

เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์

Wavelength accuracy			
Cu at 324.8 nm	323.0 nm – 326.0 nm	324.7 nm	Pass
As 193.7 nm	192.0 nm – 195.0 nm	193.7 nm	Pass
K at 766.5 nm*	765.0 nm – 768.0 nm	766.5 nm	Pass
Other.....			
High solids nebulizer setting**			
Uptake rate	7.2 – 10.6 ml / min	9.0 ml/min	Pass
Max Abs	≥ 0.75 Abs	0.77 Abs	Pass
Precision(%RSD)	≤ 0.5 %	0.4 %	Pass
Zeeman Background Correction Accuracy (%)*			
BCA @ Au 242.8 nm	< 3.7 %	***	***
Zeeman Magnetic Sensitivity Ratio (%)***			
MSR @ Cu 324.7 nm	> 70 %	***	***
Characteristic mass and sensitivity ****			
Sensitivity	≥ 0.21 Abs	****	****
Precision (%RSD)	≤ 4.0 %	****	****

* for Wideband PMT (Wavelength 190nm – 900nm)

** for Flame system

*** for Zeeman system

**** for Graphite furnace system

CALIBRATED BY : 
 Signature: 
 Engineer : Suriya Nacharoen
 Date : 23 / Dec / 2021

APPROVED BY : 
 Signature: 
 Service Manager : Suchai Sangraklatichai
 Date : 23 / Dec / 2021

ATOMIC ABSORPTION SPECTROMETER TEST CERTIFICATE

Certificate No : SV2112/20035
 Instrument Type : ATOMIC ABSORPTION SPECTROMETER
 Model : AA 240
 Serial Number : AA0909M072
 Organization : S.P.J. Scientific Co., Ltd.
 Address : 80 Soi Nakkeera Lamhong 3, Thap Chang, Sapausoong, Bangkok 10250
 Date : 23 Dec 2021

Hollow cathode lamps used

Element	Lamp number	Comments
Arsenic	56-101003-00	
Copper	56-101014-00	
Potassium	56-101042-00	
Gold	56-101021-00	

Test description	Specification	Result	Comments
Light throughput (% Gain) or (EHT)			
Cu at 324.8 nm	≤ 64 % or 380 V	41 %	Pass
As at 193.7 nm	≤ 80 % or 540 V	67 %	Pass
K at 766.5 nm*	≤ 84 % or 540 V	56 %	Pass
Other.....			
Photometric noise Cu BGC off			
STDV @ 0	≤ 0.0005	0.0001	Pass



Certificate of Analysis

Certified Reference Material



ISO 9001:2015 Accredited
Certificate Number AT-1326

Product Description:

Copper

100014-1

Lot Number:

1833105

2% (w/v) JINCO₃

Certified Value:

Element	Unit/mL	SRM ID	SRM Lot#
Copper	1000 ± 3	3114	121207

The Certified value is based on gravimetric and volumetric preparation, and verified against NIST SRM 3100 series when available via inductively coupled plasma optical emission spectrometry (ICP-OES) and/or inductively coupled plasma mass spectrometry (ICP-MS) using an internal laboratory-developed method. The uncertainty in the certified value is calculated for a 95% confidence interval and coverage factor k is about 2.

*Under the Traceability Information Section of the Certificate

1.014 g/mL ± 0.002 g/mL @ 20.0°C ± 0.3 °C

Uncertified Values:

Trace Metal Impurity Status: The data reported are based upon a scan of this specific lot via ICP-OES/ICP-MS analysis. The values are reported in µg/L.

Ag	< 0.02	Cu	< 0.02	Li	< 0.02	Rb	< 0.02	Th	< 0.02
Al	< 0.05	Dy	< 0.02	La	< 0.02	Rc	< 0.02	Ti	< 0.02
As	< 0.05	Er	< 0.02	Mg	< 0.1	Rh	< 0.02	Tl	< 0.02
Au	< 0.02	Fe	< 0.02	Mn	< 0.05	Ru	< 0.02	Tm	< 0.02
B	< 1	Fe	< 1	Mo	< 0.02	Sb	< 0.02	U	< 0.05
Ba	< 0.02	Ga	< 0.02	Na	< 5	Se	< 0.02	V	< 0.05
Be	< 0.02	Gd	< 0.02	Nb	< 0.02	Sc	< 0.1	W	< 0.02
Bi	< 0.02	Ge	< 0.02	Nd	< 0.02	Si	< 5	Y	< 0.02
Cd	< 0.02	Hf	< 0.02	Ni	< 0.1	Sm	< 0.02	Yb	< 0.02
Ce	< 0.02	Ho	< 0.02	Os	< 0.02	Sn	< 0.5	Zn	< 5
Co	< 0.02	In	< 0.02	Pb	< 0.5	Sr	< 0.02	Zr	< 0.02
Cr	< 0.05	Ir	< 0.02	Pd	< 0.02	Ta	< 0.02		
Cs	< 0.02	Lr	< 0.02	Pt	< 0.02	Tb	< 0.02		

Packaging and Storage Conditions:

The standard is packaged in a pre-sterilized polyethylene bottle. To maintain the integrity of this product, the solution should be kept tightly capped and stored under normal laboratory conditions.

Expiration Information:

The expiry date is guaranteed to be valid for eighteen months from the shipping date provided and is guaranteed through the month of expiration. For this reason, standards from the same lot may have different expiration dates.

Shipped Date: January 2019

Certificate Issue Date: December 10, 2018

Maven Mutumani

Maven Mutumani, Ph.D., Laboratory Manager

Preparation Information:

This standard is prepared using 99.9999% pure copper metal which was purchased from a qualified vendor per ISO 9001:2008 guidelines and assayed by analytical methods for conformity prior to use. This standard was manufactured under appropriate laboratory conditions using the methods developed at NIST for SRM Spectrometric Standard Solutions. Sub-boiling distilled high-purity acid has been used to place the materials in solution and to stabilize the standard. The matrix is as noted above in 18 megohm deionized water.

Stability of this product is based upon rigorous short-term and long-term testing of the solution for the certified value. This testing includes, but is not limited to, the effect of temperature and packaging on the product. If during the period of validity, a recall is instituted due to substantial changes in the stability of this product, the purchaser will be notified.

Homogeneity:

This product is determined to be homogeneous following in-house procedures developed in accordance with the requirements of ISO Guide 34 and ISO Guide 35.

Intended User:

This product is intended for use as a calibration standard, quality control standard, and/or for the validation of analytical methods. The standard is confirmed homogeneous; therefore, the minimum sample size should be consistent with the end user's measurement capabilities.

Traceability Information:

The traceability of this standard is maintained through an unbroken chain of comparisons to appropriate standards with suitable procedure and measurement uncertainties. The maintenance of the base and derived units of International System of Units (SI) with traceability of measurement results (contemporary metrology) to SI ensures their comparability over time as follows.

a. Standard Weight and Analytical Balance

The standard weights (NBS weights Inventory No 20231A) are calibrated every two years by South Carolina Metrology Laboratory that is a participant in "NIST Weights and Measures Measurement Assurance Program" with a certificate of measurement traceability to NIST primary standards.

The balances are calibrated yearly by the ISO 17025 accredited metrology service, and are verified weekly by an in-house method using standard weights.

b. Volumetric Device

The calibration of volumetric vessels are verified using the ASTM method E342.

c. Thermometer

The standard thermometers are calibrated every year by the ISO 17025 accredited metrology service. The thermometers used in-house are verified against the standard thermometers yearly.

d. Calibration Standard:

The Calibration Standard is traceable to SRM 3100 Series Spectrometric Standard Solutions. If an SRM is not available, a second source standard or independent lot is used.

Refer to Safety Data Sheet (SDS) for Hazardous Information.

NOTICE: Users should not handle this standard without being trained and using proper personal protection. The responsibility for the safe handling and use of these products rests solely with the buyer and user. The data and information contained herein are provided for informational purposes only and are not intended to be used as a substitute for the manufacturer's instructions. The information provided in this certificate pertains only to the lot number specified. None of the information provided in this certificate may be used, reproduced or transmitted in any form or by any means without written approval from High-Purity Standards.

Suriya Nacharoen
has completed *Customer Support and Basic Application* Training on
AA Instrument & Accessories
and is authorised to support this product

Approve by _____

Trainer, Burin Ngamvith
 August 2007
 Refer to training course by varian
 Australia
 Thainique
 80-82 Prachabpatai Rd., Bangkokunprum
 Pranakorn Bangkok , Thailand

[illegible]



CRYSTAL CALIBRATION SALES AND SERVICE CO., LTD.
45/48 Soi Salathammassop 31, Salathammassop Rd.,
Salathammassop, Thawewatthana, Bangkok 10170 Thailand
Tel : 0-2408-8474-5 Fax : 0-2408-8477 Email : info@crystalcal.com www.crystalcal.com



CERTIFICATE OF CALIBRATION

Certificate No. : 22-918-006
Work Order No. : 22/918

Issue Date : 4 August 2022

Details of Calibration

1. Reference Standards Instrument

Instrument	Serial No.	Certification	Due Date
1.1 Chilled Mirror Hygrometer	157966 / 157152	TH-0109-21	09 November 2022
1.2 Digital Thermometer with RTD	15000016 / RTD-11	21-910-005	22 October 2022

2. Certificate traceable

: This certificate traceable to The International System of Unit refer to
No. 1.1 National Institute of Metrology (Thailand), NAC Calibration No. 0144
No. 1.2 Crystal Calibration Sales and Service Co., Ltd., NAC Calibration No. 0260

3. Condition of item

: Used

4. Calibration location

: Permanent

Result of Calibration

1. Temperature Measurement : Without Adjustment

Calibration Point (°C)	Average Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty ± (°C)
20	20.011	20.1 0.7564	- 0.09	0.30 0.361
25	25.025	25.1 0.115	- 0.08	0.30 0.319
30	30.009	30.1 0.071	- 0.09	0.30 0.371

Resolution of UUC : 0.1 °C

2. Humidity Measurement : Without Adjustment

Calibration Point (%RH)	Calculated Standard Reading (%RH)	UUC Reading (%RH)	Correction (%RH)	Uncertainty ± (%RH)
40	40.15	42.0 1.852	1.85	1.6 3.46
50	50.22	52.0 1.772	- 1.78	1.6 3.92
60	60.09	62.0 1.911	1.91	1.6 4.14

Resolution of UUC : 1 %RH

Note : 1. Process calibration humidity measurement Reference temperature control at 25°C

2. Calculated STD humidity refer to dewpoint temperature and convert to humidity by Magnus's Equation

3. Calibrate items if good condition and this report customer request and accepted in certificate

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

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

-END-

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CERTIFICATE OF CALIBRATION

Certificate No. : 22-918-006
Work Order No. : 22/918

Issue Date : 4 August 2022

Customer Name : S.P.J.Scientific Co., Ltd.

80 Soi Saphansong, Saphansong, Bangkok 10250

Date of Received : 10 July 2022

Date of Calibration : 12 July 2022

Instrument Details : Description : Digital Thermo hygrometer

Manufacturer : N/A

Model : HTC-02

Serial No. : HTC216214

ID No. : N/A

Location : Humidity and Temperature Laboratory

Calibration Method : This instrument was calibrated by comparison of indication with Standard Chilled Mirror Hygrometer and Standard Thermometer into Temperature and Humidity Chamber controller according to calibration procedure no. CWH-H-01

Environmental Condition

Temperature : Laboratory Control at 23°C ± 3°C

Humidity : Laboratory Control at 55%RH ± 20%RH

Traceability of Measurement

: This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI) and The temperature scale in use at this laboratory is The International Temperature scale of 1990.

Calibrated by : Mr. Wuttinun Yindeepot
Calibration Engineer

Approved by : (Mr. Anuwat Yakemjit)
Laboratory Manager

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Crystal Calibration Sales and Service Co., Ltd.
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CERTIFICATE OF CALIBRATION

Certificate No. : 22-918-007
Work Order No. : 22/918

Issue Date : 4 August 2022

Details of Calibration

1. Reference Standards Instrument

Instrument	Model	Serial No. / ID No.	Certification	Due Date
Thermometer Readout	1529	BSC038	PSL-T 0660/65	21-Jun-2023
Platinum Resistance Thermometers (PRTs)	5609	02709	PSL-T 0660/65	21-Jun-2023

2. Certificate traceable : This certificate traceable to The International System of Unit (SI unit)

3. Condition of equipment : Used

4. Calibration site : Permanent

Result of Calibration

Calibration result : Without Adjustment

Calibration point (°C)	STD. Value (°C)	UUC Reading (°C)	Correction value (°C)	Uncertainty ± (°C)
20	20.0015	20.1 0.094	-0.0985	0.10 0.1%
25	25.0025	25.1 0.094	-0.0975	0.10 0.1%
30	30.0035	30.1 0.094	-0.0945	0.10 0.1%

Note : Calibrate items in good condition and this report customer request and accepted in certificate

Sheath Material : Teflon ID No. : N/A S/N No. : N/A
Immersion Depth : 130 mm Dimension of Sensor : 4 Length : 1 metres
UUC : Unit Under Calibration.

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

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

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CERTIFICATE OF CALIBRATION

Certificate No. : 22-918-007
Work Order No. : 22/918

Issue Date : 4 August 2022

Customer Name : S.P.J.Scientific Co.,Ltd.

80 Soi Saphansoong,
Saphansoong, Bangkok 10250

Date of Received : 10 July 2022

Date of Calibration : 12 July 2022

Instrument Details : Description : Digital Thermometer with RTD

Manufacturer : N/A

Model : HTC-02

Serial No. : N/A

ID No. : HTC216214

Resolution : 0.1 °C

Location : Temperature and Humidity Calibration Laboratory

Calibration Method : This instrument was calibrated by comparison of indication with Standard

Thermometer into calibration bath temperature controller according to calibration procedure no. CWI-T-09

Environmental Condition

Temperature : Laboratory Control at 23°C ± 3°C

Humidity : Laboratory Control at 55%RH ± 20%RH

Traceability of Measurement

: This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the international system of Units (SI) and The temperature scale in use at this laboratory is The International Temperature scale of 1990.

Calibrated by : Mr. Wuttinun Yindeepot

Calibration Engineer

Approved by :

(Mr. Anuwat Yakermjit)

Laboratory Manager

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NAC-TS-17025
CALIBRATION 0260

CERTIFICATE OF CALIBRATION

Issue Date : 4 August 2022 Certificate No. : 22-918-005
Work Order No. : 22/918

Details of Calibration

1. Reference Standards Instrument

Instrument	Serial No.	Certification	Due Date
1.1 Chilled Mirror Hygrometer	157966 / 157152	TH-0109-21	09 November 2022
1.2 Digital Thermometer with RTD	15000016 / RTD-11	21-970-005	22 October 2022

2. Certificate traceable

: This certificate traceable to The International System of Unit refer to

No. 1.1 National Institute of Metrology (Thailand), NAC Calibration No. 0144

No. 1.2 Crystal Calibration Sales and Service Co., Ltd., NAC Calibration No. 0260

3. Condition of item

: Used

: Permanent

Result of Calibration

1. Temperature Measurement : Without Adjustment

Calibration Point (°C)	Average Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty \pm (°C)
20	20.011	20.2	-0.19	0.30
25	25.025	25.2	-0.18	0.30
30	30.009	30.2	-0.19	0.30

2. Humidity Measurement : Without Adjustment

Calibration Point (%RH)	Calculated Standard Reading (%RH)	UUC Reading (%RH)	Correction (%RH)	Uncertainty \pm (%RH)
40	40.15	44.0	-3.85	1.6
50	50.22	53.0	-2.78	1.6
60	60.09	62.0	-1.91	1.6

Note : 1. Process calibration humidity measurement Reference temperature control at 25°C

2. Calculated STD humidity refer to dew-point temperature and convert to humidity by Magnus's Equation

3. Calibrate items it good condition and this report customer request and accepted in certificate

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

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

—END—

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NAC-TS-17025
CALIBRATION 0260

CERTIFICATE OF CALIBRATION

Issue Date : 4 August 2022 Certificate No. : 22-918-005
Work Order No. : 22/918

Customer Name

: S.P.J.Scientific Co.,Ltd.
80 Soi Saphansong,
Saphansong, Bangkok 10250

Date of Received

: 10 July 2022

Date of Calibration

: 12 July 2022

Instrument Details

: Description : Digital Thermo hygrometer

: Manufacturer : Digicon

: Model : TH-02

: Serial No. : 135049863

: ID No. : N/A

: Location : Humidity and Temperature Laboratory

Calibration Method : This instrument was calibrated by comparison of indication with Standard Chilled Mirror Hygrometer and Standard Thermometer into Temperature and Humidity Chamber controller according to calibration procedure no. CWH-H-01

Environmental Condition

Temperature : Laboratory Control at 23°C \pm 3°C

Humidity : Laboratory Control at 55%RH \pm 20%RH

Traceability of Measurement

: This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI) and The temperature scale in use at this laboratory is The International Temperature scale of 1990.

Calibrated by : Mr. Wuttinun Yindeepot

Calibration Engineer

Approved by :

(Mr. Anuwat Yaklermjit)

Laboratory Manager

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Certificate No.: C06210593

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Calibration Results:
Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 5 nm and UUC at 5 nm			
Standard Wavelength	Unit Under Calibration	Correction	Uncertainty
418.40	418	0.40	0.59
537.00	537	0.00	0.59
638.00	638	0.00	0.59
747.61	748	-0.39	0.59
807.04	807	0.04	0.59

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5816	0.578	0.0036	0.0045
	0.7130	0.710	0.0030	0.0045
	1.0151	1.011	0.0041	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.5849	0.561	0.0039	0.0045
	0.7012	0.698	0.0032	0.0045
	0.9982	0.994	0.0042	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.5249	0.524	0.0009	0.0045
	0.6621	0.662	0.0001	0.0045
	0.9420	0.941	0.0010	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5214	0.520	0.0014	0.0045
	0.6982	0.698	0.0002	0.0045
	0.9947	0.995	-0.0003	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5549	0.553	0.0019	0.0045
	0.7736	0.771	0.0026	0.0045
	1.1041	1.100	0.0041	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.5621	0.561	0.0011	0.0045
	0.7830	0.782	0.0010	0.0045
	1.0890	1.085	0.0040	0.0045

The End of Certificate

บริษัท เอสพีซี แล็บ จำกัด
SPC RT CO., LTD.
เลขที่ 00003 1194 ซอย Wachirathamsohit 57, Sukhumvit 101/1 Rd.,
Bangchak, Prakhonong, Bangkok 10260 Thailand
Tel: 0 285 4333 Ext. 3300-3308 Fax: 0 285 4424 E-mail: info.spc@spc.com Website: www.spc.com

SPCC-FM-C06-12: 23 Nov 2020



Certificate of Calibration

Equipment: SPECTROPHOTOMETER

Model: DR 3900
Serial No. (or ID.): 2106441
Manufacturer: HACH
Condition: New

Certificate No.: C06210593

Issued Date: 23 December 2021

Job No.: KSPR2116344

Page: 1 of 2

Customer: S.P.J. Scientific Co., Ltd.
80 Soi Nakkeera Lamthong 3, Thap Chap,
Saphansong, Bangkok 10250

Environment Conditions: Temperature 23 °C ± 2 °C
Humidity 50 %RH ± 15 %RH

Calibration Place: Environment Laboratory, SPC RT Co., Ltd.
1194 Soi Wachirathamsohit 57, Sukhumvit 101/1 Rd.,
Bangchak, Prakhonong, Bangkok 10260 Thailand

Calibration By: Mr.Pradit Siriboot
Calibration Date: 09 December 2021
The Method used: In house method, SPCC-WI-24, base on ASTM E 275-08 and ASTM E 387-04

Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Starna Scientific Limited.

The standard for Wavelength Certificate No. 93907 and 93914
The standard for Photometric Certificate No. 94010

Person in charge
(Mr. Pradit Siriboot)

SPC Calibration Center
SPC RT Co., Ltd.

Authorized signatory
(Mr. Dumrong Boonsapont)

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 added 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. This report shall not be reproduced except in full without approval of SPC RT Co., Ltd.

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Tel: 0 285 4333 Ext. 3300-3308 Fax: 0 285 4424 E-mail: info.spc@spc.com Website: www.spc.com

SPCC-FM-C06-12: 23 Nov 2020



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CERTIFICATE OF CALIBRATION

Certificate No. : 22-1358-005
Work Order No. : 22/1358

Issue Date : 10 October 2022

Details of Calibration

1. Certified Reference Material / Certified of Instrument

Certified Reference Material	CRM Code	Lot no.	Expire Date
1.1 Buffer Solution pH 4.00	TRM-S-2027	081020	29 August 2023
1.2 Buffer Solution pH 7.00	TRM-S-2034	300322	29 August 2023
1.3 Buffer Solution pH 10.00	TRM-S-2031	091020	29 August 2023

Instrument	Certificate no.	Serial No. / ID No.	Due Date
1.4 DC Source Calibrator	22E1250	20109000330	19 April 2023
1.5 Digital Thermometer with sensor	22-546-001	51159946/811	26 April 2023

2. This certificate traceable to the international unit (SI)

- Buffer solution no. 1.1 traceable to : Nation Institute of Metrology (Thailand)
Buffer solution no. 1.2 traceable to : Nation Institute of Metrology (Thailand)
Buffer solution no. 1.3 traceable to : Nation Institute of Metrology (Thailand)

Instrument no. 1.4 traceable to : Technology Promotion Association (Thailand-Japan) NAC Calibration No. 0008

Instrument no. 1.5 traceable to : Crystal Calibration sales and service Co., Ltd., NAC Calibration No. 0260

3. Condition of Item : Used

4. Calibration location : On-site

Result of Calibration

Measurement Function : mV Measurement /

Performing : Standard curve by Voltage calibrator at pH (4,7,10) /

Normal value	Applied DC voltage	Average Indicator reading		Uncertainty (±)	Coverage Factor
		mV	pH		
pH	mV			mV	k
0	414.1	414.0	0.00	0.083	2.00
2	295.9	295.8	2.00	0.083	2.00
4	177.5	177.5	4.00	0.083	2.00
7	0.0	0.0	7.00	0.083	2.00
9	-118.3	-118.3	9.00	0.083	2.00
10	-177.5	-177.5	10.00	0.083	2.00
12	-295.9	-295.8	12.00	0.083	2.00
14	-414.1	-414.1	14.00	0.083	2.00



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Tel : 0-2408-8474-5 Fax : 0-2408-8477 Email : info@crystalcal.com www.crystalcal.com



CERTIFICATE OF CALIBRATION

Certificate No. : 22-1358-005
Work Order No. : 22/1358

Issue Date : 10 October 2022

Customer Name : S.P.J.Scientific Co.,Ltd. /

80 Soi Saphansoong,

Saphansoong, Bangkok 10250

Date of Received : 5 October 2022

Date of Calibration : 5 October 2022

Instrument Details :	Description :	pH meter
	Manufacturer :	Hach
	Model :	HQ11D
	Serial No. :	200800040522
	ID No. :	N/A
	Resolution :	0.01 pH
	Location :	Laboratory

Calibration Method : This instrument was calibrated by in-house calibration procedure no. CWI-C-02 based on direct measurement by using standard voltage calibrator and certified reference material (CRM)

Environmental Condition

Temperature : Area Monitoring between 15°C to 40°C
Humidity : Area Monitoring between 30%RH to 85%RH

Traceability of Measurement

: This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI)

Calibrated by : Mr. Kritsada Kaewwanga
Calibration Engineer

Approved by :
(Mr. Anuwat Yaktarnjit)
Laboratory Manager

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Crystal Calibration Sales and Service Co., Ltd.

45/48 Salathammassop 31, Salathammassop Rd. Salathammassop, Thawewathana, Bangkok 10170

Phone : 0-2408-8474 Fax : 0-2408-8477 http://www.crystalcal.com Email : info@crystalcal.com





Accuracy Calibration Certificate

Customer

Company: S.P.I. SCIENTIFIC CO., LTD.
Address: 80 Soi Nukred-Lenthong 3
City: Saphangsong
Contact: Ratikorn Siripakda
Zip / Postal: 10240
State / Province: Bangkok
Order Number: 00332246410

Weighing Device

Manufacturer: Mettler Toledo
Model: ME204T00
Serial No.: B950781446
Building: N/A
Floor: 1
Room: BALANCE
Instrument Type: Weighing Instrument
SPL-TE-039
Asset Number: N/A
Terminal Model: N/A
Terminal Serial No.: N/A
Terminal Asset No.: N/A

Procedure

Calibration Guidelines: EURAMET cp-18 v. 4.0 (11/2015)
CFM00220
METTLER TOLEDO Work Instruction:
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 cp-18 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific calibration conditions.

As Found	Temperature		Humidity	
	Start: 23.2 °C	End: 23.3 °C	Start: 57.9 %	End: 60.1 %

As Found Calibration Date: 05-May-2022
As Left Calibration Date: N/A
Issue Date: 06-May-2022
Calibrator: Sakornkiet Anulomai
Approved Signatory: *Ratikorn Siripakda*
Technical Manager / Head of Calibration Center



CERTIFICATE OF CALIBRATION

Issue Date : 10 October 2022 Certificate No. : 22-1358-005
Work Order No. : 22/1358

Result of calibration

Measurement Function : pH Measurement with electrode
Performing : Three buffer standard curve using buffer nominal pH (4,7,10) *pH 4.7, 10*

STD buffer solution pH @ 25 °C	Average Indicator reading			Uncertainty (±)	Coverage factor k
	pH	mV	pH correction		
4.01	4.00	160.8	0.01	0.01	2.00
7.01	7.00	-11.5	0.01	0.01	2.00
10.00	10.00	-181.4	0.00	0.00	2.00

Descriptions of electrode:

Electrode Type : Combination Electrode
Manufacturer : HACH Model : N/A
Serial no. : 220772562511 ID No. : N/A

Detail of % slope form calculation

pH range	% Slope value	% Slope recommend
4 pH to 7 pH	97.08	95% - 105%
7 pH to 10 pH	96.05	

Note : Calibrate items in good condition and this report customer request and accepted in certificate

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

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

—END—

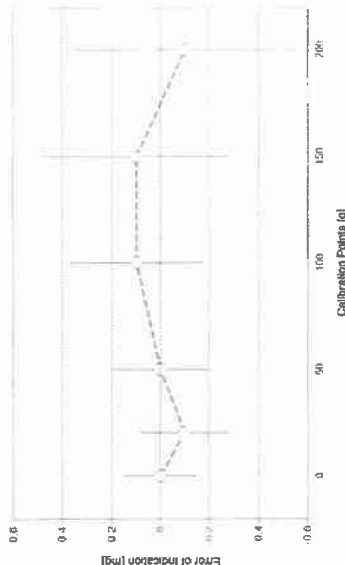
PAGE 3/3

Error of Indication

As Found	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.0000 g	0.15 mg	2
2	0.1000 g	0.1000 g	0.0000 g	0.16 mg	2
3	0.5000 g	0.5000 g	0.0000 g	0.16 mg	2
4	1.0000 g	1.0000 g	0.0000 g	0.16 mg	2
5	5.0000 g	5.0000 g	0.0000 g	0.16 mg	2
6	10.0000 g	10.0000 g	0.0000 g	0.17 mg	2
7	20.0000 g	19.9998 g	-0.0001 g	0.16 mg	2
8	50.0000 g	50.0000 g	0.0000 g	0.20 mg	2
9	100.0001 g	100.0002 g	0.0001 g	0.27 mg	2
10	150.0001 g	150.0002 g	0.0001 g	0.38 mg	2
11	200.0000 g	199.9999 g	-0.0001 g	0.44 mg	2

○ As Found
◆ As Left

For improved legibility of the graphics only increasing measurement points are shown and measurement points close to zero are not displayed.



The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor $k=2$ which can be larger than 2 according to EURAMET-08-18. 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.

Test Equipment

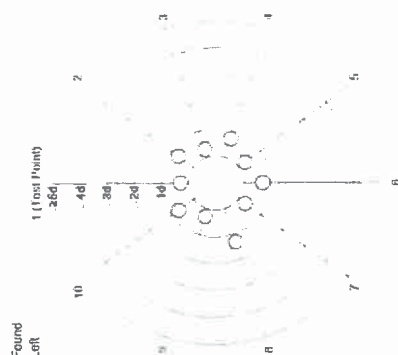
All weights used for metrological testing are traceable to national or international standards. The weights were calibrated and certified by an accredited calibration laboratory.

Weight Set 1: OIML E2			
Weight Set No.:	WS41	Date of Issue:	27-Jan-2021
Certificate Number:	171212	Calibration Due Date:	26-Jul-2022
Thermo Hygrometer			
Equipment No.:	IM159	Date of Issue:	09-Jul-2021
Certificate Number:	21114171	Calibration Due Date:	28-Jun-2022

Measurement Results

Repeatability

Test Load: 100 g	As Found	As Left
1	100.0001 g	N/A
2	100.0002 g	N/A
3	100.0001 g	N/A
4	100.0002 g	N/A
5	100.0001 g	N/A
6	100.0002 g	N/A
7	100.0001 g	N/A
8	100.0000 g	N/A
9	100.0001 g	N/A
10	100.0002 g	N/A
Standard Deviation	0.00007 g	N/A



The "g" 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	As Found	As Left
1	100.0002 g	N/A
2	100.0001 g	N/A
3	100.0002 g	N/A
4	100.0004 g	N/A
5	100.0003 g	N/A
Minimum Deviation	0.0002 g	N/A



The "g" in the graph represents the readability of this range interval in which the test was performed.

Remarks

FACT adjustment functionally 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: $2.0 \cdot 10^{-4} / K$

Temperature range on site for the evaluation of the measurement uncertainty in use: $4 K$

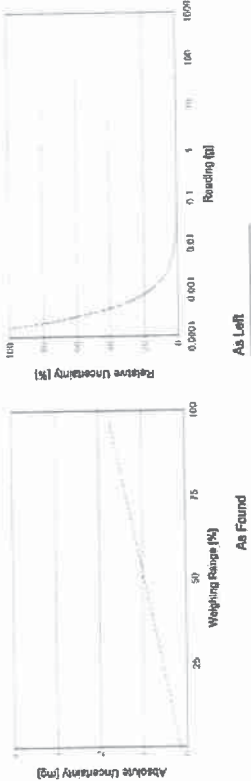
Uncertainties of Uncertainty Equation

Range	Min	Max	As Found	As Left
1	0.0001 g	220 g	$U_1 = 0.18 \text{ mg} + 0.00739 \text{ mg/g} \cdot R$	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	0.18 mg	0.73%
0.2200 g	0.18 mg	0.073%
2.2000 g	0.18 mg	N/A
22.0000 g	0.32 mg	0.0015%
220.0000 g	1.8 mg	0.00081%





CERTIFICATE OF CALIBRATION

Issue Date : 20 November 2021 Certificate No. : 21-1098-002
Work Order No. : 21/1098

Details of Calibration

1. Reference Standards Instrument

Instrument	Model	Serial No./Ins No.	Certificate No.	Due Date
Data Acquisition unit	34972A	MY48018270	20-1275-012	02 January 2022
Sensor type	RTD	RTD # 101-109	20-1275-012	02 January 2022

2. Certificate traceable

: This certificate traceable to The International System of Unit refer to
Crystal Calibration Sales and Service Co., Ltd., NAC Calibration No. 0260

3. Condition of Item

: Used

4. Calibration site

: On - Site

5. Result of Calibration

: Without adjustment

6. Evaluate Condition

: Time Constant : - Hour 31 Minute At cal. point 20 °C
Air vent : Off
Fan speed status : Fixed Fan Speed

7. Calibration note

: The results reported in this certificate refer to the condition of instrument on
this process into the steady state of chamber

8. Sensors Installation Diagram

: When : Sensor installation location in Chamber @ Working Space
A = Distance between sensor and wall of chamber is 10 cm

9. Dimensions of chamber

: W = 0.5 m ; D = 0.6 m ; H = 1.2 m

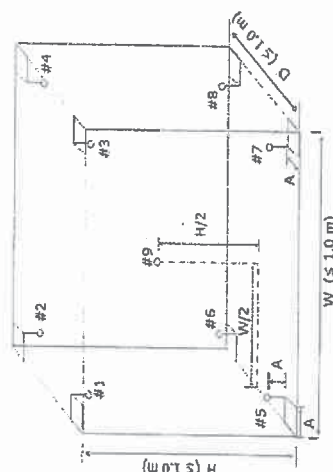


Diagram of Chamber



CERTIFICATE OF CALIBRATION

Issue Date : 20 November 2021 Certificate No. : 21-1098-002
Work Order No. : 21/1098

Customer Name

: S.P.J.Scientific Co.,Ltd.
80 Soi Saphansong,
Saphansong, Bangkok 10250
Date of Received : 12 November 2021
Date of Calibration : 12 November 2021

Instrument Details

: Description : Temperature Controlled Enclosures [Incubator] (๒๐๐)
Manufacturer : N/A
Model : N/A
Serial No. : N/A
ID No. : SPJ-TE-028
Resolution : 0.1 °C
Location : Laboratory

Calibration Method : This instrument was calibrated by insert standard thermometer into the chamber according to calibration procedure no. CWI-T-10 follow up to TLAS G-20-1/02-08 (E) : Guidelines for Calibration and Checks of Temperature Controlled Enclosures.

Environmental Conditions

Temperature : Area Monitoring between 15°C to 40°C
Humidity : Area Monitoring between 30%RH to 85%RH
Line Voltage : Area Monitoring 220 VAC ± 10%

Traceability of Measurement

This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI) and The temperature scale in use at this laboratory is The International Temperature scale of 1990.

Calibrated by : Mr. Naphonphat Punyartijaroen Approved by : (Mr. Anuwat Yaklemjit)

Calibration Engineer Laboratory Manager

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Crystal Calibration Sales and Service Co., Ltd.

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Phone : 0-2408-8474 Fax : 0-2408-8477 Email : info@crystalcal.com





CERTIFICATE OF CALIBRATION

Certificate No. : 21-1098-002
Work Order No. : 21/1098

Issue Date : 20 November 2021

Result of Temperature Distribution and Performance Check

Table1 : Reporting of Temperature Distribution

Calibration point (°C)	Average Measured Temperature (°C) @ Sensor No. (Sensor No.9 is REF)									Uncertainty ± (°C)
	#1	#2	#3	#4	#5	#6	#7	#8	#9	
20.0	19.72	19.92	20.35	20.36	19.70	19.96	20.43	20.23	20.31	0.33

2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	1974	1973	1972	1971	1970	1969	1968	1967	1966	1965	1964	1963	1962	1961	1960	1959	1958	1957	1956	1955	1954	1953	1952	1951	1950	1949	1948	1947	1946	1945	1944	1943	1942	1941	1940	1939	1938	1937	1936	1935	1934	1933	1932	1931	1930	1929	1928	1927	1926	1925	1924	1923	1922	1921	1920	1919	1918	1917	1916	1915	1914	1913	1912	1911	1910	1909	1908	1907	1906	1905	1904	1903	1902	1901	1900	1899	1898	1897	1896	1895	1894	1893	1892	1891	1890	1889	1888	1887	1886	1885	1884	1883	1882	1881	1880	1879	1878	1877	1876	1875	1874	1873	1872	1871	1870	1869	1868	1867	1866	1865	1864	1863	1862	1861	1860	1859	1858	1857	1856	1855	1854	1853	1852	1851	1850	1849	1848	1847	1846	1845	1844	1843	1842	1841	1840	1839	1838	1837	1836	1835	1834	1833	1832	1831	1830	1829	1828	1827	1826	1825	1824	1823	1822	1821	1820	1819	1818	1817	1816	1815	1814	1813	1812	1811	1810	1809	1808	1807	1806	1805	1804	1803	1802	1801	1800	1799	1798	1797	1796	1795	1794	1793	1792	1791	1790	1789	1788	1787	1786	1785	1784	1783	1782	1781	1780	1779	1778	1777	1776	1775	1774	1773	1772	1771	1770	1769	1768	1767	1766	1765	1764	1763	1762	1761	1760	1759	1758	1757	1756	1755	1754	1753	1752	1751	1750	1749	1748	1747	1746	1745	1744	1743	1742	1741	1740	1739	1738	1737	1736	1735	1734	1733	1732	1731	1730	1729	1728	1727	1726	1725	1724	1723	1722	1721	1720	1719	1718	1717	1716	1715	1714	1713	1712	1711	1710	1709	1708	1707	1706	1705	1704	1703	1702	1701	1700	1699	1698	1697	1696	1695	1694	1693	1692	1691	1690	1689	1688	1687	1686	1685	1684	1683	1682	1681	1680	1679	1678	1677	1676	1675	1674	1673	1672	1671	1670	1669	1668	1667	1666	1665	1664	1663	1662	1661	1660	1659	1658	1657	1656	1655	1654	1653	1652	1651	1650	1649	1648	1647	1646	1645	1644	1643	1642	1641	1640	1639	1638	1637	1636	1635	1634	1633	1632	1631	1630	1629	1628	1627	1626	1625	1624	1623	1622	1621	1620	1619	1618	1617	1616	1615	1614	1613	1612	1611	1610	16
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Table 2: Reporting of Performance check

Indicator		Indicator Reading (°C)			Stability ± (°C)	Uniformity (°C)	Overall variation (°C)
Set Point (°C)		MAX	MIN	Average			
20.0.		20.0	20.0	20	0.10	0.67	0.84

Note

calibrate items in good condition and this report customer request and accepted in certificate

The reference sensor is preferably located of the geometric center of chamber

The measured temperature data readout by software "Benchmark Datalogger 3"

The quoted uncertainty include "Stability" and "Loading effect (20% of Temp Uniformity)".

Stability - one-half of the greatest maximum difference of measured temperatures at any one sensor.

Iniformity = the maximum difference of measured temperatures at any sensors and the measured temperature

to 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 time.

Overall Variability - The difference of the minimum and maximum measured temperatures at corresponding measuring points.

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

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

--END--



CRYSTAL CALIBRATION SALES AND SERVICE CO., LTD.

45/48 Soi Salathammassop31, Salathammassop Rd.,
Salathammassop, Thawewatthana, Bangkok 10170 Thailand
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NSC-TS-17025
CALIBRATION 0260

CERTIFICATE OF CALIBRATION

๙/๗/๒๕๖๔

Issue Date : 20 July 2022 Certificate No. : 22-918-003
Work Order No. : 22/918

Details of Calibration

1. Reference Standards Instrument

Instrument	Model	Serial No./Ins No.	Certificate No.	Due Date
Data Acquisition unit	34972A	MY49024826	21-1039-004	22 November 2022
Sensor type	RTD	RTD# 301-309	21-1039-004	22 November 2022

- Certificate traceable : This certificate traceable to The International System of Unit refer to Crystal Calibration Sales and Service Co., Ltd., MAC Calibration No. 0260
- Condition of item : Used
- Calibration site : On - Site
- Result of Calibration : Without adjustment
- Evaluate Condition : Time Constant : - Hour 37 Minute At cal. point 4 °C
Air vent : Off
- Fan speed status : Fixed Fan Speed
- Calibration note : The results reported in this certificate refer to the condition of instrument on the process into the steady state of chamber
- Sensors Installation Diagram : When ; Sensor installation location in Chamber @ Working Space
A = Distance between sensor and wall of chamber is 5 cm
- Dimensions of chamber : W = 0.5 m ; D = 0.4 m ; H = 0.9 m

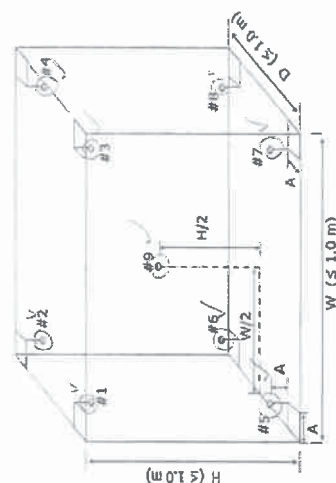


Diagram of Chamber

๙/๗/๒๕๖๔



CRYSTAL CALIBRATION SALES AND SERVICE CO., LTD.

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NSC-TS-17025
CALIBRATION 0260

CERTIFICATE OF CALIBRATION

๙/๗/๒๕๖๔

Issue Date : 20 July 2022 Certificate No. : 22-918-003
Work Order No. : 22/918

Customer Name

: S.P.J.Scientific Co.,Ltd.
80 Soi Saphansoong, Saphansoong, Bangkok 10250
Saphansoong, Bangkok 10250

Date of Received : 7 July 2022

Date of Calibration : 7 July 2022

Instrument Details : Description : Temperature Controlled Enclosures [Refrigerator] ๙/๗/๒๕๖๔

Manufacturer : BT Metrology

Model : Ref-950

Serial No. : 5/12/2011

ID No. : SPJ-TE-014

Resolution : 0.1 °C

Location : Laboratory

Calibration Method : This instrument was calibrated by insert standard thermometer into the chamber according to calibration procedure no. CWT-T-10 follow up to TLAS G-20-1/02-08 (E) : Guidelines for Calibration and Checks of Temperature Controlled Enclosures.

Environmental Conditions :

Temperature : Area Monitoring between 15°C to 40°C

Humidity : Area Monitoring between 30%RH to 85%RH

Line Voltage : Area Monitoring 220 VAC ± 10%

Traceability of Measurement :

This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI) and The temperature scale in use at this laboratory is The International Temperature scale of 1990.

Calibrated by : Mr.Sirisak Hankongkaew

Calibration Engineer

Approved by :

(Mr. Anuwat Yakermjit)

Laboratory Manager

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Crystal Calibration Sales and Service Co., Ltd.

45/48 Salathammassop 31, Salathammassop Rd., Salathammassop, Thawewatthana, Bangkok 10170

Phone : 0-2408-8474 Fax : 0-2408-8477 http://www.crystalcal.com Email : info@crystalcal.com



CALIBRATION REPORT

Issued By B.T.METROLOGY CO.,LTD.
Date of Issue 15 August 2022

B.T.METROLOGY CO.,LTD.
17/166 Soi Prachathum 14 (PEA Village)
Tungsoenghong Lakul, Bangkok 10210

Customer : S.P.J.Scientific Co.,Ltd.
Address : 88 Soi Saphansong, Saphansong, Bangkok 10250

Date of Received : 13 July 2022
Instructed - Description : COD REACTOR
Id Number : -
Manufacturer : Merck
Model Number : TR 402
Serial Number : 19490655

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.

Traceability Information

Reference Standards Description	Serial Number	Certificate Number	Cal. Date	Dule Date.
STD Thermometer with Probe, PRT	08000086	22-166-085	1/March/2022	2/March/2023
Equipment Description	Serial Number	Certificate Number	Cal. Date	Dule Date.
Data logger With Probe (TC : 01-13)	MY49020096	BTC-T-001-65	3/March/2022	4/March/2023

☐ This certification is traceable to SI Unit through the reference standard laboratory of In-house B.T.Metrology co.,Ltd Calibration Lab.
The used to perform this calibration is Traceable to National Institute of Metrology (Thailand), NIMT through Reference Standard Laboratory of Crystal Calibration Sales and Service Co.,Ltd, No. Calibration 0260 (Laboratories was Accredited by TISI According to ITS ISO / IEC 17025)

Calibrated By:

(Mr. Boonlue Somprajob)

Date of Calibration : 13 July 2022

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CRYSTAL CALIBRATION SALES AND SERVICE CO., LTD.
45/48 Soi Salahamasop31, Salahamasop Rd.,
Salahamasop, Thaweewatthana, Bangkok 10170 Thailand
Tel : 0-2008-8472-5 Fax : 0-2008-8477 Email : info@crystalcal.com www.crystalcal.com



CERTIFICATE OF CALIBRATION

Issue Date : 20 July 2022
Certificate No. : 22-918-003
Work Order No. : 22/918

Result of Temperature Distribution and Performance Check

Table 1 : Reporting of Temperature Distribution

Calibration point (°C)	Average Measured Temperature (°C) @ Sensor No. (Sensor No.9 is REF)										Uncertainty ± (°C)
	#1	#2	#3	#4	#5	#6	#7	#8	#9		
4.0	4.51	4.65	4.45	4.53	4.45	4.67	4.68	4.74	4.58		0.66
Overall : 4.51 4.65 4.45 4.53 4.45 4.67 4.68 4.74 4.58 0.66											
Uniformity : 1.14 1.31 1.11 1.19 1.11 1.32 1.34 1.41 1.94											
Stability : ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓											

Table 2 : Reporting of Performance check

Indicator Set Point (°C)	Indicator Reading (°C)			Stability ± (°C)	Uniformity (°C)	Overall variation (°C)
	MAX	MIN	Average			
4.0	4.0	4.0	4.0	0.50	0.98	1.17

Note

Calibrate items in good condition and this report customer request and accepted in certificate
The reference sensor is preferably located of the geometric center of chamber
The measured temperature data readout by software "Benchmark Datalogger 3"
The quoted uncertainty include "Stability" and "Loading effect (20% of Temp Uniformity)"
Stability - one-half of the greatest maximum difference of measured temperatures at any one sensor.
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 time.
Indicating Temperature - the average reading of indicating device that forms the integral part of the enclosure.
This result of calibration was found accurate as shown on date and place of calibration only.

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

--END--

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CALIBRATION REPORT

Cert. Number
BTC-T-007/65
Page 3 of 3 pages

Issued By B.T.METROLOGY CO.,LTD.
Date of Issue 15 August 2022

Hole No. (Position)	Max (°C)	Min (°C)	Mid-Range (°C)	Difference (°C)	Uncertainty of measurement (± °C)
13	150.4	150.4	150.40	0.00	0.7
14	150.2	150.0	150.10	0.20	
15	149.5	149.5	149.50	0.00	
16	150.9	150.9	150.90	0.00	
17	150.1	150.1	150.10	0.00	
18	149.9	149.9	149.90	0.00	
19	150.2	150.2	150.20	0.00	
20	150.2	150.2	150.20	0.00	
21	150.3	150.3	150.30	0.00	
22	150.1	150.1	150.10	0.00	
23	150.1	150.1	150.10	0.00	
24	150.1	150.1	150.10	0.00	

Verified
Approved

UUC (Hole-24)		Measured Temperature		Measured Variation	
Setting (°C)	Reading (°C)	Average Measured Temperature (°C)	Max (°C)	Min (°C)	Overall (°C)
150	150	150.2	150.9	149.5	0.8

Note: - Reference Standards are measurement in tube silicone oil at 200 value record after temperature stability.

- Level high of silicone oil is equal heater plate of UUC.

Calibrated By:

B. Somprajob

(Mr. Boonlue Somprajob)

Date of Calibration : 13 July 2022

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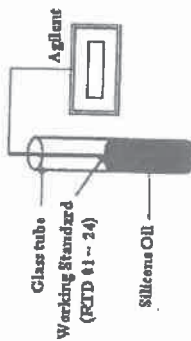
CALIBRATION REPORT

Cert. Number
BTC-T-007/65
Page 2 of 3 pages

Issued By B.T.METROLOGY CO.,LTD.
Date of Issue 15 August 2022

Appendix A (Top View)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	R
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓



149.5 ± 0.7 °C

Hole No. (Position)	Max (°C)	Min (°C)	Mid-Range (°C)	Difference (°C)	Uncertainty of measurement (± °C)
1	150.2	150.1	150.15	0.10	0.7
2	150.6	150.5	150.55	0.10	
3	150.4	150.3	150.35	0.10	
4	150.8	150.7	150.75	0.10	
5	150.3	150.2	150.25	0.10	
6	150.0	149.9	149.95	0.10	
7	150.3	150.2	150.25	0.10	
8	150.2	150.2	150.20	0.00	
9	150.4	150.3	150.35	0.10	
10	150.2	150.1	150.15	0.10	
11	150.5	150.5	150.50	0.00	
12	150.5	150.4	150.45	0.10	

149.5 ± 0.7 °C
0.15 0.85
0.95 1.25
0.35 1.05
0.45 1.45
0.15 0.45
0.05 0.15
0.15 0.45
0.40 0.30
0.35 1.05
0.15 0.55
0.50 1.20
0.45 1.15

Verified
Approved
QC 16/8/22

Calibrated By:

B. Somprajob

(Mr. Boonlue Somprajob)

Date of Calibration : 13 July 2022

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MAC T&T TS 17025
CALIBRATION ENVO

CERTIFICATE OF CALIBRATION

Issue Date : 10 October 2022

Certificate No. : 22-1358-004

Work Order No. : 22/1358

Details of calibration

1. Reference Standards Instrument

Instrument	Model	Serial No. / ID No.	Certificate No.	Due Date
Data Acquisition unit	34972A	MY57001206	22-302-001	05 March 2023
Sensor type	RTD	Channel 101 to 105	22-302-001	05 March 2023

2. Certificate traceable

This certificate traceable to The International System of Unit refer to
Crystal Calibration Sales and Service Co., Ltd., MAC Calibration No. 0260

3. Condition of item

Used

4. Calibration site

On-site

5. Result of Calibration

Without Adjustment

6. Evaluate Condition

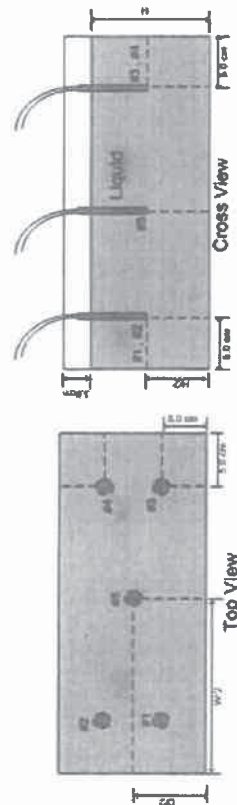
Time Constant : - Hour 33 Minute At Cal. point 65 °C
Type of Control : PID Control

7. Calibration note

Testing liquid bath use media is Water

The results reported in this certificate refer to the condition of instrument on the process into the standby state of Liquid Bath

8. Sensors Installation Diagram



Position Diagram



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MAC T&T TS 17025
CALIBRATION ENVO

CERTIFICATE OF CALIBRATION

Issue Date : 10 October 2022

Certificate No. : 22-1358-004

Work Order No. : 22/1358

Customer Name

S.P.J Scientific Co., Ltd.
80 Soi Saphansoong,
Saphansoong, Bangkok 10250

Date of Received

5 October 2022

Date of Calibration

5 October 2022

Instrument Details

Description : Water Bath
Manufacturer : Memmert
Model : WTB24
Serial No. : LD21.0340
ID No. : N/A
Resolution : 0.1 °C
Location : Laboratory

Calibration Method : This instrument was calibrated by insert standard thermometer into the liquid bath according to calibration procedure CWI-T-11 in-house methods based on ASTM E715-80 (reapproved 2006)

Environmental Conditions

Temperature : Area Monitoring between 15°C to 40°C
Humidity : Area Monitoring between 30%RH to 85%RH
Line Voltage : Area Monitoring 220 VAC ± 10%

Traceability of Measurement

This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI) and The temperature scale in use at this laboratory is The International Temperature scale of 1990.

Calibrated by : Mr. Sirisak Hantongkaew

Approved by : (Mr. Anuwat Yakiemjit)

Calibration Engineer

Laboratory Manager

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Crystal Calibration Sales and Service Co., Ltd.

45/48 Salathammassop 31, Salathammassop Rd., Salathammassop, Thawewatthana, Bangkok 10170

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CERTIFICATE OF CALIBRATION

Issue Date : 10 October 2022 Certificate No. : 22-1358-003
Work Order No. : 22/1358

Customer Name : S.P.J.Scientific Co.,Ltd.
80 Soi Saphansong,
Saphansong, Bangkok 10250
Date of Received : 5 October 2022
Date of Calibration : 5 October 2022

Instrument Details : Description : Temperature Controlled Enclosures (Hot Air Oven)
Manufacturer : Memmert
Model : UF 55
Serial No. : B221.0746
ID No. : N/A
Resolution : 0.1 °C
Location : Laboratory

Calibration Method : This instrument was calibrated by insert standard thermometer into the chamber according to calibration procedure no. CWI-T-10 follow up to TLAS G-20-1/02-08
(E) : Guidelines for Calibration and Checks of Temperature Controlled Enclosures.

Environmental Conditions :

Temperature : Area Monitoring between 15°C to 40°C
Humidity : Area Monitoring between 30%RH to 85%RH
Line Voltage : Area Monitoring 220 VAC ± 10%

Traceability of Measurement :

This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI) and The temperature scale in use at this laboratory is The International Temperature scale of 1990.

Calibrated by : Mr.Sirirak Hantongkaew
Calibration Engineer
Approved by : (Mr. Anuwat Yakkermjit)
Laboratory Manager

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CERTIFICATE OF CALIBRATION

Issue Date : 10 October 2022 Certificate No. : 22-1358-004
Work Order No. : 22/1358

Result of Temperature, Distribution and Performance Check NTC 100

Table 1 : Reporting of Temperature

Calibration point (°C)	Average Measured Temperature (°C) @ Sensor No.					Uncertainty ± (°C)
	#1	#2	#3	#4	#5	
65.0	64.92	65.10	64.88	64.86	64.98	0.19
85.0	85.10	85.25	84.96	84.88	85.09	0.24

15°C, 25°C, 35°C, 45°C, 55°C, 65°C, 75°C, 85°C, 95°C, 105°C, 115°C, 125°C, 135°C, 145°C, 155°C, 165°C, 175°C, 185°C, 195°C, 205°C, 215°C, 225°C, 235°C, 245°C, 255°C, 265°C, 275°C, 285°C, 295°C, 305°C, 315°C, 325°C, 335°C, 345°C, 355°C, 365°C, 375°C, 385°C, 395°C, 405°C, 415°C, 425°C, 435°C, 445°C, 455°C, 465°C, 475°C, 485°C, 495°C, 505°C, 515°C, 525°C, 535°C, 545°C, 555°C, 565°C, 575°C, 585°C, 595°C, 605°C, 615°C, 625°C, 635°C, 645°C, 655°C, 665°C, 675°C, 685°C, 695°C, 705°C, 715°C, 725°C, 735°C, 745°C, 755°C, 765°C, 775°C, 785°C, 795°C, 805°C, 815°C, 825°C, 835°C, 845°C, 855°C, 865°C, 875°C, 885°C, 895°C, 905°C, 915°C, 925°C, 935°C, 945°C, 955°C, 965°C, 975°C, 985°C, 995°C, 1005°C, 1015°C, 1025°C, 1035°C, 1045°C, 1055°C, 1065°C, 1075°C, 1085°C, 1095°C, 1105°C, 1115°C, 1125°C, 1135°C, 1145°C, 1155°C, 1165°C, 1175°C, 1185°C, 1195°C, 1205°C, 1215°C, 1225°C, 1235°C, 1245°C, 1255°C, 1265°C, 1275°C, 1285°C, 1295°C, 1305°C, 1315°C, 1325°C, 1335°C, 1345°C, 1355°C, 1365°C, 1375°C, 1385°C, 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MAC 704-TS 17023
CALIBRATION 0166

CERTIFICATE OF CALIBRATION

Issue Date

10 October 2022

Certificate No. : 22-1358-003

Work Order No. : 22/1358

Result of Temperature Distribution and Performance Check

Table 1 : Reporting of Temperature Distribution

Calibration point (°C)	Average Measured Temperature (°C) @ Sensor No.									Uncertainty ± (°C)
	#1	#2	#3	#4	#5	#6	#7	#8	#9	
104.0	103.92	103.67	104.02	103.98	103.90	103.78	103.79	103.78	103.86	0.39
180.0	180.01	179.19	181.07	180.31	180.00	179.66	179.36	179.80	179.86	0.65

error	0.01	0.33	0.17	0.33	0.10	0.33	0.21	0.22	0.11	
Standard Deviation	0.01	0.12	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.23
Coverage	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Stability	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Uniformity	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Table 2 : Reporting of Performance Check

Indicator	Indicator Reading (°C)			Stability ± (°C)	Uniformity ± (°C)	Overall variation ± (°C)
	MAX	MIN	Average			
Set Point (°C)	104.0	104.0	104.0	0.24	0.36	0.54
	180.0	180.0	180.0	0.28	1.32	2.17

Note

Calibrate items in good condition and this report customer request and accepted in certificate
The reference sensor is preferably located of the geometric center of chamber
The measured temperature data readout by software "Benchmark Datalogger 3"
The quoted uncertainty include "Stability" and "Loading effect (20% of Temp Uniformity)"
Stability - one-half of the greatest maximum difference of measured temperatures at any one sensor.
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 time.
Indicating Temperature - the average reading of indicating device that forms the integral part of the enclosure.
This result of calibration was found accurate as shown on date and place of calibration only.

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

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MAC 704-TS 17023
CALIBRATION 0166

CERTIFICATE OF CALIBRATION

Issue Date

10 October 2022

Certificate No. : 22-1358-003

Work Order No. : 22/1358

Details of Calibration

1. Reference Standards Instrument

Instrument	Model	Serial No./Ins No.	Certificate No.	Due Date
Data Acquisition unit	34972A	81749018270	21-1304-001	02 January 2023
Sensor type	RTD	RTDW 301-309	21-1304-001	02 January 2023

2. Certificate traceable

: This certificate traceable to The International System of Unit refer to
Crystal Calibration Sales and Service Co., Ltd., MAC Calibration No. 0260

3. Condition of item

: Used

4. Calibration site

: On - Site

5. Result of Calibration

: Without adjustment

6. Evaluate Condition

: Time Constant : Hour 33 Minute At cal. point 104 °C
Air vent : On
Fan speed status : Fixed Fan Speed

7. Calibration note

: The results reported in this certificate refer to the condition of instrument on the process into the steady state of chamber

8. Sensors Installation Diagram

: When : Sensor installation location in Chamber at Working Space

A = Distance between sensor and wall of chamber is 5 cm

9. Dimensions of chamber

: W = 0.4 m ; D = 0.33 m ; H = 0.4 m

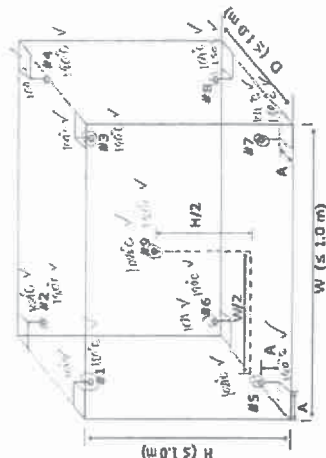


Diagram of Chamber

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