



บริษัท ปตท. น้ำมันและ การค้าปลีก จำกัด (มหาชน)

รายงานผลการปฏิบัติตามมาตรการป้องกันและแก้ไขผลกระทบสิ่งแวดล้อม

และมาตรการติดตามตรวจสอบผลกระทบสิ่งแวดล้อม

โครงการปรับปรุงท่าเทียบเรือขนถ่ายน้ำมันและก๊าซปิโตรเลียมเหลว จังหวัดสุราษฎร์ธานี

ระหว่างเดือนกรกฎาคม-ธันวาคม พ.ศ. 2565

ภาคผนวก จ

เอกสารสอบเทียบเครื่องมือ



รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Total Hydrocarbon	Total Hydrocarbon Analyzer	BKK_EN0057	9-Aug-22	9-Feb-24	18
Ambient	Non-Methane Hydrocarbon	Total Hydrocarbon Analyzer	BKK_EN0057	9-Aug-22	9-Feb-24	18
Ambient	Methane	Total Hydrocarbon Analyzer	BKK_EN0057	9-Aug-22	9-Feb-24	18
Ambient	Total VOC	TVOC Analyzer	BKK_FS0819	4-Feb-22	5-Aug-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	SGK_FS0088	14-Jul-21	12-Jan-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	SGK_FS0035	13-Jul-22	11-Jan-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	SGK_FS0089	14-Jul-21	12-Jan-23	18
Noise	Leq 24 hrs	Sound Calibrator	SGK_FS0011	9-Sep-22	9-Sep-23	12
Noise	Leq 24 hrs	Sound Level Meter	SGK_FS0013	11-Jul-22	11-Jul-23	12
Noise	Noise Annoyance	Sound Calibrator	SGK_FS0011	9-Sep-22	9-Sep-23	12
Noise	Noise Annoyance	Sound Level Meter	SGK_FS0013	11-Jul-22	11-Jul-23	12
Songkhla Lab	BOD (5 days at 20°C)	Incubator	SGK_CL0028	25-Jan-22	26-Jul-23	18
Songkhla Lab	BOD (5 days at 20°C)	DO/BOD Analyser	SGK_CL0073	2-Dec-21	2-Dec-22	12
Songkhla Lab	COD	COD Reactor	PTC/10/22004	8-Feb-22	8-Feb-23	12
Songkhla Lab	COD	Spectrophotometer	SGK_CL0038	24-Jan-22	24-Jan-23	12
Songkhla Lab	pH at 25 oC	pH meter	SGK_CL0030	9-Nov-21	10-May-23	18
Songkhla Lab	Oil & Grease	Electronic Top-Loading Balance	SGK_CL0045	5-Feb-22	5-Feb-23	12
Songkhla Lab	Oil & Grease	Oven	SGK_CL0025	9-Nov-21	10-May-23	18
Songkhla Lab	Oil & Grease	Water Bath	SGK_CL0035	5-Feb-22	6-Aug-23	12
Songkhla Lab	Total Dissolved Solids 180°C	Electronic Top-Loading Balance	SGK_CL0045	5-Feb-22	5-Feb-23	12
Songkhla Lab	Total Dissolved Solids 180°C	Oven	SGK_CL0025	9-Nov-21	10-May-23	18
Songkhla Lab	Total Suspended	Electronic Top-Loading	SGK_CL0045	5-Feb-22	5-Feb-23	12



รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Songkhla Lab	Solids Total Suspended Solids	Balance Oven	SGK_CL0025	9-Nov-21	10-May-23	18
Songkhla Lab	Dissolved Oxygen	DO Meter	SGK_FS0018	21-Jan-22	21-Jan-23	12
Songkhla Lab	Total Coliform	Autoclave	SGK_ML0001	5-Jul-21	3-Jan-23	18
Songkhla Lab	Total Coliform	Incubator	SGK_ML0013	6-Aug-22	6-Feb-24	18
Songkhla Lab	Total Coliform	pH Meter	SGK_ML0016	5-Jul-21	3-Jan-23	18
Songkhla Lab	Total Coliform	Water Bath	SGK_ML0021	6-Aug-21	4-Feb-23	18
Songkhla Lab	Fecal Coliform	Autoclave	SGK_ML0001	5-Jul-21	3-Jan-23	18
Songkhla Lab	Fecal Coliform	Incubator	SGK_ML0013	6-Aug-22	6-Feb-24	18
Songkhla Lab	Fecal Coliform	pH Meter	SGK_ML0016	5-Jul-21	3-Jan-23	18
Songkhla Lab	Fecal Coliform	Water Bath	SGK_ML0021	6-Aug-21	4-Feb-23	18
Songkhla Lab	Lead	ICP-MS	SGK_CL0048	8-Feb-22	8-Feb-23	12
Songkhla Lab	Lead	Cold Room Water	SGK_CL0065	16-Aug-21	14-Feb-23	18
Songkhla Lab	Total Solids	Electronic Top-Loading Balance	SGK_CL0045	5-Feb-22	5-Feb-23	12
Songkhla Lab	Total Solids	Oven	SGK_CL0024	9-Nov-21	10-May-23	18
Songkhla Lab	Cadmium	ICP-MS	SGK_CL0048	8-Feb-22	8-Feb-23	12
Songkhla Lab	Cadmium	Cold Room Water	SGK_CL0065	16-Aug-21	14-Feb-23	18
Songkhla Lab	Temperature	pH meter	SRT_MKT0001	9-Feb-22	9-Feb-23	12
Songkhla Lab	Total Alkalinity	pH meter	SGK_CL0030	9-Nov-21	10-May-23	18
Songkhla Lab	Conductivity	Conductivity Meter	SGK_FS0051	29-Aug-22	29-Aug-23	12
Songkhla Lab	Salinity	Conductivity Meter	SGK_FS0051	29-Aug-22	29-Aug-23	12
Songkhla Lab	Turbidity	Turbidity Meter	SGK_FS0045	20-Jun-22	20-Jun-23	12
Water Lab	Total Kjeldahl Nitrogen	Digestion Unit	BKK_EN0223	1-Feb-22	1-Feb-23	12
Water Lab	Total Kjeldahl Nitrogen	Discrete analyzer	BKK_EN0037	30-Jun-22	30-Jun-23	12
Water Lab	Ammonia Nitrogen	Discrete analyzer	BKK_EN0037	30-Jun-22	30-Jun-23	12



รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Water Lab	Nitrate	Ion Chromatography	BKK_EN0069	12-Jan-22	12-Jan-23	12
Water Lab	Phosphate	Ion Chromatography	BKK_EN0069	12-Jan-22	12-Jan-23	12
Sludge	Oil & Grease	Electronic Top-Loading Balance	BKK_EN0002	25-Feb-22	25-Feb-23	12
Sludge	Total Petroleum Hydrocarbon	Electronic Top-Loading Balance	BKK_EN0002	25-Feb-22	25-Feb-23	12
Sludge	pH aqueous phase 50% (w/v)	pH meter	BKK_EN0072	12-Sep-22	12-Mar-24	18



JIRANATEE ASSOCIATES CO., LTD.

CALIBRATION REPORTREVIEW BY Vichuta N.APPROVED BY Sararat M.NEXT CAL. DATE 9/2/67

CUSTOMER NAME : ALS Laboratory Group (Thailand) Co., Ltd.

EQUIPMENT NAME : Total Hydrocarbon Analyzer

MANUFACTURER : Baseline

MODEL : 9000 NMHC

SERIAL NO : 0314DR0170

STANDARD GAS CONCENTRATION (PPM) : 100 PPM (Methane)

CYLINDER NO : ND55981

CYLINDER PRESSURE (psig) : 900 PSI

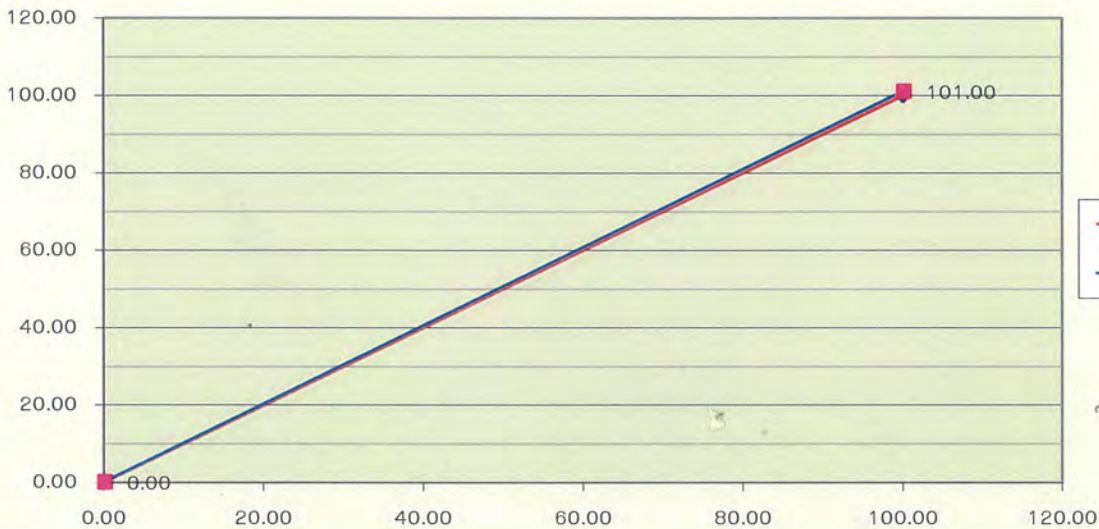
CERTIFIED DATE : 12/02/2022

CERTIFIED BY : AIRGAS

EXPIRED DATE : 12/02/2025

CALIBRATION RESULTS

POINT NO	CALIBRATION RESULTS			
	IDEAL	ACTUAL	ERROR	%ERROR
ZERO	0.00	0.00	0.00	-
1	100.00	101.00	1.0	-1.00
AVERAGE (%)				0.25

CALIBRATED BY : วิภาพล ดุสิตเจริญDATE : 9/8/65CHECKED BY : ศุภชัย อังคารDATE : 9/8/65

ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : เจ้าหน้าที่ฝ่ายบริการหลังการขาย , โทร 02-868-0812 # 31 , E-Mail : Engineer@Jiranatee.com

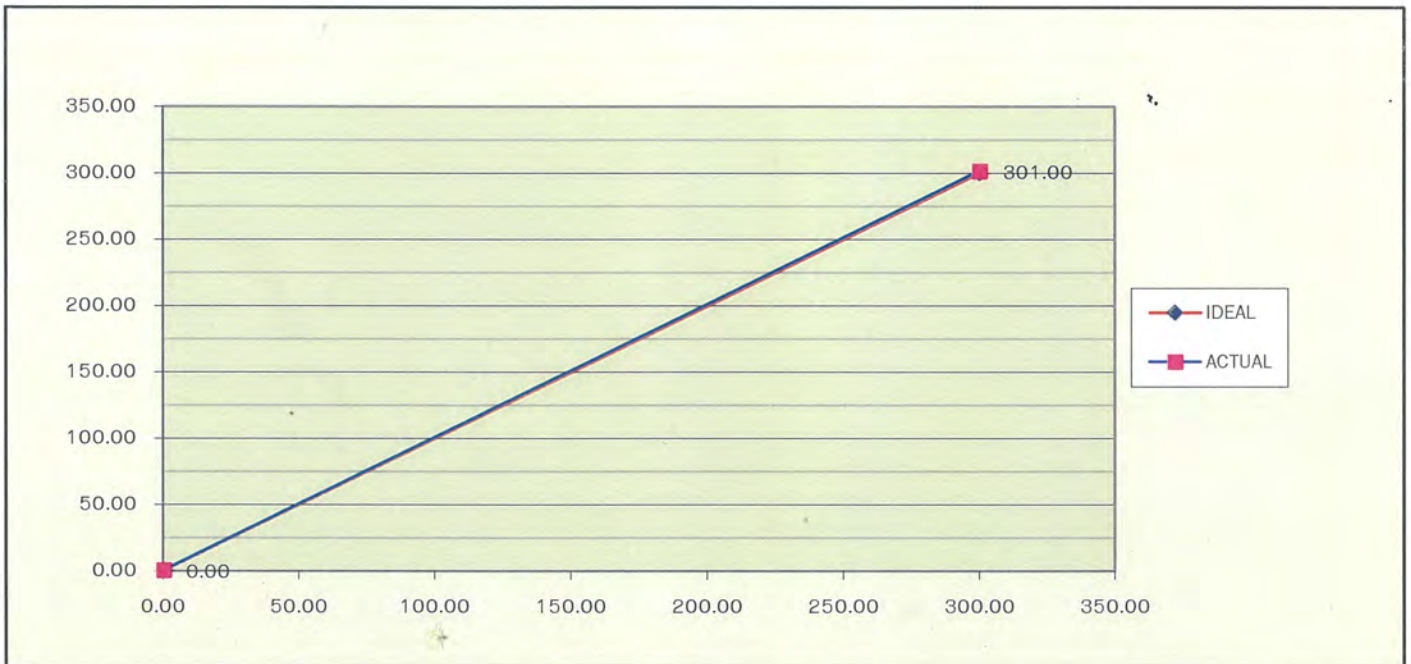
เลขที่ 63/14-15, 67/35-36 ถนน เพชรเกษม 7, 7/1 แขวง วัดท่าพระ เขต บางกอกใหญ่ กรุงเทพฯ 10600 โทร 02-868-0812-13 โทรสาร 02868-1889

CALIBRATION REPORT

CUSTOMER NAME :		ALS Laboratory Group (Thailand) Co., Ltd.		
EQUIPMENT NAME :		Total Hydrocarbon Analyzer		
MANUFACTURER :		Baseline	MODEL :	9000 NMHC
STANDARD GAS CONCENTRATION (PPM) :		: 100 PPM (Propane)	SERIAL NO :	0314DR0170
CYLINDER PRESSURE (psig) :		900 PSI	CYLINDER NO :	ND55981
CERTIFIED BY :		AIRGAS	CERTIFIED DATE :	12/02/2022
			EXPIRED DATE :	12/02/2025

CALIBRATION RESULTS

POINT NO	CALIBRATION RESULTS			
	IDEAL	ACTUAL	ERROR	%ERROR
ZERO	0.00	0.00	0.00	-
1	300.00	301.00	1.0	0.33
AVERAGE (%)				0.08



CALIBRATED BY : วรณล ศักดิ์เจริญ DATE : 9/18/65

CHECKED BY : ศิษฐ์ วัฒนา DATE : 9/18/65



ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : เจ้าหน้าที่ฝ่ายบริการหลังการขาย , โทร 02-868-0812 # 31 , E-Mail : Engineer@jiranatee.com

เลขที่ 63/14-15,67/35-36 ถนนเพชรเกษม 7,7/1 แขวง วัดท่าพระ เขต บางกอกใหญ่ กรุงเทพฯ 10600 โทร 02-868-0812-13 โทรสาร 02868-1889

FLOW CALIBRATE

CUSTOMER NAME	:	ALS Laboratory Group (Thailand) Co., Ltd.		
EQRIPMENT NAME	:	Flow Calibrator		
MANUFACTURER	:	Bios	MODEL : 510 L	SERIAL NO : 129549

Flow Parameter	Step	Set	Display	Flow Meter
Sample	Before	40	38	15 cc/min
	After	40	40	39.7 cc/min
Air	Before	175	175	190 cc/min
	After	175	175	176 cc/min
Fuel	Before	35	32	36 cc/min
	After	35	35	35 cc/min

CALIBRATED BY : วราพล ดวกิ่งเจริญ **DATE :** 9/8/65
CHECKED BY : สันติ วัฒนา **DATE :** 9/8/65



ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : เจ้าหน้าที่ฝ่ายบริการหลังการขาย , โทร 02-868-0812 # 15-16 , E-Mail : Engineer@jiranatee.com
 เลขที่ 63/14-15,67/35-36 ถนน เพชรเกษม 7,7/1 แขวง วัดท่าพระ เขต บางกอกใหญ่ กรุงเทพฯ 10600 โทร 02-868-0812-13 โทรสาร 02868-1889



บริษัท เอกเสคคิวทิฟเทรดดิ้ง จำกัด (สำนักงานใหญ่)

48/194-5 ซอยประดิษฐ์มนูธรรม 19 ถนนประดิษฐ์มนูธรรม แขวงลาดพร้าว เขตลาดพร้าว กรุงเทพฯ 10230
TEL. (662) 515-0145-50 FAX. (662) 515-0144 www.etlthai.com E-mail : info@etlthai.com

ที่ RA 013/22

ใบรายงานผลการปรับเทียบ

ชื่อผู้ขอรับบริการ : บริษัท เอแอลเอส แลบบอราทอรี กรุ๊ป (ประเทศไทย) จำกัด.
ที่อยู่ : 104 ซ.พัฒนาการ 40 ถ.พัฒนาการ แขวงสวนหลวง เขตสวนหลวง กรุงเทพมหานคร 10250.
ปรับเทียบที่ : บริษัท เอกเสคคิวทิฟเทรดดิ้ง จำกัด
ที่อยู่ : 48/194-5 ซอย ประดิษฐ์มนูธรรม 19 ถนนประดิษฐ์มนูธรรม แขวง/เขตลาดพร้าว กรุงเทพฯ 10230

รายละเอียดเครื่องมือที่ทำการปรับเทียบ :

เครื่องมือ : เครื่องตรวจวัดไอระเหยจากสารเคมี
ผลิตภัณฑ์ : RAE Systems
รุ่น : MiniRAE3000
หมายเลขเครื่อง : 592-906493
ID : BKK_FS0819

สภาวะแวดล้อม :

อุณหภูมิ : $(25 \pm 3) ^\circ\text{C}$
ความชื้นสัมพัทธ์ : $(36 \pm 15) \%$
ความดันบรรยากาศ : 760 มิลลิเมตรปรอท

วันที่ปรับเทียบมาตรฐาน : 4 กุมภาพันธ์ 2565

วิธีการปรับเทียบมาตรฐาน : ปรับเทียบโดยใช้ Standard Reference Gas ผลิตภัณฑ์ GASCO
- Isobutylene Standard Gas 100 ppm; Lot number: 304-402089381-1.

REVIEW BY

APPROVED BY

NEXT CAL. DATE

5/8/23

ผลการปรับเทียบมาตรฐาน

Sensor Type	Reference Concentration	Before Cal.	After Cal.	Error Reading	Result
PID	0.0 ppm (Air Zero)	0.0 ppm	0.0 ppm	0.0 ppm	Pass
PID	100 ppm (Isobutylene)	54.1 ppm	100.0 ppm	0.0 ppm	Pass

Flow Rate of Pump : 490 cc/min.

Accuracy : $\pm 2 \%$ at calibration point

ผู้ปรับเทียบ : สุรินทร์ สายเนตร
(นายสุรินทร์ สายเนตร)
Service Engineer

ผู้ตรวจสอบ : สุทธิพงษ์ คงทองสังข์
(นายสุทธิพงษ์ คงทองสังข์)
Service Engineer Manager

ผลการสอบเทียบ/ปรับเทียบ นี้ รับรองเฉพาะตัวอย่างและรายการที่ได้รับไว้เท่านั้น

การนำรายงานผล/ใบรับรองนี้ไปโฆษณาและการคัดลอกหรือการนำผลบางส่วนไปเผยแพร่ต่อสาธารณะต้องได้รับอนุญาตเป็นลายลักษณ์อักษรจากทางบริษัทฯ



บริษัท เอกเสคคิวทิฟเทรดดิ้ง จำกัด (สำนักงานใหญ่)

48/194-5 ซอยประดิษฐ์มนูธรรม 19 ถนนประดิษฐ์มนูธรรม แขวงลาดพร้าว เขตลาดพร้าว กรุงเทพฯ 10230
TEL.(662) 515-0145-50 FAX.(662) 515-0144 www.etlthai.com E-mail : info@etlthai.com

No. RA 013/22

Certificate of Calibration

Customer : ALS Laboratory Group (Thailand) Co.,Ltd.
Address : 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Suan Luang, Khet Suan Luang Bangkok 10250 TH.
Calibration location : Executive Trading Limited.
Address : 48/194-5 Soi Praditmanutham 19, Pradit Manutham Road, Latphrao, Bangkok 10230
Tools :
Instrument : Gas Detector
Product : RAE Systems
Model Name : MiniRAE3000
Serial Number : 592-906493
ID : BKK_FS0819
Environmental Condition :
Temperature : $(25 \pm 3) ^\circ\text{C}$
Relative Humidity : $(36 \pm 15) \%$
Pressure : 760 mmHg
Date of Calibration : February 4, 2022
Calibration Method : This instrument has been calibrated using calibration gases. Test and calibration data is On file with Executive trading limited.
Reference Standard : Isobutylene Standard Gas 100 ppm; Lot number: 304-402089381-1.

Test Result

Sensor Type	Reference Concentration	Before Cal.	After Cal.	Error Reading	Result
PID	0.0 ppm (Air Zero)	0.0 ppm	0.0 ppm	0.0 ppm	Pass
PID	100 ppm (Isobutylene)	54.1 ppm	100.0 ppm	0.0 ppm	Pass

Flow Rate of Pump : 490 cc/min.

Accuracy : $\pm 2 \%$ at calibration point

Calibrated By : Surinthorn S.
(Mr. Surinthorn Sainate)
Service Engineer

Approved By : Suttawong Kongtongsang
(Mr. Suttawong Kongtongsang.)
Service Engineer Manager

The results relate only to the items tested or calibrated.

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the company.



บริษัท เอกเสคคิวทิฟ เทรดดิ้ง จำกัด (สำนักงานใหญ่)

48/194-5 ซอยประดิษฐ์มนูธรรม 19 ถนนประดิษฐ์มนูธรรม แขวงลาดพร้าว เขตลาดพร้าว กรุงเทพฯ 10230
TEL. (662) 515-0145-50 FAX. (662) 515-0144 www.etlthai.com E-mail : info@etlthai.com

ที่ RA 013/22

ใบรายงานการตรวจเช็คเครื่องตรวจวัดก๊าซ รุ่น MiniRAE3000

หมายเลขเครื่อง : 592-906493

วันที่ตรวจเช็ค : 4 กุมภาพันธ์ 2565

ลำดับที่	รายละเอียด การตรวจสอบ	RAW COUNT		สรุป	หมายเหตุ
		REF.	REAL		
1.	PID RAW COUNT				
	Ch.H	10000-62500	39643	■ YES □ NO	
	Ch.L	<62500	29542	■ YES □ NO	
2.	Lamp	>40	45	■ YES □ NO	

ลำดับที่	รายละเอียด การตรวจซ่อม	การแก้ไข	สรุป	หมายเหตุ
1.	Motor Pump	Check flow rate	■ YES □ NO	490 cc/min.
2.	Buzzer	-	■ YES □ NO	-
3.	Li-ion Battery	-	■ YES □ NO	-
4.	Key Pad			
	Y/+	-	■ YES □ NO	-
	N/-	-	■ YES □ NO	-
	MODE	-	■ YES □ NO	-
5.	LCD Display	-	■ YES □ NO	-
6.	THP sensor	-	■ YES □ NO	-
7.	Light Sensor	-	■ YES □ NO	-
8.	Pocket Clip	-	□ YES □ NO	-
9.	PC Port	-	■ YES □ NO	-
10.	Slim Rubber Boot	-	■ YES □ NO	เปลี่ยนใหม่

ผู้ตรวจเช็ค : สุรินทร์ สายเนตร
(นายสุรินทร์ สายเนตร)
Service Engineer

ผลการสอบเทียบ/ปรับเทียบ นี้ รับรองเฉพาะตัวอย่างและรายการที่ได้รับอนุญาตไว้เท่านั้น

การนำรายงานผล/ใบรับรองนี้ไปโฆษณาและการคัดลอกหรือการนำผลบางส่วนไปเผยแพร่ต่อสาธารณะต้องได้รับอนุญาตเป็นลายลักษณ์อักษรจากทางบริษัทฯ



GASCO AFFILIATES, LLC.

320 Scarlet Blvd.
Oldsmar, FL 34677
(800) 910-0051
fax: (866) 755-8920
www.gascogas.com

CERTIFICATE OF ANALYSIS

Date: May 14, 2021
Order Number: 58376
Lot Number: 304-402089381-1

Customer: R C Systems Co Inc
Use Before: 05/14/2025

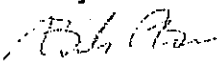
<u>Component</u>	<u>Requested Concentration</u>	<u>Analytical Result (+/- 2%)</u>
Isobutylene	100 PPM	101.2 PPM
Air	Balance	Balance

Cylinder Size: 3.70 Cu. Ft.
Contents: 105 Liter

Valve: 5/8"-18 UNF
Pressure: 1200 psig

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/ or N.I.S.T. Gas Mixture reference materials.

Analyst:


Brandon Brewer



CERTIFICATE Of Attendance

It is hereby certified that

Mr Suttiwong Kongthongsang
(Executive Trading Limited)

has attended the

RAE Products & Maintenance Training Course

Conducted by

RAE Systems BY HONEYWELL

on **31st July to 2nd August 2018**

A handwritten signature in blue ink, appearing to be "Desmond Tan".



Conducted by : Desmond Tan
Service Engineer/Technical Trainer
Date of Issue : 2nd August 2018
Valid for 2 years from date of issue

CERTIFICATE OF CALIBRATION

Certificate No: WS-06072021

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx.
Cup anemometer: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D.
Cup anemometer: WS-02F.

Serial Number : Data logger: A5791.
Cup anemometer: WSD-012.

ID No : Data logger: -.
Cup anemometer: -.

Customer : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Test Conditions : Wind tunnel cross test section area 900 cm²
Anemometer frontal area 100 cm²
Diameter of mounting pipe - mm
Blockage ratio of test object 0.111 [-]

Test Conditions : Air temperature 24.1 ±0.8 °C
Air pressure 1008.7 ±0.4 hPa
Relative air humidity 60.1 ±3.5 %RH

Calibration Procedure : Calibration was carried out base on;
IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines;
MEASNET Anemometer Calibration Procedure – Version 2: 2009;

Traceability : This calibration documents the traceable to national standard, Which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).

Measurement Date : Jul 14, 2021.
Issued Date : Jul 15, 2021.

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory: _____


Mr. Parinya Booncharoen
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WS-06072021

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

Calibration in the range of 1 – 16 m/s at a calibration interval of 1 m/s.

The results of calibration and associated measurement uncertainties are reported in the table below.

V _{STD} Reading m/s	V _{UUC} * Reading m/s	Error (m/s)	Uncertainty (%)
2.056	2.0	-0.1	2.4
4.114	4.0	-0.1	1.5
6.01	6.0	0.0	1.3
8.03	8.0	0.0	0.92
10.02	10.0	0.0	1.03
11.99	12.1	0.1	0.56
14.98	14.2	-0.8	0.48
16.03	16.3	0.3	0.42
14.98	15.2	0.2	0.42
12.99	13.2	0.2	0.53
11.01	11.1	0.1	0.57
8.99	9.0	0.0	0.81
7.03	7.0	0.0	0.95
5.101	5.0	-0.1	1.01
2.987	3.0	0.0	1.6
1.034	0.9	-0.1	5.3

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pilot static	TESTO INC.	06352145	July 16, 2020	MW-0035-20	5 – 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2500	July 16, 2020	MW-0035-20	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	July 20, 2020	MW-0036AA-20	0 - 5 m/s
4	Temperature	Zoglab	DSR-THP	March 30, 2021	CL-027-64	-30 - 70°C
5	Relative humidity	Zoglab	DSR-THP	March 30, 2021	RH-03032021	0 - 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 30, 2021	BP-01032021	500 – 1100 hPa
7	Wind tunnel	ESSOM	MP330D	-	-	0 – 50 Hz

End of certificate of calibration



CERTIFICATE OF CALIBRATION

Certificate No.: WD-06072021

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Novalynx.
: Wind direction sensor: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D.
: Wind direction sensor: WS-02P.

Serial Number : Data logger: A5791.
: Wind direction sensor: WSD-012.

ID No : Data logger: -.
: Wind direction sensor: -.

Customer : ALS laboratory group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250
Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(23\pm3)^{\circ}\text{C}$, and relative humidity of $(40\pm10)\%$.

Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and line laser is used for axis control, The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

Note: The UUC was warmed up for 1 hour prior to the calibration being performed

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: CC563-07-0045,
Certificate No.: KWS63/0044.

Measurement Date : Jul 14, 2021.

Issued Date : Jul 15, 2021.



Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya

Approved Signatory:.....

Mr. Parinya Booncharoen.
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-06072021

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

Calibration in the range of 0 – 360 ° at a calibration interval of 45°.

The results of calibration and associated measurement uncertainties are reported in table below.

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	42	-3	3.0
3		90	90	88	-2	3.0
4		135	135	135	0	3.0
5		180	180	183	3	3.0
6		225	225	228	3	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	42	-3	3.0
11		90	90	88	-2	3.0
12		135	135	135	0	3.0
13		180	180	183	3	3.0
14		225	225	228	3	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

UUC*: Unit Under Calibration The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No. : CL-052-64
Page 1 of 2

Equipment Name : Data Logger with Temperature
Sensor

Manufacturer : Novalynx

Model : 110-WS-25

Serial No. : A5791

ID No. : -

Customer

Name : ALS laboratory group (thailand) Co.,Ltd.

Address : 104 Phatthanakan 40, Phatthanakan
Rd.,Khwaeng Suan Luang, Khet Suan Luang,Bangkok
10250 Thailand.

Received date : 12 JUL 2021

Calibration date : 13 JUL 2021

Issue date : 13 JUL 2021

Reference Used During Calibration

1.Standard Temperature Probe Model : STS-100 A500,
Serial No. : 667682-09, Due date : 25 Mar 2022

2.Digital Temperature Indicator Model : DTI-1000-A MK
II, Serial No.: 671407-00591 Due date : 04 June 2022

Calibration Condition

Temperature : $(23 \pm 3)^{\circ}\text{C}$

Relative Humidity : $(55 \pm 15)\%$

Calibration Procedure

The temperature calibration was done by In-House
calibration method as WI-CL-001 according to
comparison method with standard digital temperature
indicator and standard temperature probe. The
temperature scale use was based on ITS-90.

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number : TT-0036-21, Certificate number : ER-0032-
21


Calibrated by

☐ Mr. Sorawit Thachalad

☒ Miss Orathai Wiwatwittaya



Approved Signatory:


Mr. Parinya Booncharoen
Technical Support
And Calibration Manager

Certificate No. : CL-052-64
Page 2 of 2

Result of Calibration :- ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 °C – 40 °C

Function:

This equipment was connected with temperature sensor Model : HMP60 S/N : T0931097

Dimension : Diameter 12mm. Length 80 mm.

<u>Immersion Depth (mm)</u>	<u>Standard Reading (°C)</u>	<u>UUC Reading (°C)</u>	<u>Error (°C)</u>	<u>Uncertainty (°C)</u>
60	20.049	19.8	-0.2	0.080
60	24.875	24.5	-0.4	0.13
60	29.864	29.5	-0.4	0.080
60	34.828	34.3	-0.5	0.080
60	39.831	39.3	-0.5	0.95

UUC* : Unit Under Calibration

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

*** End of Certificate ***

CALIBRATION REPORT

Calibration No. : RH-03072021

Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger.

Manufacturer : Data logger: Novalynx.
: Relative humidity sensor: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D.
: Relative humidity sensor: HMP60.

Serial Number : Data logger: A5791.
: Relative humidity sensor: T0931097.

ID No : Data logger: -
: Relative humidity sensor: -

Customer : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250
Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(25 \pm 3)^{\circ}\text{C}$, and relative humidity of $(50 \pm 15)\%$.

Measurement Method:

The Relative humidity with data logger, Unit Under Calibration (UUC) was calibrated by comparison method with the equilibrium of standard salt solution CH_3COOK : Potassium Acetate, $\text{Mg}(\text{NO}_3)_2$: Magnesium Nitrate, KCl : Potassium Chloride to determine the errors.

Measurement Date : Jul 14, 2021
Issued Date : Jul 14, 2021

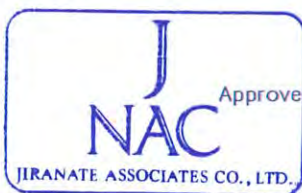
Measurement Results:

The results of calibration are reported in table below.

Standard salt solution.	Standard (%RH)	UUC _(Reading)	Error
CH_3COOK : Potassium Acetate	22.51	22.7	0.2
$\text{Mg}(\text{NO}_3)_2$: Magnesium Nitrate	52.89	52.4	-0.5
KCl : Potassium Chloride	84.34	84.1	-0.2

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....

Mr. Parinya Booncharoen.
Technical Support
and Calibration Manager

CALIBRATION REPORT

Calibration No. : BP-01072021

Page 1 of 2 Pages

Measurement Item : Barometric pressure with data logger.

Manufacturer : Data logger: Novalynx.
: Barometric pressure: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D
: Barometric pressure: 110-WS-25BP.

Serial Number : Data logger: A5791
: Barometric pressure: A5791

ID NO : -

Customer : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250, Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(25\pm3)^{\circ}\text{C}$, and relative humidity of $(50\pm15)\%$.

Measurement Method:

The Barometric pressure sensor, Unit Under Calibration (UUC) was calibrated in the pressure conditioning chamber. The standard pressure (P_{STD}) at 990 – 1015 hPa was generated by digital pressure generator. The pressure reading of UUC (P_{UUC}) were compared to the pressure reading of standard to determine the error.

Traceability:

This calibration documents the traceability to national standard which realize the unit of measurements according to the national system of units (SI) through Druck Limited via Certificate No: PS1206, Certificate No: PS1237.

Measurement Date : Jul 13, 2021
Issued Date : Jul 14, 2021

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....

Mr. Parinya Booncharoen.
Technical Support
and Calibration Manager

Continuation of Calibration report number

Calibration No: BP-01072021

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment.

The results of calibration are reported in table below.

Calibration Point (hPa)	P _(STD) reading (hPa)	P _(UUC) reading (hPa)	Error (hPa)
990	990.004	990.268	0.264
995	995.003	995.476	0.473
1000	1000.006	1000.965	0.959
1005	1005.002	1005.586	0.584
1010	1010.001	1010.881	0.880
1015	1015.007	1015.689	0.682

End of calibration report

CALIBRATION REPORT

Calibration Number. : RG-01072021

Page 1 of 2 Pages

Measurement Item : Rain gauge with data logger.

Manufacturer : Data logger: Novalynx.
: Rain gauge: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D.
: Rain gauge: 110-WS-25RG.

Serial Number : Data logger: A5791.
: Rain gauge: RG-007.

Customer : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang,
Bangkok 10250, Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(25 \pm 3)^{\circ}\text{C}$, and relative humidity of $(50 \pm 15)\%$.

Measurement Method:

The Rain gauge, Unit Under Calibration (UUC) was calibrated by Precision reference bottle with flow adjuster at low rate 0.6 mm per minute or 1 tipping every 20 seconds. The tipping number was determined by procedures below.

1. Obtain rain gauge inlet area:
Rain gauge precise diameter in cm = Diameter/2 = R (radius)
Rain gauge area = $R^2 \times 3.14$ (UUC diameter=20.3 cm, UUC radius=10.15 cm)
Rain gauge area = 323.6 cm^2 .
2. Obtain theoretical correct rain gauge answer (number of tipplings) using 323.6 cm^2 inlet area and 0.5 L of rain.
 - a) $10,000 \text{ cm}^3 / 323.6 \text{ cm}^2$ inlet area = 30.90 (rain gauge area = 1/30.90 of square meter)
 - b) $30.90 \times 0.5 \text{ L volume} = 15.45 \text{ mm}$ (mm of rain over 1 m^2 surface) 500 ml of rain volume on the rain gauge area = 15.45 mm of rain.
 - c) Number of tipping = $15.45 / 0.25 \text{ mm} = 62$ tipplings.

Note: Rain gauge is fully cleaned and leveling prior the calibration performed.

Measurement Date : Jul 13, 2021

Issued Date : Jul 14, 2021

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:

Mr. Parinya Booncharoen,
Technical Support
and Calibration Manager

Continuation of Calibration of Calibration Number

Calibration Number: RG-D1072021

Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

The results of calibration are reported in table below.

Quantity of H ₂ O (ml)	Determined Tipping	Tipping count	Acceptable Tipping count
500	62	62	60 - 64
500	62	61	60 - 64
500	62	62	60 - 64
500	62	62	60 - 64
500	62	61	60 - 64

Remark: The procedure is made to verify the correct reading of the Unit under Calibration rain gauge when a precise volume of water falls into its cone. We suggest that the number of tipping should be within $\pm 2\%$ different from the 62 tipping (correct range: 60-64 tipping) it means that the rain gauge meets the manufacturer acceptable limit.

End of calibration report

CERTIFICATE OF CALIBRATION

Certificate No.: WD-02072022

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Novalynx.
: Wind direction sensor: Novalynx.

Model/Type : Data logger: 200-WS-25LB
: Wind direction sensor: WS-02F

Serial Number : Data logger: A5192
: Wind direction sensor: -

ID No : Data logger: SGK_FS0035
: Wind direction sensor: -

Customer : ALS laboratory group (Thailand) co., ltd.
: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250
Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(23 \pm 3) ^\circ\text{C}$, and relative humidity of $(40 \pm 10) \%$.

Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and line laser is used for axis control. The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

Note: The UUC was warmed up for 1 hour prior to the calibration being performed

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: Q21086014, Certificate No.: KWS64/0025.

Measurement Date : Jul 13, 2022.
Issued Date : Jul 14, 2022.

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Jittrapon Lertsomphol



Approved Signatory:


Mr. Parinya Booncharoen.
Calibration Department Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-02072022

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

Calibration in the range of 0 – 360 ° at a calibration interval of 45°.

The results of calibration and associated measurement uncertainties are reported in table below.

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	43	-2	3.0
3		90	90	87	-3	3.0
4		135	135	133	-2	3.0
5		180	180	180	0	3.0
6		225	225	228	3	3.0
7		270	270	274	4	3.0
8		315	315	320	5	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	43	-2	3.0
11		90	90	87	-3	3.0
12		135	135	133	-2	3.0
13		180	180	180	0	3.0
14		225	225	228	3	3.0
15		270	270	274	4	3.0
16		315	315	320	5	3.0

UUC*: Unit Under Calibration The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No: WS-02072022

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx
: Cup anemometer: Novalynx

Model/Type : Data logger: 200-WS-25LB
: Cup anemometer: WS-02F

Serial Number : Data logger: A5193
: Cup anemometer: -

ID No : Data logger: SGK_FS0035
: Cup anemometer: -

Customer : ALS laboratory group (Thailand) co., ltd.
: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Test Conditions

: Wind tunnel cross test section area	900	cm ²
: Anemometer frontal area	100	cm ²
: Diameter of mounting pipe	-	mm
: Blockage ratio of test object	0.111	[-]

Test Conditions

: Air temperature	24.0	±0.8 °C
: Air pressure	1005.3	±0.4 hPa
: Relative air humidity	45.1	±3.5 %RH

Calibration Procedure Calibration was carried out base on;
IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines;
MEASNET Anemometer Calibration Procedure – Version 2: 2009;

Traceability This calibration documents the traceable to national standard, Which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).

Measurement Date : Jul 13, 2022.

Issued Date : Jul 14, 2022.

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Jitraporn Lertsomphol



Approved Signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

Continuation of Certificate of Calibration Number

Certificate No: WS-02072022

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

Calibration in the range of 1 – 16 m/s at a calibration interval of 1 m/s.

The results of calibration and associated measurement uncertainties are reported in the table below.

V _{STD} Reading m/s	V _{UUC} * Reading m/s	Error (m/s)	Uncertainty (%)
2.063	2.0	-0.1	2.4
4.115	4.1	0.0	1.1
5.97	6.1	0.1	0.97
7.99	8.0	0.0	0.79
9.99	10.2	0.2	0.69
12.03	12.3	0.3	0.63
14.02	14.3	0.3	0.58
15.98	16.4	0.4	0.48
14.99	15.3	0.3	0.57
13.01	13.3	0.3	0.52
10.97	11.1	0.1	0.52
8.98	9.0	0.0	0.74
6.99	7.0	0.0	0.81
5.121	5.1	0.0	0.86
3.000	3.0	0.0	1.7
1.040	0.9	-0.1	4.5

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TESTO INC.	06352145	Aug 07, 2021	MW-0034-21	5 – 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2500	Aug 07, 2021	MW-0034-21	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	Aug 08, 2021	MW-0035-21	0 - 5 m/s
4	Temperature	Zoglab	DSR-THP	March 30, 2022	CL-027-65	-30 - 70°C
5	Relative humidity	Zoglab	DSR-THP	March 30, 2022	RH-03032022	0 - 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 30, 2022	BP-01032022	500 - 1100 hPa
7	Wind tunnel	ESSOM	MP330D	-	-	0 - 50 Hz

End of certificate of calibration



CERTIFICATE OF CALIBRATION

Certificate No.: WD-07072021

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Novalynx.
: Wind direction sensor: Novalynx.

Model/Type : Data logger: 110-WS-25DL-D.
: Wind direction sensor: WS-02F.

Serial Number : Data logger: A5792.
: Wind direction sensor: WSD-013.

ID No : Data logger: -.
: Wind direction sensor: -.

Customer : ALS laboratory group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250
Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(23 \pm 3)^{\circ}\text{C}$, and relative humidity of $(40 \pm 10)\%$.

Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and line laser is used for axis control. The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

Note: The UUC was warmed up for 1 hour prior to the calibration being performed

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: CC563-07-0045,
Certificate No.: KWS63/0044.

Measurement Date : Jul 14, 2021.

Issued Date : Jul 15, 2021.



Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya

Approved Signatory:.....

Mr. Parinya Booncharoen.
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-07072021

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

Calibration in the range of 0 - 360 ° at a calibration interval of 45°.

The results of calibration and associated measurement uncertainties are reported in table below.

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	42	-3	3.0
3		90	90	87	-3	3.0
4		135	135	132	-3	3.0
5		180	180	180	0	3.0
6		225	225	227	2	3.0
7		270	270	272	2	3.0
8		315	315	317	2	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	42	-3	3.0
11		90	90	87	-3	3.0
12		135	135	132	-3	3.0
13		180	180	180	0	3.0
14		225	225	227	2	3.0
15		270	270	272	2	3.0
16		315	315	317	2	3.0

UUC*: Unit Under Calibration The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor $k=2$ providing a level of confidence of approximately 95%

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No: WS-07072021

Page 1 of 2 pages

Measurement Item	: Cup anemometer with data logger.		
Manufacturer	: Data logger: Novalynx. : Cup anemometer: Novalynx.		
Model/Type	: Data logger: 110-WS-25DL-D. : Cup anemometer: WS-02P.		
Serial Number	: Data logger: A5792. : Cup anemometer: WSD-013.		
ID No	: Data logger: -. : Cup anemometer: -.		
Customer	: ALS laboratory group (Thailand) co., ltd. : 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khel Suan Luang, Bangkok 10250 Thailand.		
Test Conditions	: Wind tunnel cross test section area	900	cm ²
	: Anemometer frontal area	100	cm ²
	: Diameter of mounting pipe	-	mm
	: Blockage ratio of test object	0.111	[-]
Test Conditions	: Air temperature	23.7	±0.8 °C
	: Air pressure	1005.8	±0.4 hPa
	: Relative air humidity	59.1	±3.5 %RH
Calibration Procedure	Calibration was carried out base on; IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines; MEASNET Anemometer Calibration Procedure – Version 2: 2009;		
Traceability	This calibration documents the traceable to national standard, Which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).		
Measurement Date	: Jul 14, 2021.		
Issued Date	: Jul 15, 2021.		

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory: _____

[Signature]

Mr. Parinya Booncharoen
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WS-07072021

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

Calibration in the range of 1 – 16 m/s at a calibration interval of 1 m/s.

The results of calibration and associated measurement uncertainties are reported in the table below.

V _{STD} Reading m/s	V _{UUC} Reading m/s	Error (m/s)	Uncertainty (%)
2.078	1.9	-0.2	2.5
4.132	4.0	-0.1	1.1
6.02	6.0	0.0	0.99
7.97	8.0	0.0	0.84
10.03	10.0	0.0	0.73
12.02	12.0	0.0	0.75
13.98	14.2	0.2	0.49
15.98	16.2	0.2	0.37
14.97	15.2	0.2	0.66
13.00	13.1	0.1	0.49
11.02	10.9	-0.1	0.98
9.00	9.0	0.0	0.89
6.99	7.0	0.0	1.1
5.152	5.0	-0.2	1.0
2.988	3.0	0.0	1.6
1.021	0.9	-0.1	5.4

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TGSTO INC.	06352145	July 16, 2020	MW-0035-20	5 – 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2500	July 16, 2020	MW-0035-20	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	July 20, 2020	MW-0036AA-20	0 – 5 m/s
4	Temperature	Zoglab	DSR-THP	March 30, 2021	CL-027-64	-30 – 70°C
5	Relative humidity	Zoglab	DSR-THP	March 30, 2021	RH-03032021	0 – 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 30, 2021	BP-01032021	500 – 1100 hPa
7	Wind tunnel	GSSOM	MP330D	-	-	0 – 50 Hz

End of certificate of calibration



SITHIPHORN ASSOCIATES CO.,LTD.

CALIBRATION LABORATORY



451-451/1 Sirinthorn Rd., Bangbumru, Bangplud Bangkok 10700 THAILAND.
Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiphorn.com http://www.sithiphorn.com

NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACC22028

Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No.: 34478386
ID No.: SGK_FS0011

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWANG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location : -
Ambient Temperature : (23.0 \pm 3) °C
Pressure : (101.3 \pm 3) kPa
Relative Humidity : (50.0 \pm 20) %

Received Date : 06 SEPTEMBER 2022
Calibration Date : 09 SEPTEMBER 2022
Date of Issue : 14 SEPTEMBER 2022

REVIEW BY	<i>Marakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	9/9/23

Calibrated by : Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

Continuation of Calibration Certificate

Cert. No. : ACC22028

Job No. : VC65AC0081

Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

This equipment was calibrated by based on IEC-60942-2003 Standard.

The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference microphone.

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	33461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23
Audio Analyzer	AVR-3360A	V744B6069	EF-0010-22	07-Feb-23

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

Continuation of Calibration Certificate

Cert. No. : ACC22028

Job No. : VC65AC0081

Pages : 3 of 3

Result of calibration :**1. Sound pressure level**

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	94.1	0.10	0.15	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1002.5	0.3	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
1.82	0.10	3.0

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$
or any value following calculation, providing a level of confidence of approximately 95 %

————— **End of Calibration Certificate** —————

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd.,Bangbumru, Bangplud Bangkok 10700 THAILAND.
Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiphorn.com http://www.sithiphorn.com



NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL22163

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00472128 / 170311 / 73011
ID No.: SGK_FS0013

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWANG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location : -

Ambient Temperature : (23.0 \pm 3) °C
Pressure : (101.3 \pm 3) kPa
Relative Humidity : (50.0 \pm 20) %

Received Date : 06 JULY 2022
Calibration Date : 11-18 JULY 2022
Date of Issue : 19 JULY 2022

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	11/7/23

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

Continuation of Calibration Certificate

Cert. No. : ACL22163
Job No. : VC65AC0069
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).

The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

Continuation of Calibration Certificate

Cert. No. : ACL22163

Job No. : VC65AC0069

Pages : 3 of 8

Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.2	N/A
2. Self-generated noise	✓	-	0.2	N/A
3. Acoustical signal tests of frequency weightings				
125 Hz	✓	-	0.3	0.6
1000 Hz	✓	-	0.3	0.6
8000 Hz	✓	-	0.3	0.7
4. Electrical signal tests of frequency weightings				
For 10 Hz to 4 kHz	✓	-	0.3	0.6
For > 4 kHz to 10 kHz	✓	-	0.3	0.7
For > 10 kHz to 20 kHz	-	-	-	1.0
5. Frequency and time weightings at 1 kHz	✓	-	0.2	0.2
6. Long - term stability	✓	-	0.1	0.1
7. Level linearity on the reference level range	✓	-	0.2	0.3
8. Level linearity including the level range control	✓	-	0.2	0.3
9. Tone burst response	✓	-	0.2	0.3
10. Peak C sound level	✓	-	0.2	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

Continuation of Calibration Certificate

Cert. No. : ACL22163

Job No. : VC65AC0069

Pages : 4 of 8

Result of calibration :**1. Absolute sensitivity**

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
18.2

2.2 The microphone of the sound level meter was replaced by electrical signal input device.

Frequency Weighting	Measured value (dB)
A - weight	12.0
C - weight	18.5
Flat	24.2

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.0	0.0	0.0	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	0.6	0.7	0.7	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL22163
Job No. : VC65AC0069
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	-0.1	-0.1	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	94.0	0.0	± 0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	94.0	0.0	± 0.1
Leq	94.0	0.0	± 0.1

6. Long - term stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.0	0.0	± 0.3

Continuation of Calibration Certificate

Cert. No. : ACL22163

Job No. : VC65AC0069

Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL22163
Job No. : VC65AC0069
Pages : 7 of 8

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Auto	94.0	94.0	0.0	±1.1

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.6	-0.8	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

Continuation of Calibration Certificate

Cert. No. : ACL22163

Job No. : VC65AC0069

Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.5	89.7	0.2	±1.5

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	137.0	137.0	0.0	±0.3

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$
or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22TM75

Page.: 1 of 3

Certificate of Calibration

Equipment : Incubator
Manufacturer : Memmert
Model : ICP 750
Serial No. : F816.0063
ID No. : SGK_CL0028
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
Songkhla Branch.
114/1 Moo 8, Kanjanavanij Rd., Banphru,
Hatyai, Songkhla 90250, Thailand
Location : BOD Room
Received Order : 24 January 2022
Calibration Date : 25 January 2022
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Kunchit Promprat

REVIEW BY Ananta B.
APPROVED BY Kanitta H.
NEXT CAL. DATE 26/7/23

Approved by : Malee Butkruea
Approved Signatory

- () Pornthippa Tameyakul
(✓) Malee Butkruea
() Suwit Imjai

Issue Date : 7 February 2022

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 0037405



Equipment : Incubator
 Condition As-Received : Used Item
 Reference : 2201-0617OC-3
 Procedure Used :-

Cert. No.: 22TM75

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).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY57013823	21LM3/1	26 Feb 2022

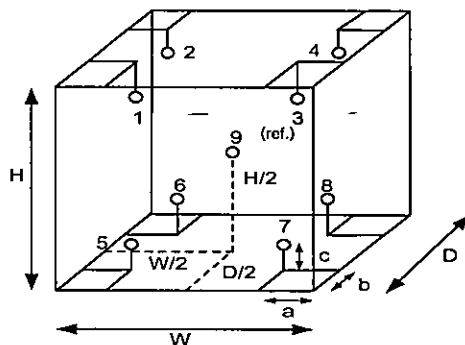
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Environment during calibration		
	Beginning	Finished
Temp. (°C)	28	28
REL.Humid. (%)	57	52
AC Supply (Volt)	231	231

Probe Installation Details :

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

Dimension of Chamber :

D = 0.60 m
 W = 1.0 m
 H = 1.2 m
 Capacity = 0.75 m³

Position :	Ref. Std. ID No.:
1	21-17RTD-01
2	21-17RTD-02
3	17RTD-03
4	17RTD-04
5	17RTD-05
6	17RTD-06
7	17RTD-07
8	17RTD-08
9 (ref.)	17RTD-09

Malu .



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2201-0617OC-3
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 22TM75

Page.: 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
20.0	20.0	20.1	0.094	0.50	0.83	0.30	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
20.0	20.280	20.370	20.363	20.378	19.915	19.925	19.673	19.727	20.098

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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Mulu .



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

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

Cert.No.: 21TW256

Page.: 1 of 2

Certificate of Testing

Equipment :	DO Meter	<div><div>REVIEW BY Preetiya P.</div><div>APPROVED BY Kanitha H.</div><div>NEXT CAL. DATE 2/12/2022</div></div>
Manufacturer :	YSI	
Model :	5000	
Serial No. :	17B101473	
ID No. :	SGK_CL0073	
Received Date :	01 December 2021	
Test Date :	02 December 2021	
Reference :	2112-0025DSC-1	
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. Songkhla Branch. 114/1 Moo 8 Karnchanawanich Rd., T.Ban Phru, A.Hat Yai, Songkhla 90250 Thailand	
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><div></div><div>Approved Signatory</div></div>	
(/) Malee Butkruea		
() Saithip Meangmai		
() Warakorn Lerngagtrakul		
Issue Date :	6 December 2021	



Cert.No.: 21TW256

Page.: 2 of 2

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 17B100103

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.12	8.11	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-

Malu.

a 1084082



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Cert. No.: 21LM26

Page.: 1 of 2

Certificate of Calibration

Equipment :	DO Meter with Sensor	<div>REVIEW BY <u>Preeiya P.</u> APPROVED BY <u>Kanitta H.</u> NEXT CAL DATE <u>2/8/12/2022</u> <u>512</u></div>
Manufacturer :	YSI	
Model :	5000	
Serial No. :	17B101473	
ID No. :	SGK_CL0073	
Submitted by :	ALS Laboratory Group (Thailand)Co.,Ltd. Songkhla Branch 114/1 Moo 8 Karnchanawanich Rd., T.Ban Phur, A.Hat Yai, Songkhla 90250 Thailand	
Location :	On Site Calibration Service Laboratory	
Received Order :	1 December 2021	
Calibrated Date :	6 December 2021	
Ambient Temperature :	(26 ± 10) °C	
Relative Humidity :	(50 ± 30) %	
AC Line Voltage :	(220 ± 22) V	
Calibrated by :	Man Pattanapongpaiboon	
Approved by :	<u>Malee</u> Approved Signatory	
<input type="checkbox"/> Pornthippa Tameyakul <input checked="" type="checkbox"/> Malee Butkruea <input type="checkbox"/> Suwit Imjai		
Issue Date :	9 December 2021	

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 0032821



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2112-0025DSC-1

Cert. No.: 21LM26

Page.: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Digital Thermometer	1502A	A52847	21I1144	20 Oct 2022

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.

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 17B100103

<u>Calibration Point</u> (°C)	<u>Immersion Depth</u> (mm)	<u>Standard Temperature</u> (°C)	<u>UUC* Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (± °C)	<u>Coverage Factor</u> <i>k</i>
20.00	60	20.001	19.96	-0.041	0.15	2.00

UUC* : Unit Under Calibration

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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Mala



Certificate of Calibration

Certificate No.:	PTC/10/22004	Page:	1 of 4
Equipment:	Cod Reactor	Condition:	New
Manufacturer:	Hach	Serial No. :	21120C1313
Model:	DRB200	ID No. :	-
Covers:	None	Holes:	30

Environment Condition:	Temperature:	25.2	°C	±	0.1	°C
	Humidity:	49.5	%RH	±	1.1	%RH
	Voltage:	221.8	VAC	±	0.6	VAC

Customer: ALS LABORATORY GROUP (THAILAND)
114/1 Moo.8, Karnchanawanich Rd., T.Ban Phru,
A.Hat Yai, Songkhla 90250 Thailand.

Calibration Place: Penta Calibration Co., Ltd. (Temperature Laboratory)
66/124 The connect 34 Village, Kanchanaphisek Road,
Dokmai, Prawet Bangkok 10250 Thailand

The Method used: In house method, PTC-WI-10, based on Compare with Standard Thermometer

Traceability: This certificate is traceable to the SI Units through Quality Reborn Co.,Ltd ,
NSC-ONSC Accreditation No.: Calibration 0292

Date Received: February 08, 2022
Date Calibrated: February 08, 2022
Date Issued: February 08, 2022
Calibrated By: Mr. Todsapol Moolsuang

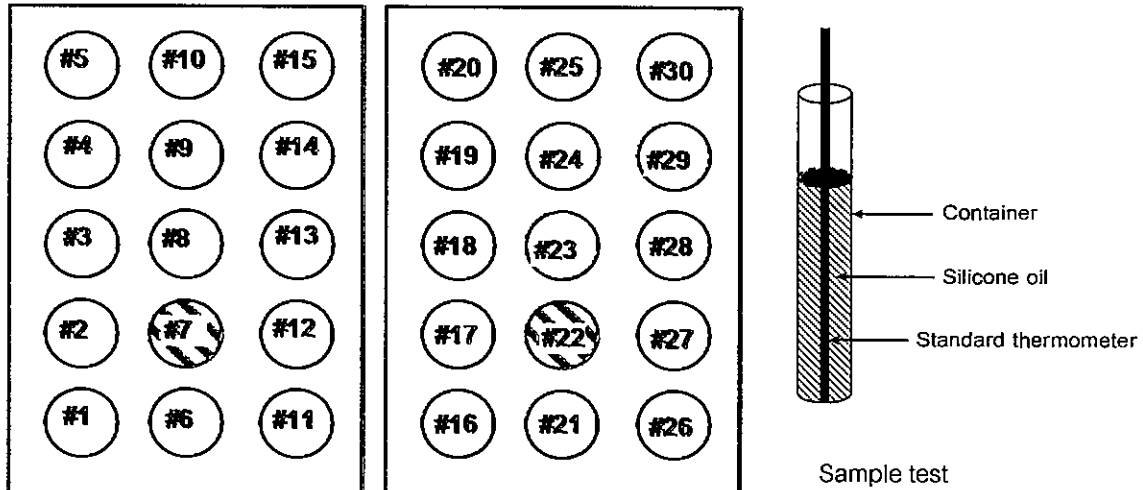
(Mr.Kriangsak Kalasri)

Reviewed by

Approved By :

(Mr. Keattisak Kerdto)

Laboratory Manager



Standard Installation Position:

Module	1									
Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
Probe No.	1	2	3	4	5	6	7	8	9	10

Module	2									
Position of Std	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Probe No.	1	2	3	4	5	6	7	8	9	10

Module	2									
Position of Std	#21	#22	#23	#24	#25	#26	#27	#28	#29	#30
Probe No.	1	2	3	4	5	6	7	8	9	10

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognised national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor ($k=2$) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The effect that the results relate only to the items calibrated.

This calibration certificate shall not be reproduced except in full only, without written approval from penta calibration co., ltd



Measurement Results:

Without adjustment

Position heating block	Calibration point (°C)	Setting (°C)	UUC Reading (°C)
Left	150	150	150

Measurement Temperature (°C) @ Probe No.			
Position	Standard Reading (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	150.77	0.77	0.64
#2	149.49	-0.51	0.63
#3	150.38	0.38	0.63
#4	150.28	0.28	0.63
#5	149.74	-0.26	0.63
#6	150.94	0.94	0.64
#7	149.01	-0.99	0.64
#8	150.82	0.82	0.64
#9	149.49	-0.51	0.63
#10	149.11	-0.89	0.63
#11	149.31	-0.69	0.64
#12	150.73	0.73	0.64
#13	150.48	0.48	0.64
#14	149.13	-0.87	0.63
#15	149.19	-0.81	0.64

UUC Characterization

UUC Setting (°C)	UUC Reading (°C)	Measured Uniformity (°C)	Measured Stability (± °C)
150	150	1.55	0.12

Note: UUC = Unit Under Calibration

Definitions

UUC Reading : The average reading of indicating device which forms the integral part of UUC.

Standard Reading : The average reading of standards at any positions or location.

Measured Uniformity : The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with any holes of UUC at steady-state. The reference probe is preferably located in the geometric center of UUC.

Measured Stability : The one-half of greatest maximum difference of measured temperatures at any one probe.



Measurement Results:

Without adjustment

Position heating block	Calibration point (°C)	Setting (°C)	UUC Reading (°C)
Right	150	150	150

Measurement Temperature (°C) @ Probe No.			
Position	Standard Reading (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#16	149.46	-0.54	0.64
#17	149.79	-0.21	0.64
#18	149.27	-0.73	0.64
#19	150.14	0.14	0.64
#20	149.38	-0.62	0.64
#21	150.81	0.81	0.64
#22	150.80	0.80	0.65
#23	150.71	0.71	0.64
#24	149.86	-0.14	0.64
#25	149.23	-0.77	0.64
#26	150.61	0.61	0.64
#27	149.10	-0.90	0.64
#28	150.71	0.71	0.64
#29	149.10	-0.90	0.64
#30	150.74	0.74	0.64

UUC Characterization

UUC Setting (°C)	UUC Reading (°C)	Measured Uniformity (°C)	Measured Stability (± °C)
150	150	1.55	0.12

Note: UUC = Unit Under Calibration

Definitions

UUC Reading : The average reading of indicating device which forms the integral part of UUC.

Standard Reading : The average reading of standards at any positions or location.

Measured Uniformity : The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with any holes of UUC at steady-state. The reference probe is preferably located in the geometric center of UUC.

Measured Stability : The one-half of greatest maximum difference of measured temperatures at any one probe.

The End of Certificate



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 22CHO32

Page.: 1 of 3

Certificate of Calibration

Equipment : UV-VIS Spectrophotometer
Manufacturer : Hach
Model : DR 3900
Serial No. : 1687645
ID No. : SGK_CL0038
Condition As-Received: Used Item
Received Date : 24 January 2022
Calibration Date : 24 January 2022
Reference : 2201-0617OC-1
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
Songkhla Branch
114/1 Moo 8, Kanjanavanij Rd., Banphru, Hatyai,
Songkhla 90250 , Thailand
Calibration Place : Chemistry Room
Ambient Temperature : (24.9 - 25.2) °C (On-Site)
Relative Humidity : (39.2 - 45.2) % (On-Site)
Calibration Procedure : In - house method :
CP-OCH4 based on ASTM E 275-01
Calibrated by : Kunchit Promprat

REVIEW BY Ananta B.
APPROVED BY Kanitta B.
NEXT CAL. DATE 24/1/23

Approved by :

Malee Butkruea
Approved Signatory

- (☒) Malee Butkruea
(☐) Saithip Meangmai
(☐) Warakorn Lerngagtrakul

Issue Date : 7 February 2022

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 0037403



Cert. No. : 22CHO32

Page : 2 of 3

Condition of calibration result

1. Reference Standard Material :

<u>Material</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due date</u>
1. Absorbance Standard set	8331	86623	08 Sep 2022
2. Wavelength Standard set	29829	94776	02 Sep 2023
3. Wavelength Standard set	29829	94777	02 Sep 2023

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 at :

- National Physical Laboratory (NPL), The United Kingdom of Great Britain and Northern Ireland
- National Institute of Standards and Technology (NIST), The United States of America

4. Spectral BandWidth : 5 nm

Scan Speed : - nm/min

Calibration Results : without adjustment

Wavelength Accuracy

Certified Values of Reference Material (nm)	UUC Reading (nm)	Uncertainty of Measurement (\pm nm)	Coverage Factor <i>k</i>
418.40	418	0.59	2.00
479.88	480	0.59	2.00
513.75	514	0.59	2.00
537.00	536	0.59	2.00
638.00	638	0.59	2.00
747.61	748	0.59	2.00
807.04	807	0.59	2.00

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Cert. No. : 22CHO32

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>
420.0	Zero	0.000	0.0028	2.00
	0.5723	0.572	0.0033	2.00
	0.7522	0.751	0.0031	2.00
	1.0907	1.090	0.0033	2.00
440.0	Zero	0.000	0.0028	2.00
	0.5616	0.560	0.0034	2.00
	0.7345	0.732	0.0032	2.00
	1.0646	1.063	0.0033	2.00
465.0	Zero	0.000	0.0028	2.00
	0.5118	0.514	0.0034	2.00
	0.6773	0.679	0.0031	2.00
	0.9809	0.984	0.0033	2.00
546.1	Zero	0.000	0.0028	2.00
	0.5228	0.522	0.0030	2.00
	0.6861	0.684	0.0030	2.00
	0.9941	0.993	0.0030	2.00
590.0	Zero	0.000	0.0028	2.00
	0.5546	0.552	0.0029	2.00
	0.7159	0.712	0.0030	2.00
	1.0369	1.033	0.0030	2.00
635.0	Zero	0.000	0.0028	2.00
	0.5401	0.538	0.0029	2.00
	0.6835	0.680	0.0029	2.00
	0.9889	0.986	0.0030	2.00

Remark

- Each individual filter is measured against the empty filter holder (blank) used to zero the spectrophotometer

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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CALIBRATION CERTIFICATE

Issued Date : 12-Nov-2021

Certificate No. : 21PH192

CSR No. : A012/00583

Page. : 1 of 2

Customer : ALS Laboratory Group (Thailand) Co., Ltd
114/1 Moo 8 Karnchanawanich Rd. T.Ban Phru,
A. Hat Yai, Songkhla 90250 TH

Calibration Place : Chemical Laboratory

Instrument Name : pH meter

Manufacturer : Mettler Toledo

Model : S220

Serial No. : B625631849

ID No. : SGK_CL0030

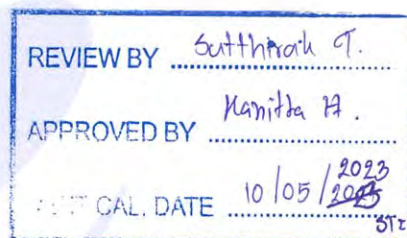
Electrode No. : 6404000

Received Date : 9-Nov-2021

Calibrated Date : 9-Nov-2021

Ambient Temperature : $(25 \pm 3) ^\circ\text{C}$

Relative Humidity : $(55 \pm 15) \%$



Calibration Method Used :

This instrument was calibrated using the Calibration In - house method : SCAL.WI.008 based on direct measurement by using certified reference Material (CRM)

The Southern Calibration Service Co.,Ltd.calibration control system complies with requirement of ISO/IEC 17025:2017

Traceability of measurement :

This Certificate is traceable to the International and /or national standards which realize the units of measurement according to the International System of Unit (SI) through :

- HACH : LANGE United For Water Quality
- WK : WK Electric Co., Ltd.
- Q Reborn : Quality Reborn Co.,Ltd.

Calibrated by : Jessadagon Lemhud

Approved by :

Sakeereen Heemhad / Technical Manager

The uncertainties are for a confidence probability of approximately 95%

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Details of Calibration

1. Reference Standard Equipment Used:

Equipment	Model	Serial No.	Cert. no.	Due Date
Standard Solution	4.005	C02840	1617	24-Aug-2022
Standard Solution	7.000	C02841	1618	24-Aug-2022
Standard Solution	10.012	C02843	1619	24-Aug-2022
Temperature/Electrical Calibrator	MC2-MF	23642	WK2102-006-229	21-Feb-2022
Digital Thermometer With Sensor	1529	B4C223	QR21-2009	15-Sep-2022

2. The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the longterm stability of instrument.

3. This certificate is not certified any commercial transaction

4. Condition of Item : normal condition , no indication for any damage or malfunction

Result of Calibration : (✓) Without Adjustment () After Adjustment

1. Electrical Measurement

Applied Voltage (mV)	pH meter Reading (mV)	Correction (mV)	Uncertainty (± mV)
177.48	177.5	-0.02	0.17
0.00	0.0	0.00	0.13
-177.48	-177.5	0.02	0.17

2. Sample Test Measurement

Standard Buffer Solutions (pH)	pH meter Reading (pH)	Correction (pH)	Uncertainty (± pH)
4.007	3.99	0.017	0.011
6.999	7.02	-0.021	0.014
10.011	10.01	0.001	0.036

3. Temperature Measurement

Cal Point (°C)	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
25	24.93	25.0	-0.07	0.11

The report 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 ...



Southern Calibration Service Co., Ltd.

669/35 Karnjanavanit Rd., Banpru, Hatyai, Songkhla 90250 Thailand

Tel: 081 599 0417 Fax: 074 805 133 Email: s.calibration@gmail.com www.scal-lab.com



CALIBRATION CERTIFICATE

Issued Date : 8-Feb-2022

Certificate No. : 22EB149

CSR No. : A023/01123

Page. : 1 of 3

Customer : ALS Laboratory Group (Thailand) Co., Ltd
114/1 Moo 8 Karnchanawanich Rd. T.Ban Phru,
A. Hat Yai, Songkhla 90250 TH

Calibration Place : Chemical Laboratory
Instrument Name : Electronic Balance
Manufacturer : Sartorius
Model : MSE224S-100-DU
Serial No. : 34705158
ID No. : SGK_CL0045
Resolution : 0.0001 g
Received Date : 5-Feb-2022
Calibrated Date : 5-Feb-2022
Ambient Temperature : (30 ±10) °C
Relative Humidity : (50 ±20) %

REVIEW BY	Ananta B.
APPROVED BY	Kanitta H.
NEXT CAL. DATE	5/02/2023

Calibration Method Used :

This instrument was calibrated using the Calibration In - house method : SCAL.WI.001 based on UKAS LAB 14 : 2015

The Southern Calibration Service Co.,Ltd.calibration control system complies with requirement of ISO/IEC 17025:2017

Traceability of measurement :

This Certificate is traceable to the International and /or national standards which realize the units of measurement according to the International System of Unit (SI) through :

- Tcs : Thai Calibration Service Co.,Ltd.

Calibrated by : Imron Rattanaylum

Approved by :

Sakeereen Heemhad / Technical Manager

This certificate may not be reproduced other than in full, except with the prior written approval of Southern Calibration Service Co., Ltd.



Certificate No. : 22EB149

CSR No. : A023/01123

Page. : 2 of 3

Details of Calibration

1. Reference Standard Equipment Used:

Equipment	Model	Serial No.	Cert. no.	Due Date
Standard Weight Set	2mg-2kg	11119514/01	M2107051S	6-Jul-2022

2. The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the longterm stability of instrument.

3. This certificate is not certified any commercial transaction

4. Condition of Item : normal condition , no indication for any damage or malfunction

Result of Calibration :: (✓) Without Adjustment () After Adjustment

1. Repeatability

Nominal Value (g)	Standard Deviation (g)
200	0.00000

2. Effect of tare

Nominal Value (g)	Standard Value (g)	Balance Reading (g)	Correction (g)
20	20.0000	20.0000	0.0000
40	40.0001	40.0000	0.0001
60	60.0000	60.0001	-0.0001
80	80.0001	80.0001	-0.0001
100	100.0000	100.0000	0.0000

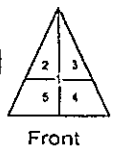
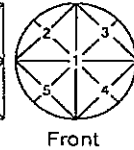
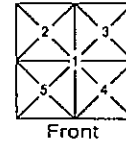
Result of Calibration :

3. Off-centre loading

A mass approximately 50g was placed on a pan and moved to various position .

The balance reading obtained are given in the table.

Position					Maximum Difference (g)
1	2	3	4	5	
50.0000	50.0000	50.0000	50.0000	50.0000	0.0000



4. Departure from nominal value

Nominal Value (g)	Standard Value (g)	UUC Reading (g)	Correction (g)	Uncertainty (\pm g)	Coverage Factor (k)
0.01	0.0100	0.0100	0.0000	0.00008	2.0
0.1	0.1000	0.1000	0.0000	0.00008	2.0
0.5	0.5000	0.5000	0.0000	0.00008	2.0
1	1.0000	1.0000	0.0000	0.00008	2.0
2	2.0000	2.0000	0.0000	0.00008	2.0
5	5.0000	5.0000	0.0000	0.00009	2.0
10	10.0000	10.0000	0.0000	0.00009	2.0
20	20.0000	20.0000	0.0000	0.00009	2.0
50	50.0000	50.0000	0.0000	0.00011	2.0
100	100.0000	100.0000	0.0000	0.00016	2.0
120	120.0000	120.0000	0.0000	0.00024	2.0
140	140.0001	140.0000	0.0001	0.00024	2.0
160	160.0000	160.0000	0.0000	0.00026	2.0
180	180.0000	180.0000	0.0000	0.00029	2.0
200	200.0000	200.0000	0.0000	0.00030	2.0

- UUC = Unit Under Calibration

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

...End...



Southern Calibration Service Co., Ltd.

669/35 Karnjanavanit Rd., Banpru, Hatyai, Songkhla 90250 Thailand

Tel: 081 599 0417 Fax: 074 805 133 Email: s.calibration@gmail.com www.scal-lab.com



CALIBRATION CERTIFICATE

Issued Date : 12-Nov-2021

Certificate No. : 21OV734

CSR No. : A012/00583

Page. : 1 of 3

Customer : ALS Laboratory Group (Thailand) Co., Ltd
114/1 Moo 8 Karnchanawanich Rd. T.Ban Phru,
A. Hat Yai, Songkhla 90250 TH

Calibration Place : Chemical Laboratory

Instrument Name : Hot Air Oven

Manufacturer : Memmert

Model : UF110

Serial No. : B416.3392

ID No. : SGK_CL0025

Resolution : 0.1 °C

Received Date : 9-Nov-2021

Calibrated Date : 9-Nov-2021

Ambient Temperature : (30 ± 10) °C

Relative Humidity : (50 ± 30) %

REVIEW BY	Sutthirak S.
APPROVED BY	Kamida H.
NEXT CAL. DATE	10/05/2023

Calibration Method Used :

This instrument was calibrated using the Calibration In - house method : SCAL.WI.012 based on G-20

The Southern Calibration Service Co.,Ltd.calibration control system complies with requirement of ISO/IEC 17025:2017

Traceability of measurement :

This Certificate is traceable to the International and /or national standards which realize the units of measurement according to the International System of Unit (SI) through :

- Q Reborn : Quality Reborn Co.,Ltd.

Calibrated by : Ibrorhim Saleemin

Approved by :

Sakeereen Heemhad / Technical Manager

The uncertainties are for a confidence probability of approximately 95%

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Details of Calibration

1. Reference Standard Equipment Used:

Equipment	Model	Serial No.	Cert. no.	Due Date
Data logger With Sensor	34970A	MY44064411	QR21-0314	9-Feb-2022

2. The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the longterm stability of instrument.

3. This certificate is not certified any commercial transaction

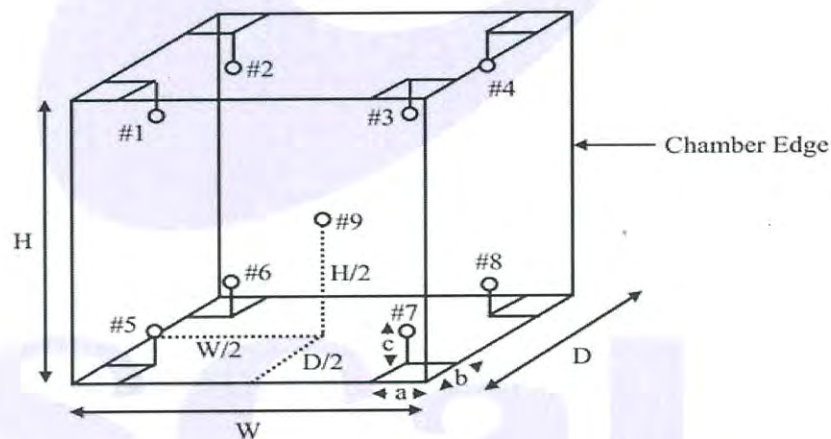
4. Condition of Item : normal condition , no indication for any damage or malfunction

Result of Calibration :

(✓) Without Adjustment

() After Adjustment

1. Sensor Installation Diagram



Sensor Installation Details

a = 5.0 cm

b = 5.0 cm

c = 5.0 cm

Dimension of the chamber

W = 40.0 cm

H = 40.0 cm

D = 33.0 cm

Result of Calibration :

2. Temperature Measurement Accuracy Test

The measurement results of the Hot Air Oven and associates are reported in the manner as shown below

Cal point (°C)	Measured Standard Temperature At Spread Locations (°C)									Uncertainty (± °C)
	#1	#2	#3	#4	#5	#6	#7	#8	Ref. 9	
40	40.28	40.25	39.80	39.87	40.23	40.19	39.97	40.01	40.09	0.36
70	70.34	70.31	70.08	69.64	69.91	69.89	69.84	69.88	69.84	0.36
103	103.17	103.21	102.75	102.67	103.02	103.06	102.80	102.83	102.94	0.36
104	104.31	104.34	103.85	103.77	104.12	104.19	103.92	103.93	104.05	0.36
105	105.13	105.16	104.64	104.60	104.90	104.96	104.65	104.71	104.82	0.36
180	180.31	180.40	180.22	179.77	180.77	180.40	179.69	180.64	180.47	0.41

3. Performance Result

The performance of the Hot Air Oven are reported as shown below

Cal point (°C)	UUC Setting (°C)	UUC Reading (°C)	Temperature Stability (± °C)	Temperature Uniformity (°C)	Overall Variation (°C)
40	40.0	40.0	0.10	0.30	0.56
70	70.0	70.0	0.10	0.58	0.72
103	103.0	103.0	0.10	0.37	0.56
104	104.0	104.0	0.10	0.41	0.66
105	105.0	105.0	0.20	0.41	0.68
180	180.0	180.0	0.10	0.63	0.81

- UUC = Unit Under Calibration

The report 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 ...



Southern Calibration Service Co., Ltd.

669/35 Karnjanavanit Rd., Banpru, Hatyai, Songkhla 90250 Thailand

Tel: 081 599 0417 Fax: 074 805 133 Email: s.calibration@gmail.com www.scal-lab.com



CALIBRATION CERTIFICATE

Issued Date : 8-Feb-2022

Certificate No. : 22WB004

CSR No. : A0223/01123

Page. : 1 of 3

Customer : ALS Laboratory Group (Thailand) Co., Ltd
114/1 Moo 8 Karnchanawanich Rd. T.Ban Phru,
A. Hat Yai, Songkhla 90250 TH

Calibration Place : Chemical Laboratory
Instrument Name : Water Bath
Manufacturer : Memmert
Model : WNE29
Serial No. : L616.0538
ID No. : SGK_CL0035
Resolution : 0.1 °C
Received Date : 5-Feb-2022
Calibrated Date : 5-Feb-2022
Ambient Temperature : (30 ± 10) °C
Relative Humidity : (50 ± 30) %

REVIEW BY	Ananta B.
APPROVED BY	Kanitta H.
NEXT CAL. DATE	6/07/2023

Calibration Method Used :

This instrument was calibrated using the Calibration In - house method : SCAL.W1.014 based on ASTM E 715 : 1980 (reapproved 2001)

The Southern Calibration Service Co.,Ltd.calibration control system complies with requirement of ISO/IEC 17025:2017

Traceability of measurement :

This Certificate is traceable to the International and /or national standards which realize the units of measurement according to the International System of Unit (SI) through :

- Q Reborn : Quality Reborn Co.,Ltd.

Calibrated by : Imron Rattanaylum

Approved by :

Sakeereen Heemhad / Technical Manager

This certificate may not be reproduced other than in full, except with the prior written approval of Southern Calibration Service Co., Ltd.

Details of Calibration

1. Reference Standard Equipment Used:

Equipment	Model	Serial No.	Cert. no.	Due Date
Data logger With Sensor	34970A	MY44064411	QR21-0314	9-Feb-2022

2. The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the longterm stability of instrument.

3. This certificate is not certified any commercial transaction

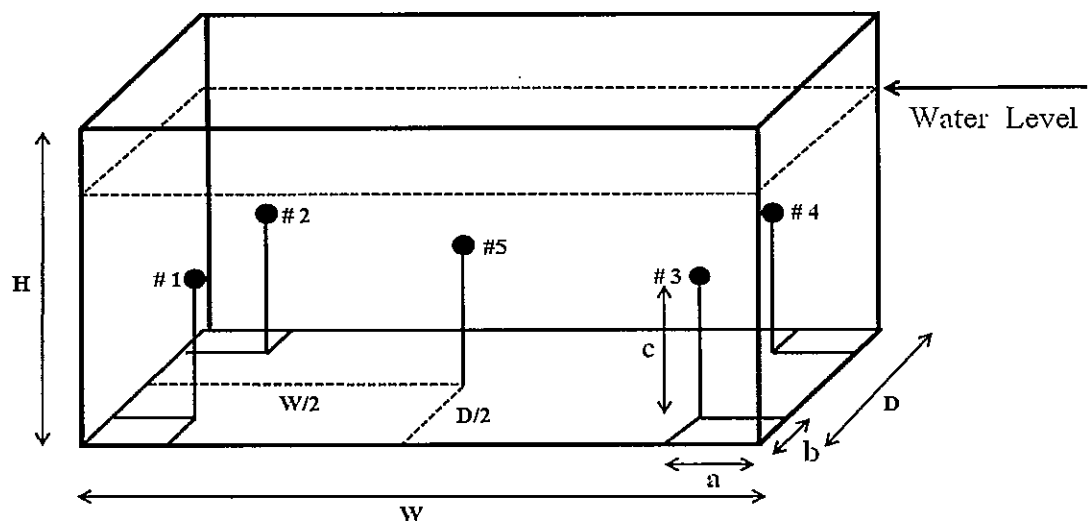
4. Condition of Item : normal condition , no indication for any damage or malfunction

Result of Calibration :

(✓) Without Adjustment

() After Adjustment

1. Sensor Installation Diagram



Sensor Installation Details

a = 5 cm
b = 5 cm
c = 5 cm

Dimension of the chamber

W = 45 cm
H = 30 cm
D = 35 cm

Result of Calibration :

2. Temperature Measurement Accuracy Test

The measurement results of the Water Bath and associates are reported in the manner as shown below

Cal point (°C)	Measured Standard Temperature At Spread Locations (°C)					Uncertainty (±°C)
	#1	#2	#3	#4	Ref.5	
80	79.95	80.07	79.95	79.99	80.03	0.14

3. Performance Result

The performance of the Water Bath are reported as shown below

Cal point (°C)	UUC Setting (°C)	UUC Reading (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
80	81.0	81.0	0.10	0.19	0.19

- UUC = Unit Under Calibration

The report 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 ...



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.: 22TW16

Page.: 1 of 2

Certificate of Testing

Equipment :	DO Meter
Manufacturer :	Mettler Toledo
Model :	Seven2Go Pro
Serial No. :	B728366470
ID No. :	SGK_FS0018
Received Date :	19 January 2022
Test Date :	21 January 2022
Reference :	2201-0586DSC-1
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. Songkhla Branch. 114/1 Moo 8 Karnchanawanich Rd., T.Ban Phru, A.Hat Yai, Songkhla 90250 Thailand
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 :	<u>Warakorn.</u> Approved Signatory
() Malee Butkruea () Saithip Meangmai (<input checked="" type="checkbox"/>) Warakorn Lernagtrakul	
Issue Date :	31 January 2022

REVIEW BY	<u>Warakorn P.</u>
APPROVED BY	<u>richa chm</u>
NEXT CAL. DATE	<u>21/01/23</u>



Cert.No.: 22TW16

Page.: 2 of 2

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 526334

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.16	8.21	0.0045

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-

Wara korn



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22LM7

Page.: 1 of 2

Certificate of Calibration

Equipment :	DO Meter with Sensor
Manufacturer :	Mettler Toledo
Model :	Seven2Go Pro
Serial No. :	B728366470
ID No. :	SGK_FS0018
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. Songkhla Branch. 114/1 Moo 8 Karnchanawanich Rd., T.Ban Phru, A.Hat Yai, Songkhla 90250 Thailand
Location :	TPA Chemistry Calibration Laboratory
Received Order :	19 January 2022
Calibrated Date :	26 January 2022
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %
AC Line Voltage :	(220 ± 22) V
Calibrated by :	Malee Butkruea
Approved by :	 Approved Signatory
() Pornthippa Tameyakul	
(<input checked="" type="checkbox"/>) Suwit Imjai	
Issue Date :	31 January 2022

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.

A 0037107



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2201-0586DSC-2

Cert. No.: 22LM7

Page.: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument

Model

Serial No.

Cert. No.

Due Date

1) Digital Thermometer

1523

2188080

2111273

22 Nov 2022

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.

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 526334'

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
20.0	80	20.001	20.2	0.199	0.16	2.00

UUC* : Unit Under Calibration

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 %.

-o0o-

Yusuf



Southern Calibration Service Co., Ltd.

669/35 Karnjanavanit Rd., Banpru, Hatyai, Songkhla 90250 Thailand

Tel: 081 599 0417 Fax: 074 805 133 Email: s.calibration@gmail.com www.scal-lab.com



CALIBRATION CERTIFICATE

Issued Date : 8-Jul-2021

Certificate No. : 21ATC051

CSR No. : A047/2301

Page. : 1 of 3

Customer : ALS Laboratory Group (Thailand) Co., Ltd
114/1 Moo 8 Karnchanawanich Rd. T.Ban Phru,
A. Hat Yai, Songkhla 90250 TH

Calibration Place : Microbiological Laboratory

Instrument Name : Autoclave

Manufacturer : TOMY

Model : SX-700

Serial No. : 52134079

ID No. : SGK_ML0001

Resolution : 1 °C

Received Date : 5-Jul-2021

Calibrated Date : 5-Jul-2021

Ambient Temperature : (30 ± 10) °C

Relative Humidity : (50 ± 30) %

REVIEW BY	APR Nattawat P.
APPROVED BY	Kanitha H.
NEXT CAL. DATE	03/01/2023

Calibration Method Used :

This instrument was calibrated using the Calibration In - house method : SCAL.WI.16.013 based on BS 2646 : 1993 (part 5)

The Southern Calibration Service Co.,Ltd.calibration control system complies with requirement of ISO/IEC 17025:2017

Traceability of measurement :

This Certificate is traceable to the International and /or national standards which realize the units of measurement according to the International System of Unit (SI) through :

- SCaL : Sounthern Calibration Service Co., Ltd.,

Calibrated by : Ibrorhim Saleemin

Approved by :

Adull Lemsoh / Laboratory Manager

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Certificate No. : 21ATC051

CSR No. : A047/2301

Page. : 2 of 3

Details of Calibration

1. Reference Standard Equipment Used:

Equipment	Model	Serial No.	Cert. no.	Due Date
Data logger With Sensor	GL220	H11119557	21SDAT001	7-May-2022

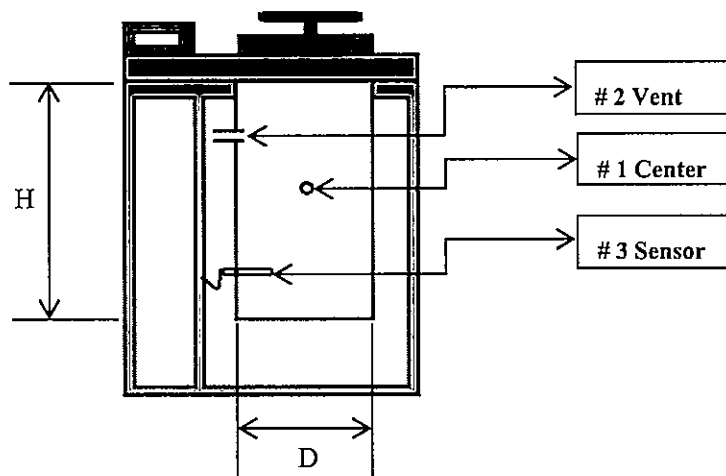
2. The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the longterm stability of instrument.

3. This certificate is not certified any commercial transaction

4. Condition of Item : normal condition , no indication for any damage or malfunction

Result of Calibration : (✓) Without Adjustment () After Adjustment

1. Sensor Installation Diagram



Chamber Diameter (D) : 30 cm

Chamber Height (H) : 70 cm



Certificate No. : 21ATC051

CSR No. : A047/2301

Page. : 3 of 3

Result of Calibration :

2. Temperature Measurement Accuracy Test

The measurement results of the Autoclave and associates are reported in the manner as shown below

Cal point (°C)	Measured Standard Temperature At Spread Locations (°C)			Pressure Reading	Operating Time (sec)	Uncertainty (±°C)
	Center #1	Vent #2	Sensor #3			
115	116.2	115.9	116.3	0.8 MPa	1800.18	0.76
118	119.2	118.9	119.3	0.1 MPa	1800.26	0.76
121	121.5	121.2	121.6	0.12 MPa	1800.34	0.76

3. Performance Result

The performance of the Autoclave are reported as shown below

Cal point (°C)	UUC Setting (°C)	UUC Reading (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
115	115	115	0.10	0.50	0.50
118	118	118	0.10	0.50	0.50
121	121	121	0.00	0.40	0.40

* UUC = Unit Under Calibration

The report 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 ...



Southern Calibration Service Co., Ltd.

669/35 Karnjanavanit Rd., Banpru, Hatyai, Songkla 90250 Thailand
Tel : 08 1599 0417 Fax : 0 7480 5133 Email : s.calibration@gmail.com www.scal-lab.com



CALIBRATION CERTIFICATE

Issued Date : 9-Aug-2022

Certificate No. : 22OV529

CSR No. : A037/01847

Page. : 1 of 3

Customer : ALS Laboratory Group (Thailand) Co., Ltd
114/1 Moo 8, Kamchanawanich Rd. Tambon, Ban Phru,
Amphoe Hat Yai, Songkhla, 90250

Calibration Place : Microbiological Laboratory

Instrument Name : Incubator

Manufacturer : Memmert

Model : ICP750

Serial No. : F816.0061

ID No. : SGK_ML0013

Resolution : 0.1 °C

Received Date : 6-Aug-2022

Calibrated Date : 6-Aug-2022

Ambient Temperature : (30 ± 10) °C

Relative Humidity : (50 ± 30) %

REVIEW BY	APPROVED BY
APPROVED BY	APPROVED BY
NEXT CAL. DATE	

Calibration Method Used :

This instrument was calibrated using the Calibration In - house method : SCAL.WI.012 based on G-20

The Southern Calibration Service Co.,Ltd.calibration control system complies with requirement of ISO/IEC 17025:2017

Traceability of measurement :

This Certificate is traceable to the International and /or national standards which realize the units of measurement according to the International System of Unit (SI) through :

- SCaL : Sounthern Calibration Service Co., Ltd.,

Calibrated by : Ibrorhim Saleemin

Approved by :

Kanyarat Chaipet / Technical Manager

The uncertainties are for a confidence probability of approximately 95%

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Details of Calibration

1. Reference Standard Equipment Used:

Equipment	Model	Serial No.	Cert. no.	Due Date
Data Acquisition/Switch Unit	34970A	MY58009813	22SDAT004	24-May-2023

2. The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the longterm stability of instrument.

3. This certificate is not certified any commercial transaction

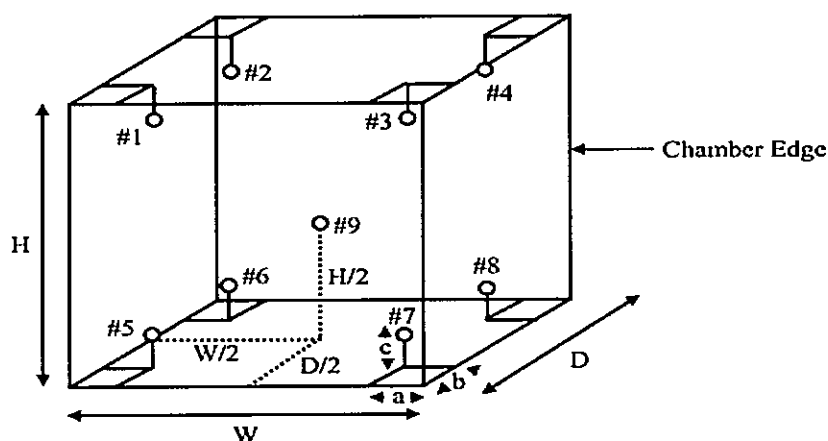
4. Condition of Item : normal condition , no indication for any damage or malfunction

Result of Calibration :

(☒) Without Adjustment

(☐) After Adjustment

1. Sensor Installation Diagram



Sensor Installation Details

a = 5.0 cm

b = 5.0 cm

c = 5.0 cm

Dimension of the chamber

W = 104.0 cm

H = 120.0 cm

D = 60.0 cm



Certificate No. : 22OV529

CSR No. : A037/01847

Page. : 3 of 3

Result of Calibration .:

2. Temperature Measurement Accuracy Test

The measurement results of the Incubator and associates are reported in the manner as shown below

Cal point (°C)	Measured Standard Temperature At Spread Locations (°C)									Uncertainty (± °C)
	#1	#2	#3	#4	#5	#6	#7	#8	Ref. 9	
35	34.99	34.92	34.95	34.88	34.96	35.00	34.94	34.94	34.94	0.38

3. Performance Result

The performance of the Incubator are reported as shown below

Cal point (°C)	UUC Setting (°C)	UUC Reading (°C)	Temperature Stability (± °C)	Temperature Uniformity (°C)	Overall Variation (°C)
35	35.0	35.0	0.10	0.12	0.19

- UUC = Unit Under Calibration

The report 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 ...



Southern Calibration Service Co., Ltd.

669/35 Karnjanavanit Rd., Banpru, Hatyai, Songkhla 90250 Thailand

Tel: 081 599 0417 Fax: 074 805 133 Email: s.calibration@gmail.com www.scal-lab.com



CALIBRATION CERTIFICATE

Issued Date : 8-Jul-2021

Certificate No. : 21PH098

CSR No. : A047/2301

Page. : 1 of 2

Customer : ALS Laboratory Group (Thailand) Co., Ltd
114/1 Moo 8 Karnchanawanich Rd. T.Ban Phru,
A. Hat Yai, Songkhla 90250 TH

Calibration Place : Microbiological Laboratory

Instrument Name : pH meter

Manufacturer : Sartorius

Model : Basic pH Meter PB-10

Serial No. : C07160695

ID No. : SGK_ML0016

Electrode No. : N/A

Received Date : 5-Jul-2021

Calibrated Date : 5-Jul-2021

Ambient Temperature : $(25 \pm 3) ^\circ\text{C}$

Relative Humidity : $(55 \pm 15) \%$

REVIEW BY	Nattawat P.
APPROVED BY	Kanpha H.
NEXT CAL. DATE	03/07/2023

Calibration Method Used :

This instrument was calibrated using the Calibration In - house method : SCAL.WI.008 based on direct measurement by using certified reference Material (CRM)

The Southern Calibration Service Co.,Ltd.calibration control system complies with requirement of ISO/IEC 17025:2017

Traceability of measurement :

This Certificate is traceable to the International and /or national standards which realize the units of measurement according to the International System of Unit (SI) through :

- HACH : LANGE United For Water Quality
- WK : WK Electric Co., Ltd.

Calibrated by : Jessadagon Lemhud

Approved by :

Adull Lemsoh / Laboratory Manager

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Certificate No. : 21PH098

CSR No. : A047/2301

Page. : 2 of 2

Details of Calibration

1. Reference Standard Equipment Used:

Equipment	Model	Serial No.	Cert. no.	Due Date
Standard Solution	4.005	C02730	1503	22-May-2022
Standard Solution	7.000	C02775	1551	20-Oct-2022
Standard Solution	10.012	C02770	1545	17-Sep-2022
Temperature/Electrical Calibrator	MC2-MF	23642	WK2102-006-229	21-Feb-2022

2. The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the longterm stability of instrument.

3. This certificate is not certified any commercial transaction

4. Condition of Item : normal condition , no indication for any damage or malfunction

Result of Calibration :: (✓) Without Adjustment () After Adjustment

1. Electrical Measurement

Applied Voltage (mV)	pH meter Reading (mV)	Correction (mV)	Uncertainty (± mV)
177.48	177.4	0.08	0.17
0.00	0.0	0.00	0.13
-177.48	-177.4	-0.08	0.17

2. Sample Test Measurement

Standard Buffer Solutions (pH)	pH meter Reading (pH)	Correction (pH)	Uncertainty (± pH)
4.006	3.99	0.016	0.012
6.997	7.01	-0.013	0.015
10.012	9.98	0.032	0.036

The report 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 ...



Southern Calibration Service Co., Ltd.

669/35 Karnjanavanit Rd., Banpru, Hatyai, Songkhla 90250 Thailand

Tel: 081 599 0417 Fax: 074 805 133 Email: s.calibration@gmail.com www.scal-lab.com



CALIBRATION CERTIFICATE

Issued Date : 9-Aug-2021

Certificate No. : 21WB064

CSR No. : A047/2346

Page. : 1 of 3

Customer : ALS Laboratory Group (Thailand) Co., Ltd
114/1 Moo 8 Karnchanawanich Rd. T.Ban Phru,
A. Hat Yai, Songkhla 90250 TH

Calibration Place : Microbiological Laboratory

Instrument Name : Water Bath

Manufacturer : Memmert

Model : WPE45

Serial No. : L716.0558

ID No. : SGK_ML0021

Resolution : 0.1 °C

Received Date : 6-Aug-2021

Calibrated Date : 6-Aug-2021

Ambient Temperature : (30 ± 10) °C

Relative Humidity : (50 ± 30) %

REVIEW BY	Nattawat P.
APPROVED BY	Kanitha H.
NEXT CAL. DATE	4/02/2023

Calibration Method Used :

This instrument was calibrated using the Calibration In - house method : SCAL.WI.014 based on ASTM E 715 : 1980 (reapproved 2001)

The Southern Calibration Service Co.,Ltd.calibration control system complies with requirement of ISO/IEC 17025:2017

Traceability of measurement :

This Certificate is traceable to the International and /or national standards which realize the units of measurement according to the International System of Unit (SI) through :

- Q Reborn : Quality Reborn Co.,Ltd.

Calibrated by : Ibrorhim Saleemin

Approved by :

Sakeereen Heemhad / Technical Manager

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 Southern Calibration Service Co., Ltd.

Details of Calibration

1. Reference Standard Equipment Used:

Equipment	Model	Serial No.	Cert. no.	Due Date
Data logger With Sensor	34970A	MY44064411	QR21-0314	9-Feb-2022

2. The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the longterm stability of instrument.

3. This certificate is not certified any commercial transaction

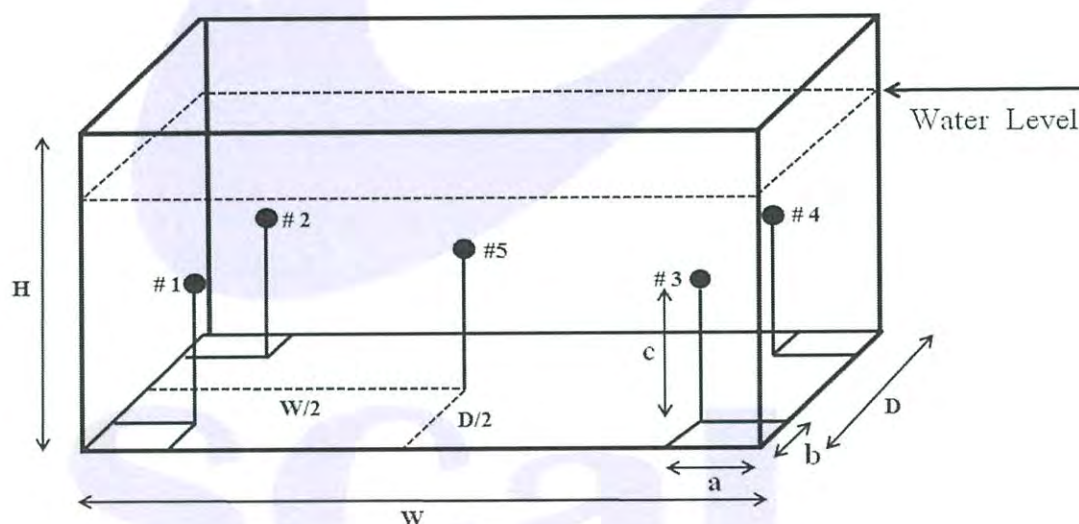
4. Condition of Item : normal condition , no indication for any damage or malfunction

Result of Calibration :.

(✓) Without Adjustment

() After Adjustment

1. Sensor Installation Diagram



Sensor Installation Details

a = 5 cm
b = 5 cm
c = 5 cm

Dimension of the chamber

W = 45 cm
H = 30 cm
D = 35 cm

Result of Calibration .:

2. Temperature Measurement Accuracy Test

The measurement results of the Water Bath and associates are reported in the manner as shown below

Cal point (°C)	Measured Standard Temperature At Spread Locations (°C)					Uncertainty (± °C)
	#1	#2	#3	#4	Ref.5	
44.5	44.49	44.55	44.48	44.51	44.47	0.14

3. Performance Result

The performance of the Water Bath are reported as shown below

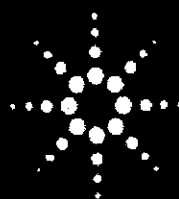
Cal point (°C)	UUC Setting (°C)	UUC Reading (°C)	Temperature Stability (± °C)	Temperature Uniformity (°C)	Overall Variation (°C)
44.5	44.6	44.6	0.20	0.24	0.24

- UUC = Unit Under Calibration

The report 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 ...

SCaL



Agilent CrossLab Compliance Services

Agilent
CrossLab

From Insight to Outcome

EQUIPMENT QUALIFICATION REPORT (EQR)

Agilent CrossLab Compliance

Qualification Type: ICPMS-OQ

System ID: JP16511669

EQP Name: AgilentRecommended

EQP Revision: ICPMS.02.50

EQP Publish Date: March 2020

Date: February 8, 2022 11:47:17 AM

Report Type: Report

Org. Name: ALS laboratory Group (Thailand) Co.,Ltd.

Org. Location: 114/1 Moo8, Kanchanawanich Rd., T.Ban Phru,
A.Hatyai, Songkhla 90250

REVIEW BYAnanta B.

APPROVED BYKanitta H.

NEXT CAL. DATE8/2/2023

Date: February 8, 2022 11:47:17 AM
System ID: JP16511669

Certificate of System Qualification

ICPMS-OQ

System ID: JP16511669

Organization Name: ALS laboratory Group (Thailand) Co.,Ltd.

Organization Location: 114/1 Moo8, Kanchanawanich Rd., T.Ban Phru, A.Hatyai, Songkhla 90250

Date: February 8, 2022 11:39:47 AM

EQP Name: AgilentRecommended

EQP Revision: ICPMS.02.50

Overall Qualification Status: Pass

Autosampler Check

Overall Autosampler Check Test Status

Pass

Integrated Sample Introduction System (ISIS) Check

Overall Integrated Sample Introduction System (ISIS) Check Test Status

Pass

Autotune

Peakwidth Mass 7	Pass
Peakwidth Mass 89	Pass
Peakwidth Mass 205	Pass
Mass Axis 7	Pass
Mass Axis 89	Pass
Mass Axis 205	Pass
Mass 7 Sensitivity No Gas	Pass
Mass 89 Sensitivity No Gas	Pass
Mass 205 Sensitivity No Gas	Pass
Mass 59 Sensitivity He	Pass
Mass 89 Sensitivity H2	Pass
Oxide Ratio 156/140	Pass
Doubly Charged Species Ratio 70/140	Pass

Date: February 8, 2022 11:39:47 AM

System ID: JP16511669

Overall Autotune Test Status

Pass

Background (No Gas Mode)

Setpoint Status:

Pass

Masses (AMU):

Measured Value:

Agilent Recommended:

Status:

	7	89	205		
	6.400	1.800	5.700	cps	
<=	6.9	<=	4.6	<=	11.5
Pass		Pass		Pass	

Overall Background (No Gas Mode) Test Status

Pass

Background (Gas Mode)

Gas Mode:

Helium

Setpoint Status:

Pass

Mass (AMU):

Measured Value:

Agilent Recommended:

Status:

	78	
	4.60	cps
<=	115	
Pass		

Gas Mode:

Hydrogen

Setpoint Status:

Pass

Mass (AMU):

Measured Value:

Agilent Recommended:

Status:

	78	
	1.45	cps
<=	4.6	
Pass		

Overall Background (Gas Mode) Test Status

Pass

Date: February 8, 2022 11:39:47 AM

System ID: JP16511669

20-Minute Stability (No Gas Mode)

Masses (AMU):

Stability RSD:

Agilent Recommended:

Status:

	7		89		205	
	1.26		0.28		0.43	%
<=	2.3	<=	2.3	<=	2.3	
Pass		Pass		Pass		

Overall 20-Minute Stability (No Gas Mode) Test Status

Pass

Instrument Details

Purpose

This section describes the as found system configuration.

Details

ICP-MS 1

Manufacturer	Agilent Technologies
Name	7900
Model Number	G8403A
Installed Options	#100H: Standard Package with Hydrogen option
Detector Type	SQ
Nebulizer	Mira Mist (G3161)
Spray Chamber	Quartz
Torch	Quartz
Sampling Cone	Ni
Skimmer Cone	Ni
Serial Number	JP16511669
Firmware Revision	4.00.02

ISIS 1

Manufacturer	Agilent Technologies
Name	ISIS3
Model Number	G8411A
Type	Peristaltic pump system
Serial Number	JP16510376

Autosampler 1

Manufacturer	Agilent Technologies
Name	SPS4
Model Number	G8410A
Serial Number	AU16351847

Chiller 1

Manufacturer	Agilent Technologies
Name	Chiller
Model Number	G3292A
Serial Number	701711328

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:	Burin Ngamvijit
Logged On User Name:	Burin_ngamvijit@agilent.com
Signature Creation Date:	February 8, 2022
Reason for Signature:	Published this original version of document

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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

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User Name: burin_ngamvjljt
 Hostname: ASSGKWX019

System Id: JP16511669
 Print Date: February 8, 2022 11:39:48 AM

OQ HW 7900ICPMS ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
February 8, 2022 9:19:05 AM	Audit	SessionCreated	Session	None
February 8, 2022 9:19:05 AM	Start	Configuration	Session	None
February 8, 2022 9:19:05 AM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
February 8, 2022 9:23:56 AM	Audit	EqpLoaded	Session	EQP details for primary technique [lcpMs] - File path: [ProtocolPacks/lcpMs/Configurations/02.50/lcpMs.02.50.eqp], EQP File Name: [lcpMs.02.50.eqp], EQP Name: [AgilentRecommended]
February 8, 2022 9:24:02 AM	End	Configuration	Session	None
February 8, 2022 9:24:09 AM	Start	Qualification	Session	OQ
February 8, 2022 9:24:09 AM	Start	Execution	Autosampler Check : SPS4: Autosampler Check	None
February 8, 2022 9:24:54 AM	End	Execution	Autosampler Check : SPS4: Autosampler Check	Run Count : 1
February 8, 2022 9:24:57 AM	Start	Execution	Integrated Sample Introduction System (ISIS) Check : ISIS3: Integrated Sample Introduction System (ISIS) Check	None
February 8, 2022 10:52:47 AM	End	Execution	Integrated Sample Introduction System (ISIS) Check : ISIS3: Integrated Sample Introduction System (ISIS) Check	Run Count : 1

User Name: burin_ngamvijit
 Hostname: ASSGKWX019

System Id: JP16511669
 Print Date: February 8, 2022 11:39:48 AM

OQ HW 7900iCPMS ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
February 8, 2022 10:52:50 AM	Start	Execution	Autotune : G8403A: Autotune 1	None
February 8, 2022 10:55:26 AM	End	Execution	Autotune : G8403A: Autotune 1	Run Count : 1
February 8, 2022 10:55:34 AM	Start	Execution	Background (No Gas Mode) : G8403A: No Gas Mode Background 1	None
February 8, 2022 10:55:56 AM	End	Execution	Background (No Gas Mode) : G8403A: No Gas Mode Background 1	Run Count : 1
February 8, 2022 10:56:00 AM	Start	Execution	Background (Gas Modes) : G8403A: Gas Mode Background :Helium	None
February 8, 2022 10:56:22 AM	End	Execution	Background (Gas Modes) : G8403A: Gas Mode Background :Helium	Run Count : 1
February 8, 2022 10:56:24 AM	Start	Execution	Background (Gas Modes) : G8403A: Gas Mode Background :Hydrogen	None
February 8, 2022 10:56:40 AM	End	Execution	Background (Gas Modes) : G8403A: Gas Mode Background :Hydrogen	Run Count : 1
February 8, 2022 10:56:43 AM	Start	Execution	20-Minute Stability (No Gas Mode) : G8403A: 20-Minute Stability (No Gas Mode) 1	None
February 8, 2022 11:01:33 AM	End	Execution	20-Minute Stability (No Gas Mode) : G8403A: 20-Minute Stability (No Gas Mode) 1	Run Count : 1
February 8, 2022 11:07:37 AM	End	Qualification	Session	OQ
February 8, 2022 11:07:37 AM	Start	Reporting	Session	None

Page 2 / 3

User Name: burln_ngamvijit

System Id: JP16511669

Hostname: ASSGKWX019

Print Date: February 8, 2022 11:39:48 AM

OQ HW 7900ICPMS ALS Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
February 8, 2022 11:38:19 AM	Audit	Reporting	Session	Report Generated : Certificate



CALIBRATION CERTIFICATE

Issued Date : 19-Aug-2021

Certificate No. : 21OV449

CSR No. : A078/3892

Page : 1 of 3

Customer : ALS Laboratory Group (Thailand) Co., Ltd
114/1 Moo 8 Karnchanawanich Rd. T.Ban Phru,
A. Hat Yai, Songkhla 90250 TH

Calibration Place : Chemical Laboratory

Instrument Name : Cold Room Water

Manufacturer : MODULAR

Model : N/A

Serial No. : N/N

ID No. : SGK_CL0065

Resolution : 0.1 °C

Received Date : 16-Aug-2021

Calibrated Date : 16-Aug-2021

Ambient Temperature : (30 ± 10) °C

Relative Humidity : (50 ± 30) %

REVIEW BY Sutthirak T.

APPROVED BY Kanitta H.

NEXT CAL. DATE 14/02/2023

Calibration Method Used :

This instrument was calibrated using the Calibration In - house method : SCAL.WI.012 based on G-20

The Southern Calibration Service Co.,Ltd.calibration control system complies with requirement of ISO/IEC 17025:2017

Traceability of measurement :

This Certificate is traceable to the International and /or national standards which realize the units of measurement according to the International System of Unit (SI) through :

- Q Reborn : Quality Reborn Co.,Ltd.

Calibrated by : Ibrorhim Saleemin

Approved by :

Sakeereen Heemhad / Technical Manager

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 Southern Calibration Service Co., Ltd.

Details of Calibration

1. Reference Standard Equipment Used:

Equipment	Model	Serial No.	Cert. no.	Due Date
Data logger With Sensor	34970A	MY44064411	QR21-0314	9-Feb-2022

2. The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the longterm stability of instrument.

3. This certificate is not certified any commercial transaction

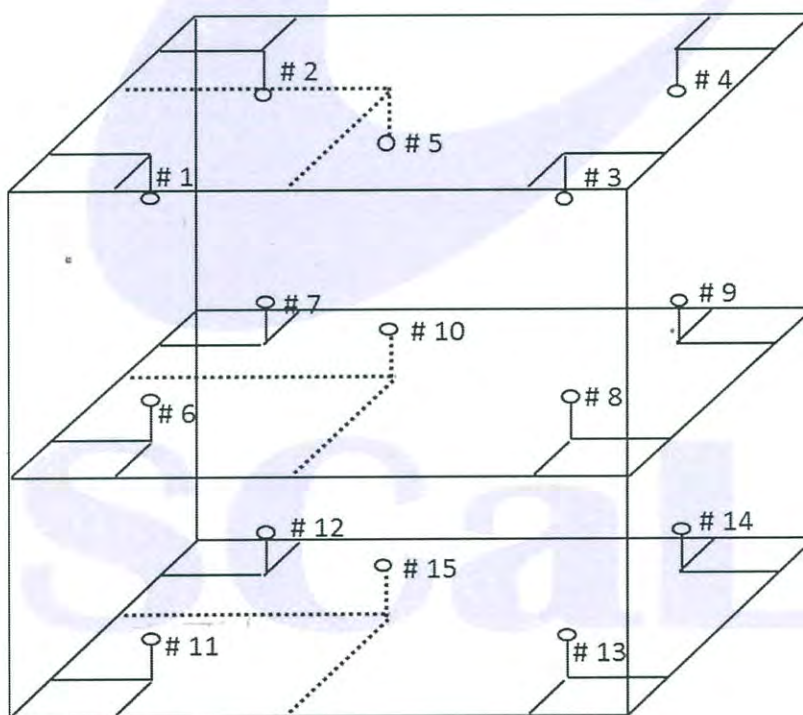
4. Condition of Item : normal condition , no indication for any damage or malfunction

Result of Calibration ∴

(✓) Without Adjustment

() After Adjustment

1. Sensor Installation Diagram



Sensor Installation Details

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

Dimension of the chamber

W = 370.0 cm
H = 250.0 cm
D = 540.0 cm

Result of Calibration :

2. Temperature Measurement Accuracy Test

The measurement results of the Cold Room Water and associates are reported in the manner as shown below

Cal point (°C)	Measured Standard Temperature At Spread Locations (°C)														
	#1	#2	#3	#4	#5	#6	#7	#8	#9	Ref.10	#11	#12	#13	#14	#15
4	3.63	3.35	3.58	3.80	4.14	3.76	3.77	3.72	3.82	3.80	3.62	3.88	3.67	3.80	3.61

The uncertainty of measurement was ± 0.38 °C

3. Performance Result

The performance of the Cold Room Water are reported as shown below

Cal point (°C)	UUC Setting (°C)	UUC Reading (°C)	Temperature Stability (\pm °C)	Temperature Uniformity (°C)	Overall Variation (°C)
4	4.0	4.0	1.23	0.69	3.33

* UUC = Unit Under Calibration

The report 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 ...



CALIBRATION CERTIFICATE

Issued Date : 12-Nov-2021

Certificate No. : 21OV733

CSR No. : A012/00583

Page. : 1 of 3

Customer : ALS Laboratory Group (Thailand) Co., Ltd
114/1 Moo 8 Karnchanawanich Rd. T.Ban Phru,
A. Hat Yai, Songkhla 90250 TH

Calibration Place : Chemical Laboratory

Instrument Name : Hot Air Oven

Manufacturer : Memmert

Model : UF110

Serial No. : B416.3387

ID No. : SGK_CL0024

Resolution : 0.1 °C

Received Date : 9-Nov-2021

Calibrated Date : 9-Nov-2021

Ambient Temperature : (30 ± 10) °C

Relative Humidity : (50 ± 30) %

REVIEW BY Sutthirak O.
APPROVED BY Kanitta H.
NEXT CAL. DATE 10/05/2023

Calibration Method Used :

This instrument was calibrated using the Calibration In - house method : SCAL.WI.012 based on G-20

The Southern Calibration Service Co.,Ltd.calibration control system complies with requirement of ISO/IEC 17025:2017

Traceability of measurement :

This Certificate is traceable to the International and /or national standards which realize the units of measurement according to the International System of Unit (SI) through :

- Q Reborn : Quality Reborn Co.,Ltd.

Calibrated by : Ibrorhim Saleemin

Approved by :

Sakeereen Heemhad / Technical Manager

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 Southern Calibration Service Co., Ltd.

Details of Calibration

1. Reference Standard Equipment Used:

Equipment	Model	Serial No.	Cert. no.	Due Date
Data logger With Sensor	34970A	MY44064411	QR21-0314	9-Feb-2022

2. The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the longterm stability of instrument.

3. This certificate is not certified any commercial transaction

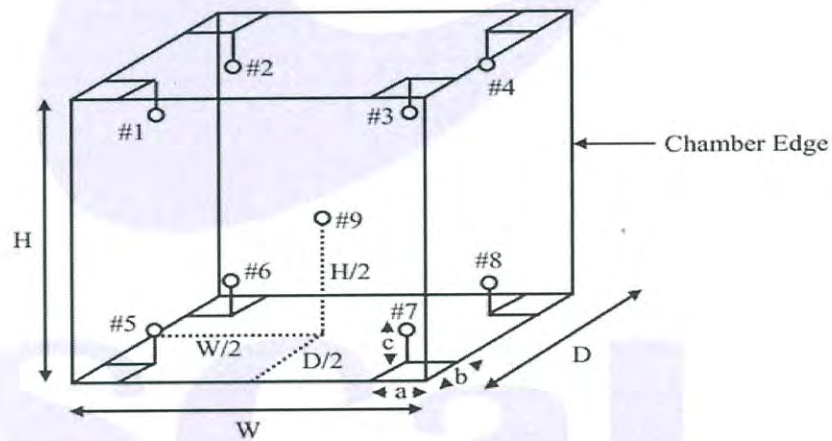
4. Condition of Item : normal condition , no indication for any damage or malfunction

Result of Calibration ∴

(✓) Without Adjustment

() After Adjustment

1. Sensor Installation Diagram



Sensor Installation Details

a = 5.0 cm

b = 5.0 cm

c = 5.0 cm

Dimension of the chamber

W = 40.0 cm

H = 40.0 cm

D = 33.0 cm

Result of Calibration :

2. Temperature Measurement Accuracy Test

The measurement results of the Hot Air Oven and associates are reported in the manner as shown below

Cal point (°C)	Measured Standard Temperature At Spread Locations (°C)									Uncertainty (± °C)
	#1	#2	#3	#4	#5	#6	#7	#8	Ref. 9	
40	39.85	39.81	39.68	39.57	39.94	39.80	39.81	39.93	39.69	0.36
70	70.53	70.23	70.08	69.74	70.51	70.37	70.43	69.79	70.15	0.36
103	103.47	102.96	102.95	102.77	103.40	103.46	103.33	102.73	102.83	0.36
104	104.47	103.92	103.95	103.77	104.33	104.46	104.30	103.73	103.80	0.36
105	105.34	104.85	104.85	104.67	105.16	105.27	105.07	104.81	105.06	0.36
180	180.04	180.03	179.99	179.86	180.11	180.28	180.27	180.16	180.26	0.41

3. Performance Result

The performance of the Hot Air Oven are reported as shown below

Cal point (°C)	UUC Setting (°C)	UUC Reading (°C)	Temperature Stability (± °C)	Temperature Uniformity (°C)	Overall Variation (°C)
40	40.0	40.0	0.10	0.34	0.47
70	70.0	70.0	0.10	0.48	0.82
103	103.0	103.0	0.10	0.71	0.74
104	104.0	104.0	0.10	0.71	0.74
105	105.0	105.0	0.20	0.39	0.70
180	180.0	180.0	0.20	0.53	0.62

- UUC = Unit Under Calibration

The report 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 ...



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 22CH185

Page.: 1 of 2

Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	Mettler Toledo
Model :	Seven2Go S2
Serial No. :	B728378040
ID No. :	SRT_MKT0001
Condition As-Received:	Used Item
Received Date :	08 February 2022
Calibration Date :	09 February 2022
Reference :	2202-0244DSC-11
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250 Thailand
Ambient Temperature :	(25 ± 2.5) °C
Relative Humidity :	(50 ± 15) %
Calibration Procedure :	In - house method : - CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)

REVIEW BY	<i>Nirakorn F.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	<i>9/2/23</i>

Calibrated by : Uthen Kankawi

Approved by :

Malee

Approved Signatory

- (☒) Malee Butkruea
() Saithip Meangmai
() Warakorn Lerngagtrakul

Issue Date : 14 February 2022

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 0037919



Cert. No.: 22CH185

Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument : -

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Document Process Calibrator	46530031	130RC098	21E3245	07 Oct 2022

This certification is traceable to the International System of Unit maintained at:-

- Traceable to National Institute of Metrology (Thailand), NIMT

2. 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	766820	23 Sep 2023
pH 6.983	CPA chem	766822	04 Sep 2022
pH 10.015	CPA chem	766824	04 Sep 2022

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

Calibration Results**Function : mV Measurement****Performing standard curve by Fluke at pH (4,7,10)**

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (±mV)	Coverage factor <i>k</i>
	pH	mV	mV	pH		
pH Meter S/N.: B728378040	4.00	177.48	178	4.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-178	10.00	0.58	2.00

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 (±)	Coverage factor <i>k</i>
pH Electrode S/N.: 1033814	4.008	4.01	190	0.0085	2.05
	6.983	6.98	13	0.0099	2.00
	10.015	10.02	-164	0.0096	2.00

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 %.

-o0o-

Malu .



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
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TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22LM9

Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter with Sensor

Manufacturer : Mettler Toledo

Model : Seven2Go S2

Serial No. : B728378040

ID No. : SRT_MKT0001

Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand

Location : TPA On Site Calibration Laboratory

Received Order : 8 February 2022

Calibrated Date : 11 February 2022

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

AC Line Voltage : (220 ± 22) V

Calibrated by : Preecha Hlahib

Approved by :

Approved Signatory

() Pornthippa Tameyakul

(/) Malee Butkruea

() Suwit Imjai

Issue Date : 18 February 2022

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.

A 0037966



Equipment : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2202-0244DSC-14

Cert. No.: 22LM9

Page.: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Digital Thermometer	1523	2188080	2111273	22 Nov 2022

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.

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 1033814

<u>Calibration Point</u> (°C)	<u>Immersion Depth</u> (mm)	<u>Standard Temperature</u> (°C)	<u>UUC* Reading</u> (°C)	<u>Error</u> (°C)	<u>Uncertainty</u> (± °C)	<u>Coverage Factor</u> <i>k</i>
20.0	120	20.006	20.1	0.094	0.16	2.00
25.0	120	25.001	25.2	0.199	0.16	2.00
30.0	120	30.004	30.3	0.296	0.16	2.00
35.0	120	35.004	35.3	0.296	0.16	2.00
40.0	120	40.004	40.3	0.296	0.16	2.00
45.0	120	45.006	45.3	0.294	0.16	2.00
50.0	120	50.004	50.3	0.296	0.16	2.00

UUC* : Unit Under Calibration

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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Maku .



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

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

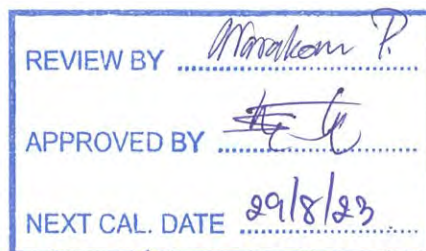
TEL. 0-2717-3000-24 FAX. 0-2719-9484

Cert.No.: 22CH1137

Page.: 1 of 2

Certificate of Calibration

Equipment :	Conductivity Meter
Manufacturer :	Mettler Toledo
Model :	Seven2Go S3
Serial No. :	B914464504
ID No. :	SGK_FS0051
Condition As-Received:	Used Item
Received Date :	26 August 2022
Calibration Date :	29 August 2022
Reference :	2208-0961DSC-1
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. Songkhla Branch. 114/1 Moo 8 Karnchanawanich Rd., T.Ban Phru, A.Hat Yai, Songkhla 90250 Thailand
Ambient Temperature :	(25 \pm 2.5) °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 : Uthen Kankawi

Approved by :

Malee

Approved Signatory

- (☒) Malee Butkruea
() Saithip Meangmai
() Warakorn Lernagatrakul

Issue Date : 2 September 2022

The Uncertainties are for a confidence probability of approximately 95%.

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A 0009518



Cert.No.: 22CH1137

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	22I484	17 Apr 2023

This certification is traceable to the International System of Unit maintained at:-

- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials :-

- Conductivity calibration solution, Thermo Scientific (traceable to NIST)

<u>Conductivity Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
84 $\mu\text{S/cm}$	Thermo Scientific	152/02	14 Apr 2023
1413 $\mu\text{S/cm}$	Thermo Scientific	081/02	26 Feb 2024
12.88 mS/cm	Thermo Scientific	041/01	29 Jan 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 $\mu\text{S/cm}$

Conductivity Electrode Serial No.: 5819080541

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (\pm)	Coverage factor k
84 $\mu\text{S/cm}$	82.15 $\mu\text{S/cm}$	84.25 $\mu\text{S/cm}$	4.3 $\mu\text{S/cm}$	2.00
1413 $\mu\text{S/cm}$	1374 $\mu\text{S/cm}$	1413 $\mu\text{S/cm}$	15 $\mu\text{S/cm}$	2.00
12.88 mS/cm	12.51 mS/cm	12.83 mS/cm	0.14 mS/cm	2.00

Remark - UUC* = Unit Under Calibration

- Cell constant = 0.548 cm^{-1}

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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Malu.



Internal Calibration

REVIEWED BY	Somsak J.
APPROVED BY	Kanitta H.
NEXT CAL. DATE	20/06/23

Equipment :	<u>Turbidity Meter</u>	Manufacture :	<u>HACH</u>
ID No. :	<u>SGK_FS0045</u>	Model :	<u>2100Q/QIS</u>
Calibrate Date :	<u>June 20, 2022</u>	Serial No. :	<u>19010C073443</u>

Calibration Point	1st (NTU)	2nd (NTU)	3rd (NTU)	AVG (NTU)	Specifications	Evaluate
Standard 20 NTU	20.0	20.2	20.1	20.1	19 to 21 NTU	Pass
Standard 100 NTU	99.6	99.8	99.8	99.7	95 to 105 NTU	Pass
Standard 800 NTU	791.0	793.0	794.0	792.7	760 to 840 NTU	Pass

Calibrated by Somsak J.
(Scientist 2)

Approved by : Kanitta H.
(Section Head)

Certificate of Analysis List

For request number 1568060

Catalog Number Entered	Lot Number Entered	Related Catalog Number	Related Lot Code	Description
2660501 STANDARD 800 NTU	1236R	2659405-TH	1291	STABLCAL sup TS sup0 FORMAZIN
2684701	1284	2659405-TH	1291	<0.1 NTU Calibration Solution
2684801 STANDARD 20 NTU	1265	2659405-TH	1291	STABLCAL sup TS sup0 FORMAZIN
2684901 STANDARD 100 NTU	1246	2659405-TH	1291	STABLCAL sup TS sup0 FORMAZIN

Total Enclosures: 4



An ISO 9001 Certified Company

Certificate of Analysis***This is a Component of 2659405-TH lot A1291***

Page 1

COMMODITY: <0.1 NTU Calibration Solution

COMMODITY NUMBER: 2684701

MANUFACTURE DATE:

DATE OF ANALYSIS:

LOT NUMBER: A1284

10/21/2021

10/22/2021

<i>TEST</i>	<i>SPECIFICATIONS</i>	<i>RESULTS</i>
Turbidity	0 to 0.1 NTU	0.06 NTU

The expiration date is Jan 2023

Formazin and StablCal® solutions provided by Hach are not NIST traceable because the NI does not carry turbidity standards. However, the use of Formazin and StablCal® as used in Hach method 8195 are accepted by the EPA as a primary standard to be used in the calibration of turbidity instruments.

Certified by

Scott Als
Analytical Services Chemist



An ISO 9001 Certified Company

Certificate of Analysis***This is a Component of 2659405-TH lot A1291***

Page 1

COMMODITY: **STABLCAL|sup|TS|sup0 FORMAZIN STANDARD 20 NTU**
COMMODITY NUMBER: **2684801** MANUFACTURE DATE: DATE OF ANALYSIS:
LOT NUMBER: **A1265** 10/21/2021 10/28/2021

<i>TEST</i>	<i>SPECIFICATIONS</i>	<i>RESULTS</i>
Turbidity	19 to 21 NTU	20.4 NTU

The expiration date is Jan 2023

Formazin and StablCal® solutions provided by Hach are not NIST traceable because the NI does not carry turbidity standards. However, the use of Formazin and StablCal® as us in Hach method 8195 are accepted by the EPA as a primary standard to be used in the calibration of turbidity instruments.

Certified by

Scott Als
Analytical Services Chemist



An ISO 9001 Certified Company

Certificate of Analysis***This is a Component of 2659405-TH lot A1291***

Page 1

COMMODITY: **STABLCAL|sup|TS|sup0 FORMAZIN STANDARD 100 NTU**
COMMODITY NUMBER: **2684901** MANUFACTURE DATE: DATE OF ANALYSIS:
LOT NUMBER: **A1246** 11/5/2021 11/11/2021

<i>TEST</i>	<i>SPECIFICATIONS</i>	<i>RESULTS</i>
Turbidity	95 to 105 NTU	103.0 NTU

The expiration date is Feb 2023

Formazin and StablCal® solutions provided by Hach are not NIST traceable because the NI does not carry turbidity standards. However, the use of Formazin and StablCal® as used in Hach method 8195 are accepted by the EPA as a primary standard to be used in the calibration of turbidity instruments.

Certified by

Scott Als
Analytical Services Chemist

***Certificate of Analysis******This is a Component of 2659405-TH lot A1291***

Page 1

COMMODITY: STABLCAL|sup|TS|sup0 FORMAZIN STANDARD 800 NTU

COMMODITY NUMBER: 2660501

MANUFACTURE DATE:

DATE OF ANALYSIS:

LOT NUMBER: A1236R

9/10/2021

9/10/2021

<i>TEST</i>	<i>SPECIFICATIONS</i>	<i>RESULTS</i>
Turbidity	760 to 840 NTU	819.0 NTU

The expiration date is Jan 2023

Formazin and StablCal® solutions provided by Hach are not NIST traceable because the NI does not carry turbidity standards. However, the use of Formazin and StablCal® as used in Hach method 8195 are accepted by the EPA as a primary standard to be used in the calibration of turbidity instruments.

Certified by _____

Scott Als
Analytical Services Chemist



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T220133I01 "Substitute for Calibration Certificate Number T220133" Page 1 of 5

Certificate of Calibration

Equipment : Digestion Unit

Manufacturer : Environmental Express

Model : TKN100

Serial No. : 2017TKNBC142

Customer Code : BKK_EN0223

ID No. : T6773A4

Customer : ALS Laboratory Group (Thailand) Co.,Ltd.

104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,
Khet Suan Luang, Bangkok 10250

Customer Location : Wet Chemistry Lab1

Date of Receipt : 26 January 2022

Calibrated By : Watcharapon Sangtong (Technician)

Approved By :  / Sujjar Naknakred (Site Calibration Manager)

Date of Issue : 20 FEB 2022

REVIEW BY	Sinluk P.
APPROVED BY	KLAL
NEXT CAL. DATE	1/2/23

The uncertainties are for a confidence probability of approximately 95%.

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

Certificate No. T220133I01

Page 2 of 5

Calibration Report

Equipment : Digestion Unit
Date of Calibration : 1 February 2022
Environment : Temperature : 23.9 - 26.3 °C
Line Voltage : 221.4 - 225.1 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert four standard thermocouples type S into its chamber , the other one thermocouple type T use for ambient temperature measurement . The calibration was done in according to WI-T10.

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	Type S	M20A1-(CH17-CH20)	T210011	14 March 2022
DATA LOGGER	34970A	T149	T210011	14 March 2022

3. This certificate is traceable to :

National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)

4. Condition of calibrated item : good

Equipment Description :

Time Constant 2 Hour 1 Minute At 380 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close
☒ Not Available

5. Adjustment :

(X) without adjustment

() after adjustment

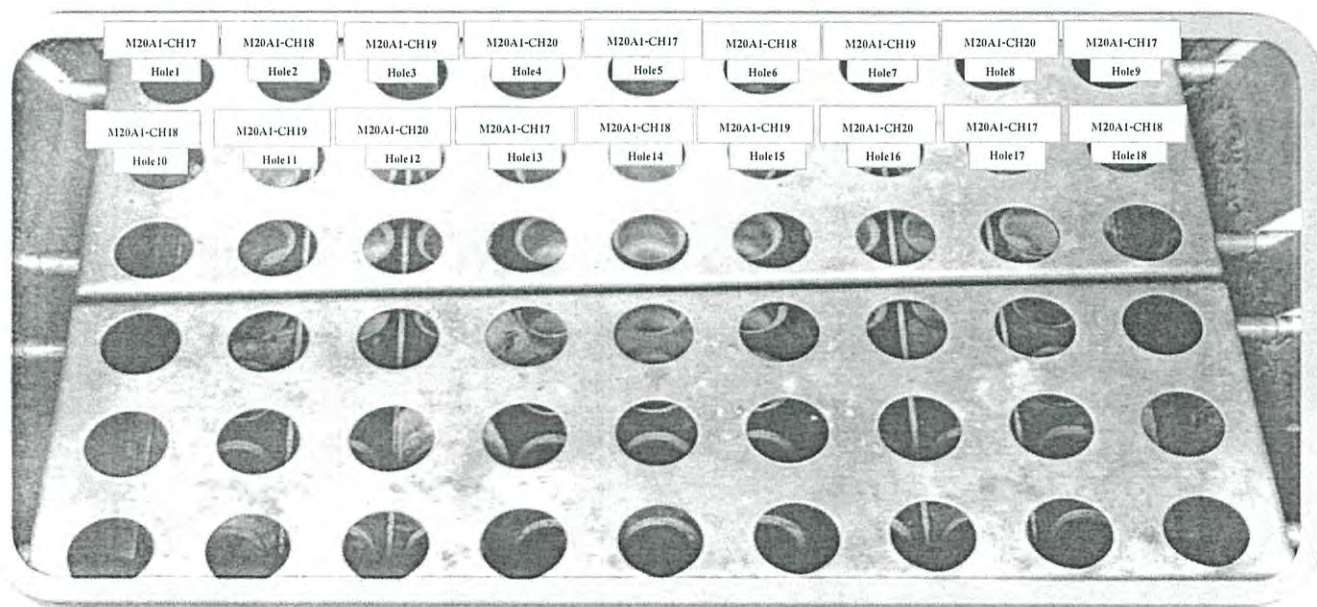
Approved By. _____



Certificate No. T220133I01

Page 3 of 5

Calibration Report



FRONT

Measurement Results

Cal. Point	Setting	Reading	STD.	Position of Standards at Block								
(°C)	(°C)	(°C)	Reading	Hole1	Hole2	Hole3	Hole4	Hole5	Hole6	Hole7	Hole8	Hole9
				M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17
380.0	380.0	379.8 - 380.2	Max °C	376.5	377.1	377.3	382.0	383.8	380.9	376.0	377.0	376.3
			Min °C	376.1	376.7	377.0	381.8	383.5	380.6	375.7	376.7	375.9
			Average °C	376.3	376.9	377.1	381.9	383.6	380.8	375.8	376.9	376.1
			Stability ± °C	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.1	0.2

Cal. Point	Setting	Reading	STD.	Position of Standards at Block								
(°C)	(°C)	(°C)	Reading	Hole10	Hole11	Hole12	Hole13	Hole14	Hole15	Hole16	Hole17	Hole18
				M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18
380.0	380.0	379.8 - 380.2	Max °C	377.3	378.1	382.6	383.2	381.8	380.8	380.4	376.6	378.2
			Min °C	376.9	377.6	382.2	382.7	381.4	380.5	380.1	375.8	377.4
			Average °C	377.1	377.9	382.4	382.9	381.6	380.6	380.3	376.2	377.8
			Stability ± °C	0.2	0.3	0.2	0.2	0.2	0.1	0.1	0.4	0.4

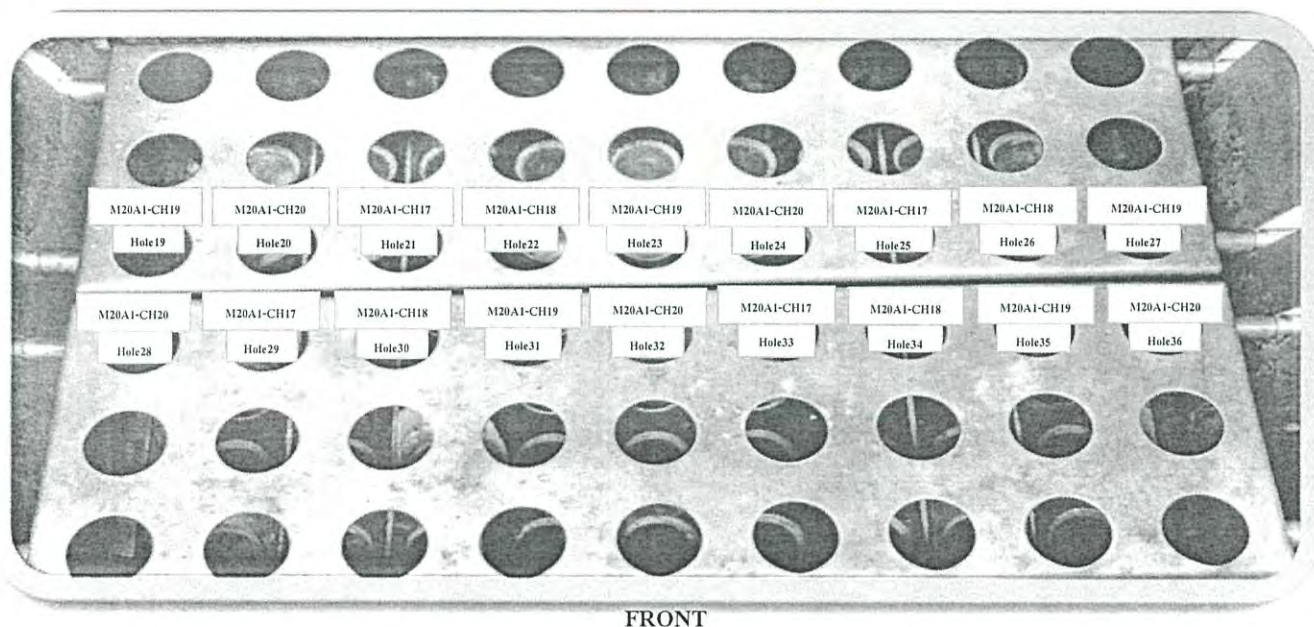
Approved By. _____



Certificate No. T220133I01

Page 4 of 5

Calibration Report



Measurement Results

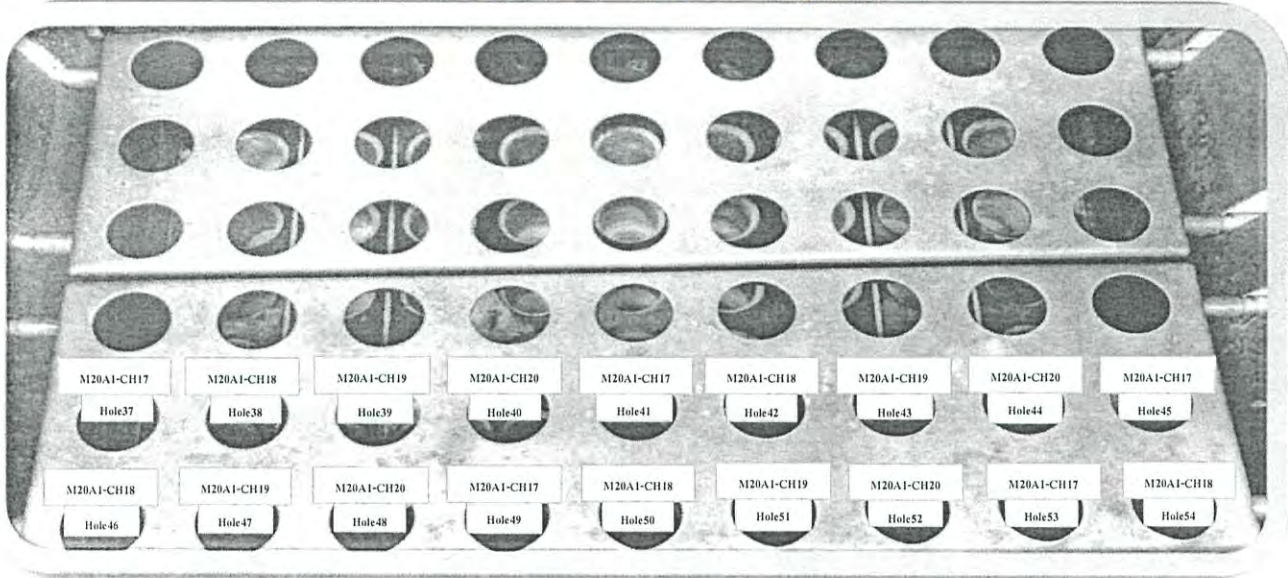
Cal. Point	Setting	Reading	STD.	Position of Standards at Block								
(°C)	(°C)	(°C)	Reading	Hole19	Hole20	Hole21	Hole22	Hole23	Hole24	Hole25	Hole26	Hole27
				M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19
380.0	380.0	379.8 - 380.2	Max °C	379.2	383.0	382.8	384.1	383.1	384.1	377.2	377.4	378.4
			Min °C	378.4	382.3	382.2	383.6	382.6	383.7	376.9	377.1	378.0
			Average °C	378.8	382.7	382.5	383.9	382.8	383.9	377.0	377.2	378.2
			Stability ± °C	0.4	0.3	0.3	0.3	0.3	0.2	0.2	0.1	0.2

Cal. Point	Setting	Reading	STD.	Position of Standards at Block								
(°C)	(°C)	(°C)	Reading	Hole28	Hole29	Hole30	Hole31	Hole32	Hole33	Hole34	Hole35	Hole36
				M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20
380.0	380.0	379.8 - 380.2	Max °C	380.6	381.9	383.9	381.4	382.0	378.3	379.4	380.4	376.2
			Min °C	380.1	381.5	383.5	381.1	381.7	377.9	379.0	379.8	375.8
			Average °C	380.4	381.7	383.7	381.2	381.8	378.1	379.2	380.1	376.0
			Stability ± °C	0.3	0.2	0.2	0.2	0.1	0.2	0.2	0.3	0.2

Approved By. _____



Calibration Report



FRONT

Measurement Results

Cal. Point	Setting	Reading	STD.	Position of Standards at Block								
(°C)	(°C)	(°C)	Reading	Hole37	Hole38	Hole39	Hole40	Hole41	Hole42	Hole43	Hole44	Hole45
				M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17
380.0	380.0	379.8 - 380.2	Max °C	381.1	383.5	384.2	379.8	381.3	381.4	381.3	380.6	380.7
			Min °C	380.8	383.2	383.9	379.4	380.8	381.0	380.9	380.2	380.4
			Average °C	381.0	383.4	384.1	379.6	381.1	381.2	381.1	380.4	380.6
			Stability ± °C	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2

Cal. Point	Setting	Reading	STD.	Position of Standards at Block								
(°C)	(°C)	(°C)	Reading	Hole46	Hole47	Hole48	Hole49	Hole50	Hole51	Hole52	Hole53	Hole54
				M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18	M20A1-CH19	M20A1-CH20	M20A1-CH17	M20A1-CH18
380.0	380.0	379.8 - 380.2	Max °C	377.2	377.8	382.8	378.6	379.5	380.4	383.3	383.0	378.1
			Min °C	376.8	377.2	382.2	378.3	379.3	380.1	383.1	382.7	377.8
			Average °C	377.0	377.5	382.5	378.4	379.4	380.2	383.2	382.8	377.9
			Stability ± °C	0.2	0.3	0.3	0.2	0.1	0.2	0.1	0.2	0.2

The expanded uncertainty of temperature measurement was ± 1.63 °C

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

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

Approved By. 



บริษัท ดับเบิล เอส ไดแอกโนสติกส์ จำกัด
DOUBLE S DIAGNOSTICS CO., LTD.

4 ซอยอุดมสุข 14 แขวงบางนา เขตบางนา กรุงเทพมหานคร 10260 โทรศัพท์: (02) 747-7009 โทรสาร: (02) 747-7008
4 Soi Udomsuk 14, Bangna, Bangkok 10260 Tel. (02) 747-7009 Fax: (02) 747-7008

Maintenance Plan YEAR : 2022

เดือน	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
รวม						OK						

Periodical maintenance check list for Konelab

	6M	12M	Note!
1.Diluent-wash tubing change	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
2.ISE tubing change	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
3.Syringe check/change		<input checked="" type="checkbox"/>	
4.Dispensing check/ change		<input checked="" type="checkbox"/>	
5.Waste tubing change when necessary		<input checked="" type="checkbox"/>	
6.Lamp check/change	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
7.Mixer paddle/paddle change(not Konelab20)		<input checked="" type="checkbox"/>	
8.ISE needles check/change		<input checked="" type="checkbox"/>	
9.Pump tubing check/ chance	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
10.Broken/worn out part check /change		<input checked="" type="checkbox"/>	
11.Peristaltic pump check /cleaning/ lubrication	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
12.Heating check		<input checked="" type="checkbox"/>	
13.Cooling check		<input checked="" type="checkbox"/>	
14.Dispenser mechanic check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
15.Cuvette transfer mechanic check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
16.Dispenser movement check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
17.Sample/reagent register check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
18.Dispensing tubing tightness check	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
19.Photometer and optics cleaning/check/adjustment	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
20.Workstation PC cleaning if necessary	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
21.Mechanic cleaning/lubrication	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
22.Instrument cleaning if necessary	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
23.Complete analyzer testing with waterblank/QC or sample	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
24.Test parameters/Adjustment/config. Save to USB key	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
25.UPS Test	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

Place: ALS LAB Instrument: K20 Aquaken 290
Date/Time: 30-6-65 Serial no: 22781
Service done by: Install date:
Signature of customer: Date/Time: 30/6/22



REVIEW BY	Autcharawan S.
APPROVED BY	Sarasat M.
NEXT CAL. DATE	12 / Jan / 23
	12 / Jan / 22
	ASL

Certificate of Calibration

ICS-2100: Anion (ID#659)

This certificate is to verify that instrument below are calibrated

by Archemica Lab Co., Ltd.

ICS-2100 S/N: 15010977

AS-HV S/N: 5450A36659

For

ALS Laboratory Group (Thailand) Co., Ltd.



Operator Signature: _____

Date: Jan 12, 2022

(Mr.Thitipong Piromkripuk)

Applications Chemist



Certificate of Calibration

Represent to Certificate of Calibration ,PTC/07/22071

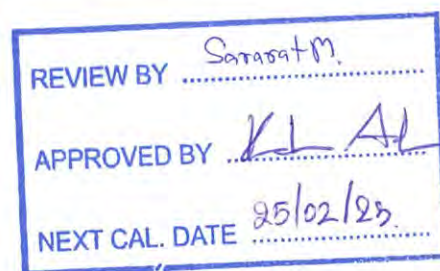
Certificate No.:	PTC/07/22071	Page:	1 of 2
Equipment:	Digital Balance	Condition:	Normal
Manufacturer:	Sartorius	Serial No:	26207042
Model:	MSE224-100-DU	ID No:	BKK_EN0002
Type of Balance:	Single interval		



Customer: ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakarn 40 Phatthanakarn Rd.,
khwaeng Phatthanakarn, Khet Suan Luang, Bangkok 10250.

Environment Condition: Temperature 21.5 °C \pm 0.7 °C
Humidity 61.8 %RH \pm 4.7 %RH
Air density 1.19 kg/m³

Calibration Place: ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakarn 40 Phatthanakarn Rd.,
khwaeng Phatthanakarn, Khet Suan Luang, Bangkok 10250.



The Method used: In house method, PTC-WI-07, base on Euramet cg. 18

Traceability: This certificate is traceable to the SI Units through Thai Calibration Service Co.,Ltd.
, NSC-ONSC Accreditation No.: Calibration 0189

Date Received: February 25, 2022

Calibration Date: February 25, 2022

Issued Date: March 01, 2022

Calibration By: Mr. Rungroje Metakul



PENTA CALIBRATION CO.,LTD

(Mr.Kriangsak Kalasri)

Reviewed by

Approved By :

(Mr. Keattisak Kerdto)

Laboratory Manager

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognised national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor ($k=2$) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The effect that the results relate only to the items calibrated.

This calibration certificate shall not be reproduced except in full only, without written approval from penta calibration co., ltd



Represent to Certificate of Calibration ,PTC/07/22071

Certificate No.: PTC/07/22071

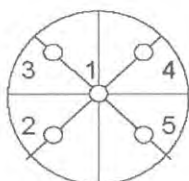
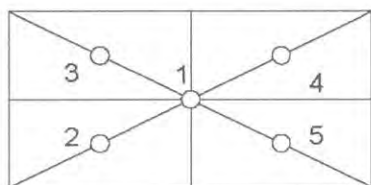
Page: 2 of 2

Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

Eccentric Error: Weight to be 1/3 ,1/2 or of Maximum capacity



Eccentricity test 100 (g)

Position (g)				
1	2	3	4	5
0.0000	-0.0002	-0.0001	0.0001	-0.0001
Maximum deviation:				0.0002

Repeatability Test : Weight to be $1/2 \leq L_1 \leq$ Maximum capacity

Determination of the standard deviation of weighing balance., Readability 0.0001 (g)

Nominal test value (g)	Standard Deviation
200	0.00005

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

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
0	0.00000	0.0000	0.0000	0.00016	2.52
0.1	0.10000	0.1000	0.0000	0.00017	2.20
0.5	0.50000	0.5000	0.0000	0.00016	2.28
1	1.00001	1.0000	0.0000	0.00016	2.28
2	2.00001	2.0000	0.0000	0.00016	2.28
5	5.00001	5.0000	0.0000	0.00016	2.28
10	10.00002	10.0000	0.0000	0.00016	2.28
20	20.00002	20.0000	0.0000	0.00016	2.23
50	50.00001	50.0000	0.0000	0.00017	2.15
100	100.00002	99.9999	0.0001	0.00020	2.06
120	120.00004	120.0000	0.0000	0.00023	2.03
150	150.00003	150.0000	0.0000	0.00026	2.00
200	200.00003	199.9999	0.0001	0.00030	2.00

Note: Weight of adjust - (g)

The End of Certificate



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 22CH1222

Page.: 1 of 2

Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	Mettler Toledo
Model :	Seven Compact S220
Serial No. :	B520948426
ID No. :	BKK_EN0072
Condition As-Received:	Used Item
Received Date :	09 September 2022
Calibration Date :	12 September 2022
Reference :	2209-0312DSC-1
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250 Thailand
Ambient Temperature :	(25 ± 2.5) °C
Relative Humidity :	(50 ± 15) %
Calibration Procedure :	In - house method : - CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)

REVIEW BY	<u>Sinluk P.</u>
APPROVED BY	<u>KL AL</u>
NEXT CAL. DATE	<u>12/03/24</u>

Calibrated by : Warakorn Lerngagtrakul

Approved by :

Malee

Approved Signatory

- (☒) Malee Butkruea
(☐) Saithip Meangmai
(☐) Warakorn Lerngagtrakul

Issue Date : 15 September 2022

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.



Cert. No.: 22CH1222

Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument : -

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023

This certification is traceable to the International System of Unit maintained at:-

- Traceable to National Institute of Metrology (Thailand), NIMT

2. 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	823320	20 June 2024
pH 6.985	CPA chem	794122	14 Feb 2023
pH 10.008	CPA chem	823323	20 June 2023

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

Calibration Results**Function : mV Measurement****Performing standard curve by Fluke at pH (4,7,10)**

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (\pm mV)	Coverage factor <i>k</i>
	pH	mV	mV	pH		
pH Meter S/N.: B520948426	4.000	177.48	177.4	4.000	0.058	2.00
	7.000	0.00	0.0	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00

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 <i>k</i>
pH Electrode S/N.: PCE-86-EX1001	4.008	3.999	153.9	0.0055	2.09
	6.985	7.017	-13.7	0.0084	2.00
	10.008	9.996	-179.0	0.0078	2.06

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 %.

-oOo-

Malu.

a 1126274