT through Reference Standard Laboratory of Thailand Institute of Scientific and Technological Research (TISTR), No. Calibration 0260.(Laboratories was Accreditation by TISI According to ITS ISO / IEC 17025

Calibrated By:



(Mr. Boonlue Somprajob)

Date of Calibration : 1 January 2024

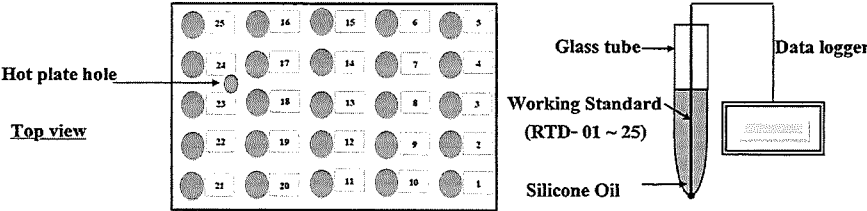
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CALIBRATION REPORT

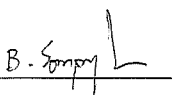
Issued By B.T.METROLOGY CO.,LTD.
Date of Issue 3 January 2024

Cert. Number
BTC-T-01/67
Page 2 of 4 pages

Appendix A.



Calibrated By:



(Mr. Boonlue Somprajob)

Date of Calibration : 1 January 2024

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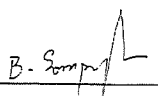
CALIBRATION REPORT

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Date of Issue 3 January 2024

Cert. Number
BTC-T-01/67
Page 3 of 4 pages

Hole No. (Position)	Max (°C)	Min (°C)	Mid-Range (°C)	Difference (°C)	Uncertainty of measurement (\pm °C)
1	149.3	149.2	149.3	0.1	0.5
2	147.6	147.4	147.5	0.1	
3	149.6	149.4	149.5	0.1	
4	149.9	149.7	149.8	0.1	
5	149.8	149.7	149.8	0.1	
6	147.9	147.7	147.8	0.1	
7	151.6	151.4	151.5	0.2	
8	150.6	150.4	150.5	0.2	
9	150.8	150.6	150.7	0.2	
10	149.6	149.4	149.5	0.2	
11	147.6	147.4	147.5	0.2	
12	152.0	151.7	151.9	0.3	
13	152.4	152.2	152.3	0.2	
14	151.3	151.1	151.2	0.2	
15	152.4	152.0	152.2	0.4	
16	151.4	151.1	151.3	0.3	
17	150.8	150.6	150.7	0.2	
18	152.6	152.3	152.5	0.3	
19	150.0	149.8	149.9	0.2	
20	151.0	150.7	150.9	0.3	
21	148.8	148.6	148.7	0.1	
22	149.5	149.4	149.5	0.2	
23	149.5	149.4	149.5	0.1	
24	150.9	150.7	150.8	0.3	
25	148.8	148.7	148.8	0.2	
Hot plate hole	150.3	149.6	150.0	0.6	

Calibrated By:


(Mr. Boonlue Somprajob)

Date of Calibration : 1 January 2024

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CALIBRATION REPORT

Issued By B.T.METROLOGY CO.,LTD.
Date of Issue 3 January 2024

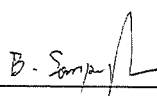
Cert. Number
BTC-T-01/67
Page 4 of 4 pages

UUC		Average Measured Temperature * (°C)	Measured Temperature		Measured Variation		
Setting (°C)	Reading (°C)		Max (°C)	Min (°C)	Stability (\pm °C)	Uniformity (°C)	Overall (°C)
150.0	147.4 ~ 152.6	150.1	152.6	147.4	0.3	4.8	5.2

Note : - Reference Standards are measurement in tube silicone oil at 240 value record after temperature stability.
- Level high of silicone oil is equal heater plate of UUC.

... end of certificate ...

Calibrated By:


(Mr. Boonlue Somprajob)

Date of Calibration : 1 January 2024


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Mettler-Toledo (Thailand) Ltd.
846/4 - 846/5 Lasalle Rd., Bangna Tai Sub-District
Bangna District, Bangkok 10260
+662 723 0382
MT-TH.ServiceSupport@mt.com



Accuracy Calibration Certificate

Customer

Company: Environment Research & Technology Co., Ltd.
Address: 25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Rd., Toongsonghong
City: Laksi Contact: Ramita Taengthai
Zip / Postal: 10210
State / Province: Bangkok
Order Number: 

Weighing Device

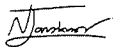
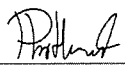
Manufacturer: Mettler Toledo Instrument Type: Weighing Instrument
Model: MS204TS/00 Asset Number: ERTC-L-IN-114
Serial No.: B547728937 Terminal Model: N/A
Building: N/A Terminal Serial No.: N/A
Floor: 5 Terminal Asset No.: N/A
Room: 504

Range	Max. Capacity	Readability (d)
1	220 g	0.0001 g

Procedure

Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)
METTLER TOLEDO Work Instruction: CP/W002/20
This calibration certificate contains measurements for As Found calibration. No As Left calibration was performed because the device was not modified after As Found calibration. Therefore, results for As Left correspond to As Found.
The sensitivity/span of the weighing instrument was adjusted before calibration with a built-in weight.
In accordance with EURAMET cg-18 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific calibration conditions.

	Temperature		Humidity	
As Found	Start: 26.9 °C	End: 27.0 °C	Start: 44.5 %	End: 44.6 %

As Found Calibration Date: 15-Jan-2024 Calibrator: 
As Left Calibration Date: N/A
Issue Date: 15-Jan-2024 Nithit Jongkrod
Approved Signatory: 
Technical Manager / Head of Calibration Center

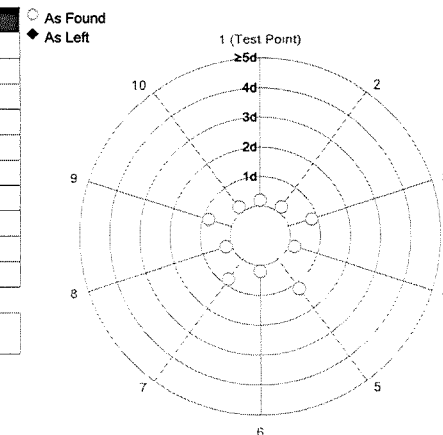
Measurement Results

Repeatability

Test Load: 100 g

	As Found	As Left
1	100.0000 g	N/A
2	100.0000 g	N/A
3	100.0001 g	N/A
4	100.0000 g	N/A
5	99.9999 g	N/A
6	100.0000 g	N/A
7	100.0001 g	N/A
8	100.0000 g	N/A
9	100.0001 g	N/A
10	100.0000 g	N/A

Standard Deviation	0.00006 g	N/A
--------------------	-----------	-----



The "d" in the graph represents the readability of the range/interval in which the test was performed.

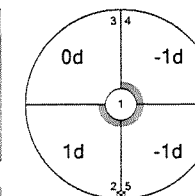
The results of this graph are based upon the absolute values of the differences from the mean value.

Eccentricity

Test Load: 100 g

Position	As Found	As Left
1	100.0000 g	N/A
2	100.0001 g	N/A
3	100.0000 g	N/A
4	99.9999 g	N/A
5	99.9999 g	N/A

Maximum Deviation	0.0001 g	N/A
-------------------	----------	-----

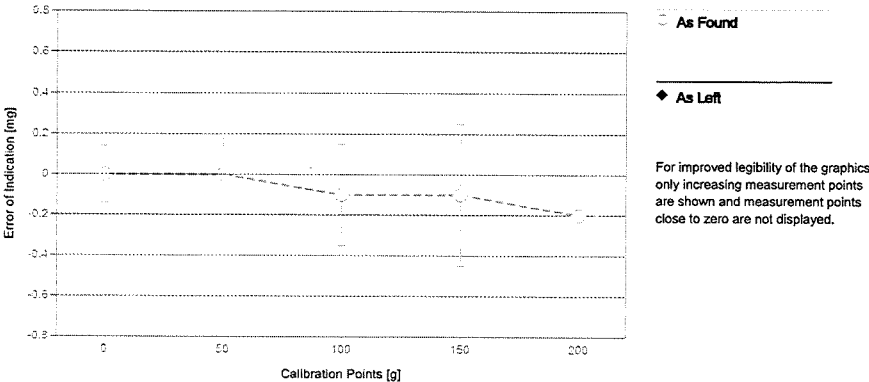


As Found

The "d" in the graph represents the readability of the range/interval in which the test was performed.

Error of Indication

As Found					
	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.0000 g	0.14 mg	2
2	0.0500 g	0.0500 g	0.0000 g	0.15 mg	2
3	0.1000 g	0.1000 g	0.0000 g	0.15 mg	2
4	0.5000 g	0.5001 g	0.0001 g	0.15 mg	2
5	1.0000 g	1.0000 g	0.0000 g	0.15 mg	2
6	5.0000 g	5.0001 g	0.0001 g	0.16 mg	2
7	10.0000 g	10.0000 g	0.0000 g	0.16 mg	2
8	50.0000 g	50.0000 g	0.0000 g	0.19 mg	2
9	100.0001 g	100.0000 g	-0.0001 g	0.25 mg	2
10	150.0001 g	150.0000 g	-0.0001 g	0.35 mg	2
11	200.0000 g	199.9998 g	-0.0002 g	0.39 mg	2



The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor k – which can be larger than 2 according to EURAMET cg-18. The value of the measurand lies within the assigned range of values with a probability of approximately 95%.

The user is responsible for maintaining environmental conditions and the settings of the weighing instrument when it was calibrated. The results of this calibration certificate relate only to the calibrated item.

Test Equipment

All weights used for metrological testing are traceable to national or international standards. The weights were calibrated and certified by an accredited calibration laboratory.

Weight Set 1: OIML E2

Weight Set No.:	WS52	Date of Issue:	22-Nov-2022
Certificate Number:	182272	Calibration Due Date:	21-May-2024

Thermo Hygrometer

Equipment No.:	IN302	Date of Issue:	11-Oct-2023
Certificate Number:	SG-H-00656/66	Calibration Due Date:	08-Oct-2024

Remarks

- FACT adjustment functionality activated
- Equipment condition: Good
- Next calibration according to customer's procedure
- Calibration data not decide by calibration laboratory

End of Accredited Section

The information below and any attachments to this calibration certificate are not part of the accredited calibration.

Measurement Uncertainty of the Weighing Instrument in Use

Stated is the expanded uncertainty with k=2 in use. The formula shall be used for the estimation of the uncertainty under consideration of the errors of indication. The value R represents the net load indication in the unit of measure of the device.

Temperature coefficient for the evaluation of the measurement uncertainty in use: 3.0 · 10⁻⁶ / K
Temperature range on site for the evaluation of the measurement uncertainty in use: 3 K

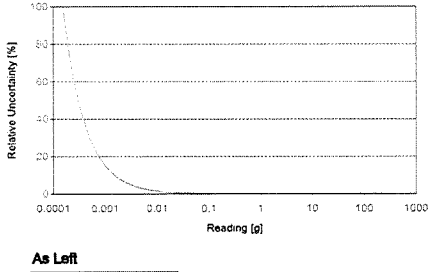
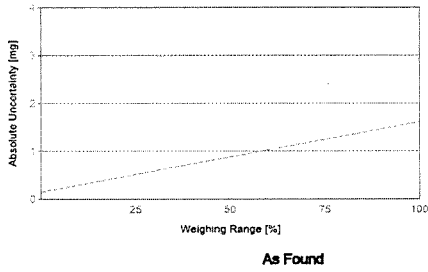
Linearization of Uncertainty Equation

	Range		As Found	As Left
	d	Max		
1	0.0001 g	220 g	$U_1 = 0.15 \text{ mg} + 0.00663 \text{ mg/g} \cdot R$	N/A

To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

Absolute and Relative Measurement Uncertainty in Use for Various Net Indications (Examples)

Net Indication	As Found		As Left	
0.0220 g	0.15 mg	0.68%	N/A	N/A
0.2200 g	0.15 mg	0.069%	N/A	N/A
2.2000 g	0.16 mg	0.0075%	N/A	N/A
22.0000 g	0.30 mg	0.0013%	N/A	N/A
220.0000 g	1.6 mg	0.00073%	N/A	N/A



GWP®
Certificate



As Found



As Left



The weighing device meets the given process requirements.

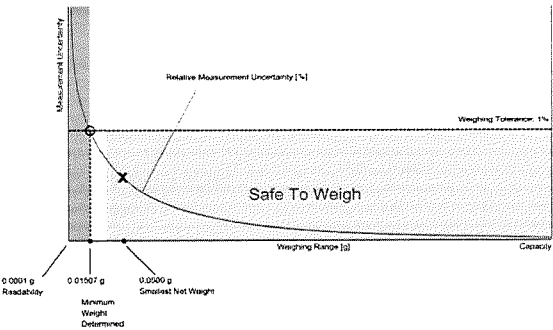
The weighing device meets the given process requirements.

Tests Performed: ☒ As Found ☐ As Left ☒ No adjustments/modifications made. As Left results correspond to As Found.

Process Requirements

Weighing Tolerance: 1% | Smallest Net Weight: 0.0500 g | Safety Factor: 2

Safe Weighing Range



While the values in this graph reflect the actual calibration results, the measurement uncertainty curves are simply a visual representation. This graph reflects As Left testing, unless only As Found was performed.

Minimum Weight

As Found Minimum Weight Table

Minimum weights for different weighing tolerances and safety factors					
Tolerance	Safety Factor				
	1	2	3	5	10
0.1%	0.15156 g	0.30515 g	0.46083 g	0.77857 g	1.61241 g
0.2%	0.07553 g	0.15156 g	0.22810 g	0.38273 g	0.77857 g
0.5%	0.03015 g	0.06038 g	0.09069 g	0.15156 g	0.30515 g
1%	0.01507 g	0.03015 g	0.04526 g	0.07553 g	0.15156 g
2%	0.00753 g	0.01507 g	0.02261 g	0.03770 g	0.07553 g
5%	0.00301 g	0.00602 g	0.00904 g	0.01507 g	0.03015 g

✓ Pass: The determined minimum weight meets the requirement for the smallest net weight.

As Left Minimum Weight Table

Minimum weights for different weighing tolerances and safety factors					
Tolerance	Safety Factor				
	1	2	3	5	10
0.1%	0.15156 g	0.30515 g	0.46083 g	0.77857 g	1.61241 g
0.2%	0.07553 g	0.15156 g	0.22810 g	0.38273 g	0.77857 g
0.5%	0.03015 g	0.06038 g	0.09069 g	0.15156 g	0.30515 g
1%	0.01507 g	0.03015 g	0.04526 g	0.07553 g	0.15156 g
2%	0.00753 g	0.01507 g	0.02261 g	0.03770 g	0.07553 g
5%	0.00301 g	0.00602 g	0.00904 g	0.01507 g	0.03015 g

✓ Pass: The determined minimum weight meets the requirement for the smallest net weight.

At these net minimum weight values, the measurement uncertainty of the weighing device is equal to or less than 1/1 (no safety factor), 1/2, 1/3, 1/5, or 1/10 of the required tolerance. The values are calculated with $k = 2$ and based on the linear formula of the measurement uncertainty of the weighing device in use.

The safety factor for As Found is always 1. This implies no safety factor. As Found testing looks at the behavior of the instrument from the past until test occurred. For the past, it is necessary to know that the tolerance was met, but not the safety factor. The safety factor is a proactive measure to apply for future measurements.

Notes on minimum weight values in above table:

- If "N/A" is shown above, no appropriate value could be calculated.
- METTLER TOLEDO is not responsible for the definition of the process requirements.

Measurement Results

Results Summary

	Repeatability	Eccentricity	Error of Indication
As Found	✓	✓	✓
As Left	✓	✓	✓

✓ = Passed

✗ = Failed

! = Safety Factor not met

Repeatability

Test Load: 100 g

Tolerance	Control Limit	As Found		As Left	
		Std. Deviation	Result	Std. Deviation	Result
0.1%	N/A	0.00006 g*	N/A	0.00006 g*	N/A
0.2%	0.00005 g		✗		✗
0.5%	0.00013 g		✓		✓
1%	0.00025 g		✓		✓
2%	0.00050 g		✓		✓
5%	0.00125 g		✓		✓

*The calculated standard deviation value is below the rounding error of the balance. The 0.41*d rule is used for the assessment of this repeatability test and the calculation of the minimum weight.

The weighing tolerance is met if the standard deviation is less than or equal to the corresponding control limit.

Eccentricity

Test Load: 100 g

Tolerance	Control Limit	As Found		As Left	
		Deviation	Result	Deviation	Result
0.1%	0.0500 g	0.0001 g	✓	0.0001 g	✓
0.2%	0.1000 g		✓		✓
0.5%	0.2500 g		✓		✓
1%	0.5000 g		✓		✓
2%	1.0000 g		✓		✓
5%	2.5000 g		✓		✓

The weighing tolerance is met if the deviation is less than or equal to the corresponding control limit.

Error of Indication

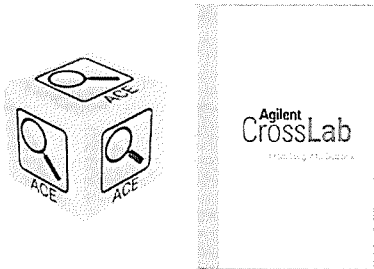
As Found

		Control limits for various weighing tolerances					
Reference Value	Error	0.1%	0.2%	0.5%	1%	2%	5%
0.0000 g	0.0000 g	N/A	N/A	N/A	N/A	N/A	N/A
50.0000 g	0.0000 g	0.0250 g	0.0500 g	0.1250 g	0.2500 g	0.5000 g	1.2500 g
100.0001 g	-0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0001 g	-0.0001 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
200.0000 g	-0.0002 g	0.1000 g	0.2000 g	0.5000 g	1.0000 g	2.0000 g	5.0000 g
Result		✓	✓	✓	✓	✓	✓

As Left

		Control limits for various weighing tolerances					
Reference Value	Error	0.1%	0.2%	0.5%	1%	2%	5%
0.0000 g	0.0000 g	N/A	N/A	N/A	N/A	N/A	N/A
50.0000 g	0.0000 g	0.0250 g	0.0500 g	0.1250 g	0.2500 g	0.5000 g	1.2500 g
100.0001 g	-0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0001 g	-0.0001 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
200.0000 g	-0.0002 g	0.1000 g	0.2000 g	0.5000 g	1.0000 g	2.0000 g	5.0000 g
Result		✓	✓	✓	✓	✓	✓

The weighing tolerance is met if the error (of indication) for each test point is less than or equal to the corresponding control limit for that particular weighing tolerance. Results at or close to the zero point cannot be assessed.



Agilent CrossLab Compliance

Qualification Type:	ES-OQ
System ID:	MY15330001
EQP Name:	AgilentRecommended
EQP Revision:	ES.02.50
EQP Publish Date:	March 2020
Date:	November 28, 2023 1:10:31 PM
Report Type:	Report
Org. Name:	Environment Research & Technology Co.,Ltd
Org. Location:	25/114 Moo 6 Soi Chinaket, Ngamwongwan Rd., Bangkok 10210

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Test Summary

Purpose

This section includes the Overall Qualification Status and details for each test that meets at least one of the following criteria: (1) was not scheduled; (2) was scheduled but not run; (3) was processed more than once; (4) passed recommended limits only when dual limits were selected; (5) required deviation(s) or comment(s); (6) required integration event change(s). Tests that pass and do not meet any criteria above are not included.

For a complete list of scheduled tests, see the table of contents. For supporting documentation, refer to the Attachments section.

NOTE: A Pass for the Overall Qualification Status indicates that all scheduled tests were run and passed; R, I, D, and C are blank if not applicable for that specific test.

R: runs
I: integration event changes
D: number of deviations submitted
C: number of comments submitted
Status: NS (not scheduled); NR (scheduled but not run); NC (unlocked but not completed)

Details				
Test	Status			
	R	I	D	C
There were no repeated or re-integrated tests. All test resulted in a pass status.				
Overall Qualification Status				
Pass				

Service Details

Purpose

This section includes local contact and delivery details for this service.

General Details	
Service Order No./Request:	6006377416
EQP Name:	AgilentRecommended
EQP Revision:	ES.02.50
Report Type:	Report
Organization Details	
Name:	Environment Research & Technology Co.,Ltd
Location:	25/114 Moo 6 Soi Chinaket, Ngamwongwan Rd., Bangkok 10210
Local Contact Details	
Name:	K Raiwin Posit
Job Title:	Supervisor Scientist
Qualification Location:	ICPOES Room
Operator Details	
Name:	Worawit Timakul
Job Title:	Field Service Engineer
Data Acquisition Details	
Acquisition Software Name:	ICP Expert
Acquisition Software Revision:	7.1.0.6821
Customer Data System (CDS):	Es: ICP Expert

Instrument Details

Purpose

This section describes the as found system configuration.

Details	
Spectrometer 1	
Manufacturer	Agilent Technologies
Name	5100 VDV
Model Number	G8011A
Sample Introduction	Double pass glass cyclonic spraychamber and seaspray nebulizer
Serial Number	MY15330001
Firmware Revision	2994
Chiller 1	
Manufacturer	Agilent Technologies
Name	Chiller
Model Number	G8481A
Serial Number	1A1560387
Autosampler 1	
Manufacturer	Agilent Technologies
Name	SPS4
Model Number	G8410A
Serial Number	AU15220240
Vapor Generator 1	
Manufacturer	Agilent Technologies
Name	VGA77P
Model Number	G8475A
Serial Number	MY15330002

Protocol Details

Purpose

This section lists the revisions for all test units used in this report. For complete test-specific and high-level change details, refer to the Revision History document.

Test Revision	Test
ES.02.50	Autosampler Operation
ES.02.50	Instrument Tests
ES.02.50	Preparation

Preparation

Purpose

This test records a status for each preparation task for the Agilent ICP-OES.

Configuration Details

Model/Serial No.:	G8011A	MY15330001
-------------------	--------	------------

Results

Criteria	Observed Result	Expected Result	Status
Does the plasma ignite successfully in the first three attempts?	Yes	Yes	Pass
Was the detector calibration performed and completed successfully?	Yes	Yes	Pass
Was the instrument calibration performed and completed successfully?	Yes	Yes	Pass

Test Evidence

Image Details: Was the detector calibration performed and completed successfully?

Date and Time: November 28, 2023 12:56:03 PM

Host Name: 5CG0202NQ4

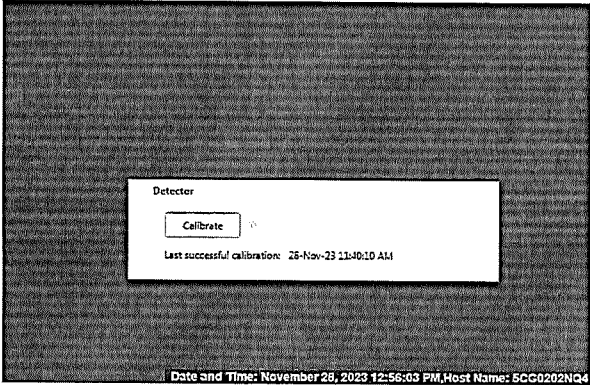
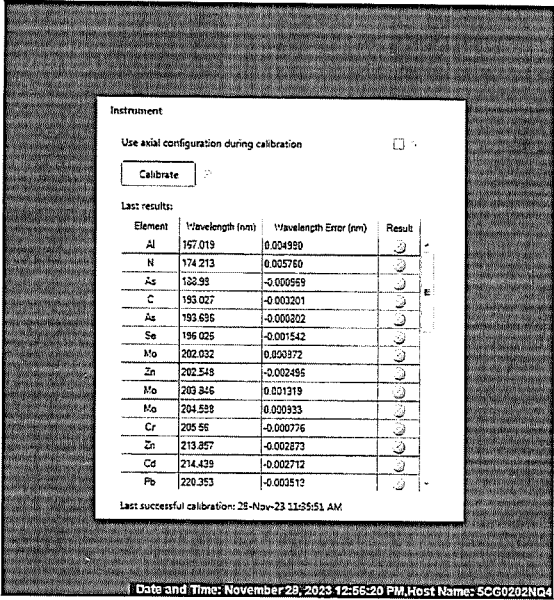


Image Details: Was the instrument calibration performed and completed successfully?

Date and Time: November 28, 2023 12:56:20 PM

Host Name: 5CG0202NQ4



Overall Test Status

Pass	Runs: 1
------	---------

Instrument Tests

Purpose

This test records a status for each of the automated tests within the Agilent ICP-OES CDS. For detailed test criteria, refer to the attached report.

Configuration Details

Model/Serial No.:	G8011A	MY15330001
-------------------	--------	------------

Results	Observed Result	Expected Result	Status
---------	-----------------	-----------------	--------

Are the Functional Tests results within acceptance criteria?

Subsystem Communications	<input type="text" value="Yes"/>	<input type="text" value="Yes"/>	<input type="text" value="Pass"/>
Air Flow	<input type="text" value="Yes"/>	<input type="text" value="Yes"/>	<input type="text" value="Pass"/>
Water Flow	<input type="text" value="Yes"/>	<input type="text" value="Yes"/>	<input type="text" value="Pass"/>
Gas Flows	<input type="text" value="Yes"/>	<input type="text" value="Yes"/>	<input type="text" value="Pass"/>
RF Generator	<input type="text" value="Yes"/>	<input type="text" value="Yes"/>	<input type="text" value="Pass"/>
Camera	<input type="text" value="Yes"/>	<input type="text" value="Yes"/>	<input type="text" value="Pass"/>
Optics	<input type="text" value="Yes"/>	<input type="text" value="Yes"/>	<input type="text" value="Pass"/>

Are the Instrument Performance Tests results within acceptance criteria?

Resolution	<input type="text" value="Yes"/>	<input type="text" value="Yes"/>	<input type="text" value="Pass"/>
Sensitivity	<input type="text" value="Yes"/>	<input type="text" value="Yes"/>	<input type="text" value="Pass"/>
Precision	<input type="text" value="Yes"/>	<input type="text" value="Yes"/>	<input type="text" value="Pass"/>

Overall Test Status

Pass	Runs: <input type="text" value="1"/>
------	--------------------------------------

Autosampler Operation

Purpose

This test verifies that the autosampler operates properly.

Configuration Details

Model/Serial No.:	G8410A	AU15220240
-------------------	--------	------------

Results

Criteria	Observed Result	Expected Result	Status
----------	-----------------	-----------------	--------

Does the autosampler successfully move to the specified location(s)?	<input type="text" value="Yes"/>	<input type="text" value="Yes"/>	<input type="text" value="Pass"/>
--	----------------------------------	----------------------------------	-----------------------------------

Overall Test Status

Pass	Runs: <input type="text" value="1"/>
------	--------------------------------------

Declaration of Change Control

This document is under change control. Revision history is maintained and printed on each document. Access to the master documents is limited to process owners. Documents receive periodic review and cannot be assigned an evergreen status. The qualification performed according to this document refers only to the hardware/software configuration in place at the time of the qualification. Agilent Technologies recommends that instrument configuration change management procedures be in place in order to maintain the validation process. Any changes to the analytical or computer hardware or software must be clearly specified. A change management system provides a means for determining the degree of requalification required according to the extent of the changes made. All details of the changes must be thoroughly recorded and documented, together with details of completed tests and their results. Note: Hardware/software configuration management is the customer's responsibility.

Attachments

Training requirements note: The delivery engineer attaches an ACE technique-specific training certificate to the Equipment Qualification Report (EQR). Obtaining ACE technique-specific certification includes pre-requisite trainings for Data Integrity, General Compliance topics (GMP, GLP, ALCOA, etc.), instrument hardware and software components, and the ACE technique itself. The one certificate encompasses all pre-requisite trainings as documented in the Agilent Learning Management System called Success Factors.

Location	Category	Document Name	Page
EQR	General	Certificate of Qualification for ACE	13
EQR	General	Operator's training certificate and qualifications	14
EQR	General	Operator's training certificate and qualifications	15
EQR	General	Certificate of System Qualification	16
EQR	General	Instrument's Test Report	17
EQR	General	Software Verification	20
EQR	Material	Certificate of Analysis Wavelength calibration solution	21

General

Document Name: Certificate of Qualification for ACE



Agilent Technologies

Agilent Compliance Engine Self Qualification

Date: October 18, 2023 10:19:46 AM

Drive Serial #: 90593EBA Platform Revision: ACE 3.12.112

Individual self-qualification reports for each specific technique installed are also available upon request. They provide additional details on the general report from the concise summary and are structured by the actual algorithms challenged during the process. There is not a one-to-one relationship between algorithms and OQ program tests because some algorithms are used by several tests and across multiple similar hardware components of the qualified systems.

Technique Type	Tests Completed	Result
Atomic Absorption	7	Conforms
Capillary Electrophoresis	10	Conforms
Dissolution	6	Conforms
Emission Spectroscopy	3	Conforms
Gas Chromatography - GCMS	17	Conforms
Gas Chromatography	29	Conforms
Gel Permeation Chromatography	9	Conforms
ICP-MS	6	Conforms
Infrared Spectroscopy	7	Conforms
Liquid Chromatography	17	Conforms
Liquid Chromatography - LCMS	8	Conforms
Microfluidics	18	Conforms
Sample Preparation - Gas Chromatography	9	Conforms
Sample Preparation - Liquid Chromatography	8	Conforms
Supercritical Fluid Chromatography	15	Conforms
Software	6	Conforms
UV-Vis Spectrophotometer	13	Conforms

Overall Qualification Status

Conforms

General

Document Name: Operator's training certificate and qualifications



Agilent Technologies

Certificate of Completion

Learner Name: Worawit Timakul

Title Of Course: ANV-CE-ICPOES-2-008-A: Agilent 5100 ICP-OES Support Neophyte Training

Completion Date: August 25, 2016


Certified By Company: Learning at Agilent

All Service and Support training certificates have the following specific limitations.

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

General

Document Name: Operator's training certificate and qualifications



Certificate of Completion

Learner Name:

Worawit Timakul

Title Of Course:

ANV-CE-ICPOES-2-007-C: CrossLab Compliance Hardware Specific Delivery for Agilent ICP-OES Systems

Completion Date:

October 30, 2020

Certified By Company:

Learning at Agilent

All Service and Support training certificates have the following specific limitations.

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

Date: November 28, 2023 1:10:31 PM
System ID: MY15330001

General

Document Name: Certificate of System Qualification



Certificate of Completion

Learner Name:

Worawit Timakul

Title Of Course:

AN-CE-SS-II-030-A: ACE 3.X User Update Training

Completion Date:

July 1, 2020

Certified By Company:

Learning at Agilent

All Service and Support training certificates have the following specific limitations.

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

Date: November 28, 2023 1:10:31 PM
System ID: MY15330001

General

Document Name: Instrument's Test Report

Report Summary

Instrument Model	Agilent 5100 VDV ICP-OES
Instrument ID	G8011A
Instrument Serial Number	MY15330001
Software Version	7.1.0.6821
Firmware Version	2994
Tested By	Worawit T.
Test Completed On	27-Nov-23 2:23:13 PM

Result Summary

Resolution Test	Pass
Sensitivity Test	Pass
Precision Test	Pass

Resolution Test

Pass

Element Wavelength	Specification	Width
N (174.213 nm)	≤ 9.40	7.28
As (188.980 nm)	≤ 8.20	6.66
C (193.027 nm)	≤ 11.50	8.01
Mo (202.032 nm)	≤ 8.20	6.71
Cr (206.158 nm)	≤ 13.40	10.27
Zn (213.857 nm)	≤ 8.70	7.56
Pb (220.353 nm)	≤ 9.50	7.70
Co (228.615 nm)	≤ 17.20	10.70
Ba (230.424 nm)	≤ 9.40	8.14
Mn (257.610 nm)	≤ 13.30	9.43
Mn (260.568 nm)	≤ 20.30	15.91
Cr (267.716 nm)	≤ 11.00	9.30
Cu (324.754 nm)	≤ 25.00	17.80
Cu (327.395 nm)	≤ 14.20	12.73
Sr (338.071 nm)	≤ 33.50	27.28
Ba (455.403 nm)	≤ 44.00	31.08
Sr (460.733 nm)	≤ 36.00	21.11
Ba (493.408 nm)	≤ 36.00	29.33
Ba (614.171 nm)	≤ 42.00	32.02
Ar (675.283 nm)	≤ 74.00	64.85
K (766.491 nm)	≤ 80.00	62.51

Document Name: Instrument's Test Report

Sensitivity Test

Pass

Radial

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	111.1	1111.0	85.2
Se (196.026 nm)	≥ 41.0	SRBR	68.5	856.2	116.6
Zn (213.857 nm)	≥ 1421.0	SRBR	3583.1	52766.1	215.1
Pb (220.353 nm)	≥ 46.0	SRBR	183.7	2811.8	201.8
Mn (257.610 nm)	≥ 3518.0	SRBR	10286.2	279763.9	735.8
Al (396.152 nm)	≥ 3.4	SBR	8.2	37571.9	4071.0
Ba (493.408 nm)	≥ 34.0	SBR	100.5	1198903.7	11807.1
K (766.491 nm)	≥ 1.8	SBR	3.8	100874.8	20871.5

Axial

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	248.6	3738.6	202.3
Se (196.026 nm)	≥ 159.0	SRBR	163.8	3040.9	283.3
Zn (213.857 nm)	≥ 234.0	SRBR	1402.0	19646.6	192.6
Zn (213.857 nm)	≥ 1743.0	SRBR	8340.9	200514.1	574.6
Cd (214.439 nm)	≥ 4227.0	SRBR	7608.2	156421.5	420.7
Pb (220.353 nm)	≥ 320.0	SRBR	631.4	16069.9	600.3
Mn (257.610 nm)	≥ 10625.0	SRBR	32328.3	1472044.4	2087.5
Cr (267.716 nm)	≥ 1048.0	SRBR	4308.3	155802.6	1286.3
Cu (324.754 nm)	≥ 19.0	SBR	57.8	242584.8	4123.5
Al (396.152 nm)	≥ 6.0	SBR	21.9	239924.8	10474.6
Ba (493.408 nm)	≥ 60.0	SBR	236.0	7235267.3	30527.2
K (766.491 nm)	≥ 24.0	SBR	68.8	3110677.8	44585.8

Document Name: Instrument's Test Report

Precision Test			Pass
Radial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 2.60	0.74	
Se (196.026 nm)	≤ 2.60	0.65	
Zn (213.857 nm)	≤ 1.50	0.21	
Pb (220.353 nm)	≤ 2.60	0.51	
Mn (257.610 nm)	≤ 1.50	0.25	
Al (396.152 nm)	≤ 1.50	0.30	
Ba (493.408 nm)	≤ 1.50	0.60	
K (766.491 nm)	≤ 1.50	0.20	
Axial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 1.50	0.51	
Se (196.026 nm)	≤ 1.50	0.37	
Zn (206.200 nm)	≤ 1.50	0.30	
Zn (213.857 nm)	≤ 1.50	0.26	
Cd (214.439 nm)	≤ 1.50	0.21	
Pb (220.353 nm)	≤ 1.50	0.30	
Mn (257.610 nm)	≤ 1.50	0.63	
Cr (267.716 nm)	≤ 1.50	0.17	
Cu (324.754 nm)	≤ 1.50	0.32	
Al (396.152 nm)	≤ 1.50	0.30	
Ba (493.408 nm)	≤ 1.50	0.48	
K (766.491 nm)	≤ 1.50	0.53	


General

Document Name: Software Verification

Software Verification Report					
Date:	Monday, November 27, 2023	Time:	2:58:23 PM (UTC +07:00:00)	Host Name:	5100VDV-HP
Windows User Name :	Admin	Base Revision Number:	7.0.1	Product Name :	ICP Expert
Install Type:	N/A	Additional Packages:	NA		
Base Reference File Name : ICPReferenceFile.xml					
Summary :					
Overall Evaluation of Installation Check : PASS					
File Report Summary					
No missing files or invalid files found					
No system file difference found					
Files Registration Report Summary					
Files Registration check not required for this product					
Registry Report Summary					
Registry entries check not required for this product					

Materials

Document Name: Certificate of Analysis Wavelength calibration solution



CERTIFICATE OF ANALYSIS

Agilent Product Name: Wavelength Calibration Solution for ICP-OES & MP-AES, 5 mg/L, 500mL

Agilent Part No: 6610030100

Lot No: 0012990411

Product Specifications

Analyte	Starting Material	CAS #	Certified Conc.	Analyte	Starting Material	CAS #	Certified Conc.
Al	Al(NO ₃) ₃	7784-27-2	5.000 ± 0.025 mg/L	Mn	Mn	7439-96-5	5.000 ± 0.025 mg/L
As	As	7440-38-2	5.000 ± 0.025 mg/L	Mo	(NH ₄) ₂ MoO ₄	13106-76-5	5.000 ± 0.025 mg/L
Ba	Ba(NO ₃) ₂	10022-31-8	5.000 ± 0.025 mg/L	Ni	Ni	7440-02-0	5.000 ± 0.025 mg/L
Cd	Cd	7440-43-0	5.000 ± 0.025 mg/L	Pb	Pb	7439-92-1	5.000 ± 0.025 mg/L
Co	Co	7440-48-4	5.000 ± 0.025 mg/L	Se	Se	7782-49-2	5.000 ± 0.025 mg/L
Cr	Cr(NO ₃) ₃	13548-38-4	5.000 ± 0.025 mg/L	Sr	Sr(NO ₃) ₂	10042-76-9	5.000 ± 0.025 mg/L
Cu	Cu	7440-50-8	5.000 ± 0.025 mg/L	Zn	Zn	7440-06-6	5.000 ± 0.025 mg/L
K	KNO ₃	7757-79-1	50.00 ± 0.25 mg/L				

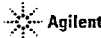
Metric: 5% HNO₃

Intended Use: This solution is intended for use as a certified reference material or calibration standard for inductively coupled plasma optical emission spectroscopy (ICP-OES), inductively coupled plasma mass spectrometry (ICP-MS), atomic absorption spectroscopy (flame AAS or GFAAS), microwave plasma atomic emission spectroscopy (MP-AES), x-ray fluorescence spectroscopy (XRF), and other techniques for elemental analysis.

Certification & Traceability: This CRM was manufactured under a quality management system that is registered to ISO 9001, ISO 17034 and ISO/IEC 17025. This CRM was prepared to the certified concentrations shown above by gravimetric methods using single-element concentrates that were certified using the "High Performance ICP-OES" protocol developed by NIST and are directly traceable to the NIST SRMs listed below. This solution was stabilized using high purity nitric acid (HNO₃) and diluted with filtered (0.22µm), 18 M-ohm deionized water. The balances used in the preparation of this CRM are calibrated regularly with traceability to NIST. All volumetric dilutions are performed in Class A calibrated glassware. The certified concentrations were determined based upon gravimetric procedures. Secondary verification of the certified concentrations was performed using ICP-OES that was calibrated and/or referenced against NIST SRMs: 3101a, 3103a, 3104a, 3108, 3113, 3112a, 3114, 3141a, 3132, 3134, 3136, 3128, 3149, 3153a, and 3168a. The uncertainty associated with each certified concentration represents the expanded uncertainty at the 95% confidence level using a coverage factor of k=2.

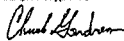
Instructions for Use: Agilent recommends that the solution be thoroughly mixed by repeated shaking or swirling of the bottle immediately prior to use. To achieve the highest accuracy the analyst should: (1) use only pre-cleaned containers and transferware, (2) avoid pipetting directly from the CRM's original container, (3) use a minimum sub-sample size of 500µL, (4) make dilutions using calibrated balances or certified volumetric class A flasks and pipettes, (5) dilute to volume using the same matrix as the original CRM, and (6) never pour used product back into the original container. The solution should be kept tightly capped and stored under normal laboratory conditions. Do not freeze, heat, or expose to direct sunlight. Minimize exposure to moisture or high humidity.

Document Name: Certificate of Analysis Wavelength calibration solution



Period of Validity: Agilent ensures the accuracy of this solution until the expiration date shown below, provided the instructions for use are followed. During the period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution.

Sample lot approval:


Chuck Goudreau, Certifying Officer

Date of release: 18 October 2022

Date of expiration: 30 April 2024

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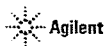
Date: November 28, 2023 1:10:31 PM
System ID: MY15330001

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Date: November 28, 2023 1:10:31 PM
System ID: MY15330001

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Document Name: Certificate of Analysis Wavelength calibration solution



Hazard Information: Refer to the Safety Data Sheet (SDS), which can be obtained at www.agilent.com/chem/pds.

Homogeneity: This solution was determined to be homogeneous by procedures consistent with the requirements of ISO 17034 and ISO Guide 35. Replicate samples of the finished solution were analyzed to confirm its homogeneity, in accordance with USP 6-13 Assayment of Homogeneity and Stability. To ensure homogeneity, users should not take a smaller sub-sample than specified in the instructions for use, as doing so will invalidate the certified values and uncertainties.

Further information: Please contact Agilent for further information about this CRM.

Quality Certifications: This CRM was prepared under a quality management system that is:

- Registered to ISO 9001 – Quality Management Systems – Requirements (TUV NORD Cert. Reg. No. 44 100 18560231)
- Accredited to ISO 17034 – General Requirements for the Competence of Reference Material Producers (A2LA Cert. No. 2848.02)
 - ISO 17034 references additional requirements specified in ISO Guide 31 and ISO Guide 25.
- Accredited to ISO/IEC 17025 – General Requirements for the Competence of Testing and Calibration Laboratories (A2LA Cert. No. 2848.01)
- LGC Standards, 218 Abbey Road, Winchester, NH 02142

Document Name: Certificate of Analysis Wavelength calibration solution

Electronic Signature

Purpose

This signature page was created and published because the ACE sign-off action was executed, which is valid for the entire document, including attachments. The ACE sign-off is an electronic signature that requires two distinct identification components: unique username and personal password. The Agilent representative who has delivered this service understands the meaning and legal status of an electronic signature. As a trained official operator, the Agilent representative has a unique password and logon to access ACE and electronically sign this document. (Other e-signatures can be applied to this document using a Document Content Management or other suitable method defined in your data access and control procedures.)

Details

Full Name of Signer: Worawit Timakul
Logged On User Name: worawit.timakul@agilent.com
Signature Creation Date: November 28, 2023
Reason for Signature: Executed protocol and published this original version of document

Regulatory Disclaimer

This document provides a protocol to verify and record instrument configuration and evidence of proper operation. It has been prepared from our interpretation of applicable regulations as well as industry best practices. The document is designed to provide an important component of a complete compliance package. Validation depends upon many factors and use of this protocol alone does not assure compliance. Agilent Technologies makes no promises or representations as to its sufficiency for any specific regulatory program.

Warranty

Agilent Technologies makes no warranty of any kind to this material, including but not limited to, the implied warranties or merchantability and fitness for a particular purpose. Agilent Technologies shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance, or use of this material.

User Name: worawit.timakul			System Id: MY15330001	
Report Generated by Hostname: 5CG0202NQ4			Print Date: November 28, 2023 1:10:41 PM	
OQHW ICP 5100 ENVI Research Transaction log :				
Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 28, 2023 12:54:08 PM	Audit	SessionCreated	Session	None
November 28, 2023 12:54:08 PM	Start	Configuration	Session	None
November 28, 2023 12:54:08 PM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
November 28, 2023 12:54:32 PM	Audit	EqpLoaded	Session	EQP details for primary technique [Es] - File path: [ProtocolPacks/Es/Configurations/02.50/Es.02.50.eqp], EQP File Name: [Es.02.50.eqp], EQP Name: [AgilentRecommended], Protocol Revision :[Es.02.50]
November 28, 2023 12:54:38 PM	End	Configuration	Session	None
November 28, 2023 12:54:41 PM	Start	Qualification	Session	OQ
November 28, 2023 12:54:41 PM	Start	Execution	Preparation : 5100 VDV; Qualitative Test - No setpoints associated	None
November 28, 2023 12:56:26 PM	End	Execution	Preparation : 5100 VDV; Qualitative Test - No setpoints associated	Run Count : 1
November 28, 2023 12:56:27 PM	Start	Execution	Instrument Tests : 5100 VDV; Qualitative Test - No setpoints associated	None
November 28, 2023 12:56:57 PM	End	Execution	Instrument Tests : 5100 VDV; Qualitative Test - No setpoints associated	Run Count : 1

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User Name: worawit.timakul
Report Generated by Hostname: 5CG0202NQ4

System Id: MY15330001
Print Date: November 28, 2023 1:10:41 PM

OQHW ICP 5100 ENvI Research Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 28, 2023 12:57:03 PM	Start	Execution	Autosampler Operation ; Autosampler 1 - SPS4; Qualitative Test - No setpoints associated	None
November 28, 2023 12:57:08 PM	End	Execution	Autosampler Operation ; Autosampler 1 - SPS4; Qualitative Test - No setpoints associated	Run Count : 1
November 28, 2023 12:57:09 PM	End	Qualification	Session	OQ
November 28, 2023 12:57:09 PM	Start	Reporting	Session	None
November 28, 2023 1:04:49 PM	Audit	AceRestarted	Session	None
November 28, 2023 1:04:50 PM	Audit	SessionReloaded	Session	None
November 28, 2023 1:04:58 PM	Start	Qualification	Session	OQ
November 28, 2023 1:08:10 PM	Audit	Reporting	Session	Report Generated : Certificate
November 28, 2023 1:09:28 PM	Audit	Reporting	Session	Report Generated : Report

User Name: worawit.tmakul
Report Generated by Hostname: 5CG0202NQ4

System Id: MY15330001
Print Date: November 28, 2023 1:10:41 PM

OQHW ICP 5100 ENVI Research Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 28, 2023 1:10:31 PM	Audit	Reporting	Session	Report Signed : Certificate PDF Name: OQHW/ICP 5100 ENvi Research_20231128_Certificate_1.pdf User Name: worawit.timakul@agilent.com Full Name of Signer: Worawit Timakul Reason for signature: Executed protocol and published this original version of document



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert.No.: 24CHO1
Page.: 1 of 3



Cert. No. : 24CHO1

Page : 2 of 3

Certificate of Calibration

Equipment : UV-VIS Spectrophotometer
Manufacturer : PerkinElmer
Model : Lambda 365+
Serial No. : 365PK22072603
ID No. : ERTC-L-In.-180
Condition As-Received: Used Item
Received Date : 03 January 2024
Calibration Date : 03 January 2024
Reference : 2401-0001ON-17
Submitted by : Environment Research & Technology Company Limited.
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,
Toongsonghong, Laksi, Bangkok 10210
Calibration Place : ห้องปฏิบัติการวิเคราะห์ Spectrophotometer
Ambient Temperature : (24.5 - 25.2) °C (On-Site)
Relative Humidity : (53.7 - 60.2) % (On-Site)
Calibration Procedure : In - house method :
CP-OCH4 based on ASTM E 275-01

Calibrated by : Kunchit Promprat

Approved by :


Approved Signatory

() Saithip Meangmai
() Warakorn Lernagatrakul
(X) Ponpan Paipim

Issue Date : 16 January 2024

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full, except with the prior written
Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

Condition of calibration result

1. Reference Standard Material :

Material	Serial No.	Certificate No.	Due date
1. Absorbance Standard set	32588	103225	08 Jul 2024
2. Absorbance Standard set	32592	104226	04 Aug 2024
3. Absorbance Standard set	8331	105939	28 Sep 2024
4. Wavelength Standard set	8417	100498	25 Mar 2024
5. Wavelength Standard set	8418	100499	25 Mar 2024
6. Stray Light Standard set	8419	108963	01 Feb 2025

2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This certificate is traceable to the International System of Unit maintained through :
- Starna Scientific Ltd.

4. Spectral BandWidth : 1 nm
Scan Speed : 30 nm/min

Calibration Results : without adjustment

Wavelength Accuracy

Certified Values of Reference Material (nm)	UUC Reading (nm)	Uncertainty of Measurement (± nm)	Coverage Factor k
360.89	360.89	0.12	2.00
459.99	460.16	0.12	2.00
536.52	536.36	0.12	2.00
638.00	637.58	0.12	2.00
879.41	879.48	0.12	2.00



Cert. No. : 24CHO1

Page : 3 of 3

Calibration Results : without adjustment

Photometric Accuracy

Wavelength (nm)	Certified Values of Reference Material (Abs)	UUC Reading (Abs)	Uncertainty of Measurement (\pm Abs)	Coverage Factor <i>k</i>
350.0	Zero	0.0000	0.0046	2.00
	0.4253	0.4238	0.0051	2.00
	Zero	0.0000	0.0050	2.00
	0.6389	0.6389	0.0056	2.00
546.1	Zero	0.0000	0.0028	2.00
	0.5224	0.5241	0.0028	2.00
	0.6856	0.6839	0.0028	2.00
	0.9937	0.9925	0.0028	2.00
635.0	Zero	0.0000	0.0028	2.00
	0.5397	0.5407	0.0028	2.00
	0.6832	0.6812	0.0028	2.00
	0.9886	0.9871	0.0028	2.00

Stray Light

* Straylight at 260.74 nm \pm 0.11 nm	Reading at 260.74 nm \pm 0.11 nm
Abs	2.2103
%T	0.5666

Remark

- Each individual filter is measured against the empty filter holder (blank) used to zero the spectrophotometer
- The Potassium Dichromate filled cells are measured against a Perchloric acid blank.
- Cut-off wavelength of stray light reference material (Potassium Iodide) at wavelength 260.74 nm \pm 0.11 nm
- Result = Pass, If Absorbance > 2.00 Abs and Transmission < 1.0 %T at Wavelength 260.74 nm \pm 0.11 nm
- * : Not NSC-ONSC Accredited

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

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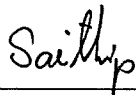
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TEL. 0-2717-3000 FAX. 0-2719-9484

Cert.No.: 24TW2

Page.: 1 of 2

Certificate of Testing

Equipment :	DO Meter
Manufacturer :	YSI
Model :	Pro2030
Serial No. :	21H104437
ID No. :	-
Received Date :	05 January 2024
Test Date :	08 January 2024
Reference :	2401-0077DN-10
Submitted by :	Environment Research & Technology Company Limited. 25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road, Toongsonghong, Laksi, Bangkok 10210
Laboratory Condition :	Temperature (25 ± 5) °C Humidity (50 ± 20) %
Test Procedure :	In - house method : CP-CH9 by Comparison Technique with Azide Modification Method
Tested by :	Walalak Sirithean
Approved by :	<div style="text-align: center;"> _____ Approved Signatory</div>
<div><input checked="" type="checkbox"/> Saithip Meangmai <input type="checkbox"/> Warakorn Lerngagtrakul <input type="checkbox"/> Ponpan Paipim</div>	
Issue Date :	10 January 2024

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Cert.No.: 24TW2

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

This certification is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center, Technology Promotion Association (Thailand-Japan).

<u>Instruments</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Burette	-	130BU10	23CG1172	22 Mar 2025
2) Balance	1124013382	140RC006	23MM18	20 Feb 2024

2. Standard Material :-

<u>Material</u>	<u>Manufacturer</u>	<u>Lot.No.</u>	<u>Assay</u>
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 21G100097

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.18	8.18	0.0055

This report was certified only for the instrument we tested. It is allowable to use for study the system efficiency, The environmental impact control and present to organization it may concerned. Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced other in full, without written approval of the laboratory

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Saitthip

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Cert.No.: 24CH11

Page.: 1 of 2

Certificate of Calibration

Equipment :	Conductivity Meter
Manufacturer :	HM DIGITAL
Model :	COM-100
Serial No. :	PONPE5851661
ID No. :	NO.5
Condition As-Received:	Used Item
Received Date :	05 January 2024
Calibration Date :	08 January 2024
Reference :	2401-0077DN-7
Submitted by :	Environment Research & Technology Company Limited. 25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road, Toongsonghong, Laksi, Bangkok 10210
Ambient Temperature :	$(25 \pm 2.5) ^\circ\text{C}$
Relative Humidity :	$(50 \pm 15) \%$
Calibration Procedure:	In -house method : - CP-CH6 : based on direct measurement by using certified reference material (CRM)
Calibrated by :	Walalak Sirithean

Approved by :

Approved Signatory

- ☒ Saithip Meangmai
☐ Warakorn Lerngagtrakul
☐ Ponpan Paipim

Issue Date :

10 January 2024

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

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Cert.No.: 24CH11

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instrument :-

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Certificate No.</u>	<u>Due date</u>
1) Thermometer	9549224	130RC003	23I435	10 Apr 2024

- This Certification is traceable to SI Through Technology Promotion Association (Thailand - Japan)

2. Certified Reference Materials :-

- Conductivity calibration solution, CPA chem Ltd., The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835
- Conductivity calibration solution, Thermo Scientific (traceable to NIST)

<u>Conductivity Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
*100 $\mu\text{S/cm}$	Thermo Scientific	193/01	11 May 2024
1413.0 $\mu\text{S/cm}$	CPA Chem	931955	30 Sep 2024

- Control Conductivity calibration solution temperature by Water bath (25 ± 0.1) $^{\circ}\text{C}$

3. This certificate is valid only to the item calibrated on date and place of calibration.

Calibration results

Function : Conductivity Measurement

(*) After Adjustment at 1413.0 $\mu\text{S/cm}$

Conductivity Electrode Serial No.: PONPE5851661

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (\pm)	Coverage factor k
*100 $\mu\text{S/cm}$	97.0 $\mu\text{S/cm}$	98.8 $\mu\text{S/cm}$	5.1 $\mu\text{S/cm}$	2.00
1413.0 $\mu\text{S/cm}$	1170 $\mu\text{S/cm}$	1410 $\mu\text{S/cm}$	11 $\mu\text{S/cm}$	2.00

Remark

- UUC* = Unit Under Calibration

- * = Not NSC - ONSC Accredited

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

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Saitthip

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