

ภาคผนวก ง

เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์



ALS Laboratory Group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal.	Freq. Calibrate (Months)
Noise	Leq 24 hrs	Sound Calibrator	RYG_F50215	13-Aug-20	13-Aug-21	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_F50386	20-Jul-20	20-Jul-21	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_F50387	8-Sep-20	8-Sep-21	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_F50434	7-Jan-21	7-Jan-22	12
Noise	Noise Annoyance	Sound Calibrator	RYG_F50215	13-Aug-20	13-Aug-21	12
Noise	Noise Annoyance	Sound Level Meter	RYG_F50386	20-Jul-20	20-Jul-21	12
Noise	Noise Annoyance	Sound Calibrator	RYG_F50215	24-Mar-21	24-Mar-22	12
Noise	Noise Annoyance	Sound Level Meter	RYG_F50386	12-Jan-21	12-Jan-22	12
Rayong Lab	pH at 25 °C	pH meter	RYG_EN0018	20-Aug-20	20-Aug-21	12
Rayong Lab	Color (at Original pH)	Spectrophotometer	RYG_EN0037	17-Jul-20	15-Jan-22	18
Rayong Lab	Color (at pH 7.0)	Spectrophotometer	RYG_EN0037	17-Jul-20	15-Jan-22	18
Rayong Lab	BOD (5 days at 20°C)	DO meter with Sensor	RYG_EN0032	21-Aug-20	21-Aug-21	12
Rayong Lab	BOD (5 days at 20°C)	Incubator	RYG_EN0154	22-May-20	22-May-21	12
Rayong Lab	COD	Spectrophotometer	RYG_EN0037	17-Jul-20	15-Jan-22	18
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG_EN0002	25-Dec-19	25-Jun-21	18
Rayong Lab	Total Suspended Solids	Chamber Oven	RYG_EN0008	28-Oct-19	28-Apr-21	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RYG_EN0002	25-Dec-19	25-Jun-21	18
Rayong Lab	Total Dissolved Solids 180°C	Chamber Oven	RYG_EN0010	28-Oct-19	28-Apr-21	18
Rayong Lab	Oil & Grease	Electronic Balance	RYG_EN0002	25-Dec-19	25-Jun-21	18
Rayong Lab	Oil & Grease	Chamber Oven	RYG_EN0006	28-Oct-19	28-Apr-21	18
Rayong Lab	Oil & Grease	Water Bath	RYG_EN0061	28-Oct-19	28-Apr-21	18
Rayong Lab	Temperature	pH Meter	RYG_F50392	16-Dec-20	16-Dec-21	12
Water Lab	pH at 25 °C	pH meter	BRK_EN0072	26-Mar-21	24-Sep-22	18
Water Lab	Color (at Original pH)	Spectrophotometer	RYG_EN0037	17-Jul-20	15-Jan-22	18
Water Lab	Color (at pH 7.0)	Spectrophotometer	RYG_EN0037	17-Jul-20	15-Jan-22	18
Water Lab	Oil & Grease	Electronic Top-Loading Balance	BRK_EN0002	10-Mar-21	10-Mar-22	12
Water Lab	Oil & Grease	Water Bath	BRK_EN0148	10-Sep-20	10-Mar-22	18
Water Lab	Total Suspended Solids	Electronic Top-Loading Balance	BRK_EN0002	10-Mar-21	10-Mar-22	12
Water Lab	Total Suspended Solids	Oven	BRK_EN0007	1-Jul-20	30-Dec-21	18
Water Lab	Total Dissolved Solids 180°C	Electronic Top-Loading Balance	BRK_EN0002	10-Mar-21	10-Mar-22	12
Water Lab	Total Dissolved Solids 180°C	Oven	BRK_EN0007	1-Jul-20	30-Dec-21	18



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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ (ต่อ)

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal.	Freq. Calibrate (Months)
Water Lab	BOD (5 days at 20°C)	DO Meter	BRK_EN0017	29-Dec-20	29-Jun-22	18
Water Lab	BOD (5 days at 20°C)	Incubator	BRK_EN0005	27-May-20	25-Nov-21	18
Water Lab	COD	Hot Block	BRK_EN0222	7-Apr-21	7-Apr-22	12
Water Lab	COD	Spectrophotometer	BRK_EN0018	16-Oct-20	16-Oct-21	12
Water Lab	Temperature	pH Meter	BRK_LG0004	18-Jan-21	18-Jan-22	12
Water Lab	Total Organic carbon	TOC Analyzer	BRK_EN0066	29-Oct-20	29-Oct-21	12

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirthorn Rd, Bangbunru, Bangkok 10700 THAILAND.
Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.com



NSC-TS1-ITS 17025
CALIBRATION 0199

Cert. No. : ACC20023
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR

Manufacturer : RION

Model : NC-74

Serial No. : 34178123

ID No. :

Condition As Found : GOOD

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

Location :

Ambient Temperature : (23.0 ± 3) °C

Pressure : (101.3 ± 3) kPa

Relative Humidity : (50.0 ± 20) %

Received Date : 10 AUGUST 2020

Calibration Date : 13 AUGUST 2020

Date of Issue : 17 AUGUST 2020

Calibrated by :

Nathakorn Pisutpaisan

Approved by :

T. Petchurani
(Thanakul Petchurani)

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.

QF-TS12-04-03-051060

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACC20023
Job No. : VC63AC0063
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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY53202742	EF-0008-20	03-Feb-21
Digital Multimeter	33461A	MY53220104	EEL.BP. 199/0163	05-Feb-21
Digital Multimeter	33461A	MY53220076	EEL.BP. 200/0163	02-Feb-21
Digital Multimeter	33461A	MY53220116	EEL.BP. 201/0163	06-Feb-21
Programmable Attenuator	MAT-1070	00119	EF-0010-20	04-Feb-21
Condenser Microphone	4180	2977900	AA-1007-20	07-Feb-21
Measuring Amplifier	NA-42KAI	34560495	AA-3005-20	06-Feb-21
Audio Analyzer	AVR-3360A	V744B6069	EF-0011-20	06-Feb-21

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).

QF-TS12-04-03-051060

T. Petchurani

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	94.09	0.09	0.18	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1001.4	0.1	1.0	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
1.21	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

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 01073423 / 169513 / 73684
ID No.:
Condition As Found : GOOD
Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAEANG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %
Received Date : 17 JULY 2020
Calibration Date : 20-21 JULY 2020
Date of Issue : 22 JULY 2020

Calibrated by :

Nathakorn Pisutpaisan

Approved by :

7. Petchurai
(Thanakul Petchurai)

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REVIEW BY	W. Petchurai
APPROVED BY	7. Petchurai
NEXT CAL. DATE	20/4/21

Continuation of Calibration Certificate

Cert. No. : ACL20102
Job No. : VC63AC0056
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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-20	03-Feb-21
Waveform Generator	33511B	MY52302742	EF-0008-20	03-Feb-21
Digital Multimeter	33461A	MY53220104	EEL.BP. 199/0163	05-Feb-21
Digital Multimeter	33461A	MY53220076	EEL.BP. 200/0163	02-Feb-21
Digital Multimeter	33461A	MY53220116	EEL.BP. 201/0163	06-Feb-21
Programmable Attenuator	MAT-1070	00119	EF-0010-20	04-Feb-21
Condenser Microphone	4180	2977900	AA-1007-20	04-Feb-21
Measuring Amplifier	NA-42KAI	34560495	AA-3005-20	06-Feb-21

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. : ACL20102
Job No. : VC63AC0056
Pages : 3 of 8

Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.3	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	✓	-	0.5	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	✓	-	0.1	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	✓	-	0.1	0.3
10. Peak C sound level	✓	-	0.1	0.35
11. Overload indication	✓	-	0.1	0.25
12. High level stability	✓	-	0.1	0.1

Continuation of Calibration Certificate

Cert. No. : ACL20102
Job No. : VC63AC0056
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.97)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.4

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.7
Flat	23.3

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)		
	Flat	C-weight	A-weight
125	0.1	0.0	0.1
1000	-0.2	-0.2	-0.2
8000	1.3	1.4	1.4

QF-TS12-04-03-051060

9-PT1

Continuation of Calibration Certificate

Cert. No. : ACL20102
Job No. : VC63AC0056
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
63	-0.1	-0.1	0.0
125	0.0	0.0	0.0
250	0.0	0.0	0.0
500	0.0	0.1	0.0
1000	0.0	0.0	0.0
2000	0.0	0.1	0.0
4000	0.0	0.0	0.0
8000	0.0	0.1	0.1

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

QF-TS12-04-03-051060

9-PT1

Continuation of Calibration Certificate

Cert. No. : ACL20102
Job No. : VC63AC0056
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	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 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	26.0	0.0	± 1.1
25.0	25.1	0.1	± 1.1

QF-TS12-04-03-051060

F. P. 1

Continuation of Calibration Certificate

Cert. No. : ACL20102
Job No. : VC63AC0056
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	± 0.5

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	134.1	0.1	± 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
	0.25	1	99.0	98.9	-0.1	$1.5; -5.0$
SEL	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, Lepeak (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	135.2	-0.2	± 2.0
Negative half cycle	135.4	135.2	-0.2	± 2.0

QF-TS12-04-03-051060

F. P. 1

Continuation of Calibration Certificate

Cert. No. : ACL20102
Job No. : VC63AC0056
Pages : 8 of 8

11. Overload indication

Measured value (dB)	Deviated Value (dB)		Acceptance Limits (dB)
	Positive	Negative	
one-half cycle			
89.5	89.6	0.1	±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

451-451/1 Sindhorn Rd, Bangbunru, Bangkok 10700 THAILAND.
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Cert. No. : ACL20134
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No.: 01073608 / 172153 / 85748
ID No.: RYG_FS0387

Condition As Found : GOOD

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

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %
Received Date : 27 AUGUST 2020
Calibration Date : 08-10 SEPTEMBER 2020
Date of Issue : 15 SEPTEMBER 2020

Calibrated by : Nathakorn Pisupaisan

Approved by : *T. Peichur*
(Thanakul Peichurai)

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.

REVIEW BY	W. Peichur
APPROVED BY	<i>T. Peichur</i>
NEXT CAL. DATE	5/9/21

Continuation of Calibration Certificate

Cert. No. : ACL20134
Job No. : VC63AC0069
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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-20	03-Feb-21
Waveform Generator	33511B	MY52302742	EF-0008-20	03-Feb-21
Digital Multimeter	33461A	MY53220104	EEL.BP. 199/0163	05-Feb-21
Digital Multimeter	33461A	MY53220076	EEL.BP. 200/0163	02-Feb-21
Digital Multimeter	33461A	MY53220116	EEL.BP. 201/0163	06-Feb-21
Programmable Attenuator	MAT-1070	00119	EF-0010-20	04-Feb-21
Condenser Microphone	4180	2977900	AA-1007-20	04-Feb-21
Measuring Amplifier	NA-42KAI	34560495	AA-3005-20	06-Feb-21

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. : ACL20134
Job No. : VC63AC0069
Pages : 3 of 8

Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.3	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	✓	-	0.1	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	✓	-	0.1	0.3
10. Peak C sound level	✓	-	0.1	0.35
11. Overload indication	✓	-	0.1	0.25
12. High level stability	✓	-	0.1	0.1

Continuation of Calibration Certificate

Cert. No. : ACL20134
Job No. : VC63AC0069
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.97)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.2

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

Frequency Weighting	Measured value (dB)
A - weight	11.2
C - weight	17.5
Flat	23.1

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)		
	Flat	C-weight	A-weight
125	0.3	0.4	0.4
1000	-0.1	-0.1	-0.2
8000	-0.3	-0.3	-0.2

QF-TS12-04-03-051060

7. P.T.1.

Continuation of Calibration Certificate

Cert. No. : ACL20134
Job No. : VC63AC0069
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
63	0.0	-0.1	-0.1
125	0.0	0.0	0.0
250	0.0	0.0	0.0
500	0.0	0.0	0.0
1000	0.0	0.0	0.0
2000	0.0	0.0	0.0
4000	0.0	0.0	0.0
8000	0.0	0.1	0.1

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

QF-TS12-04-03-051060

7. P.T.2.

Continuation of Calibration Certificate

Cert. No. : ACL20134
Job No. : VC63AC0069
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	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	53.9	-0.1	±1.1
49.0	49.0	0.0	±1.1
44.0	43.9	-0.1	±1.1
39.0	38.9	-0.1	±1.1
34.0	33.9	-0.1	±1.1
30.0	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	28.0	0.0	±1.1
27.0	26.9	-0.1	±1.1
26.0	25.9	-0.1	±1.1
25.0	25.0	0.0	±1.1

QF-TS12-04-03-051060

S. Potha

Continuation of Calibration Certificate

Cert. No. : ACL20134
Job No. : VC63AC0069
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	±0.5

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
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.3	-1.1	±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	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

QF-TS12-04-03-051060

S. Potha

Continuation of Calibration Certificate

Cert. No. : ACL20134
Job No. : VC63AC0069
Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.6	89.6	0.0	±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

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

Cert. No. : ACL21017
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00296517 / 179118 / 87525
ID No.: RYG_FS0434

Condition As Found : GOOD

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

Location :
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %
Received Date : 29 DECEMBER 2020
Calibration Date : 07-08 JANUARY 2021
Date of Issue : 12 JANUARY 2021

Calibrated by : Nathakorn Pisulpaisan

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.

REVIEW BY : <i>W. Petchurai</i>
APPROVED BY : <i>[Signature]</i>
NEXT CAL. DATE : 7/1/22

Continuation of Calibration Certificate

Cert. No. : ACL21017
Job No. : VC64AC0031
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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-20	03-Feb-21
Waveform Generator	33511B	MY52302742	EF-0008-20	03-Feb-21
Digital Multimeter	33461A	MY53220104	EEL.BP. 199/0163	05-Feb-21
Digital Multimeter	33461A	MY53220076	EEL.BP. 200/0163	02-Feb-21
Digital Multimeter	33461A	MY53220116	EEL.BP. 201/0163	06-Feb-21
Programmable Attenuator	MAT-1070	00119	EF-0010-20	04-Feb-21
Condenser Microphone	4180	2977900	AA-1007-20	04-Feb-21
Measuring Amplifier	NA-42KAI	34560495	AA-3005-20	06-Feb-21

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. : ACL21017
Job No. : VC64AC0031
Pages : 3 of 8

Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.3	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	✓	-	0.1	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	✓	-	0.1	0.3
10. Peak C sound level	✓	-	0.1	0.35
11. Overload indication	✓	-	0.1	0.25
12. High level stability	✓	-	0.1	0.1

Continuation of Calibration Certificate

Cert. No. : ACL21017

Job No. : VC64AC0031

Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.97)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.2

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

Frequency Weighting	Measured value (dB)
A - weight	10.8
C - weight	17.2
Flat	22.8

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)		
	Flat	C-weight	A-weight
125	0.1	0.1	0.2
1000	-0.1	-0.1	-0.1
8000	0.4	0.5	0.5
			Acceptance Limits
			± 1.5
			± 1.0
			± 5.0

QF-TS12-04-03-051060

77 R.T.1

Continuation of Calibration Certificate

Cert. No. : ACL21017

Job No. : VC64AC0031

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
63	0.0	0.0	-0.1
125	0.0	0.0	0.0
250	0.0	0.0	-0.1
500	0.0	0.0	0.0
1000	0.0	0.0	0.0
2000	0.0	0.0	0.0
4000	0.0	0.0	0.0
8000	0.0	0.1	0.1
			Acceptance Limits
			±2.0
			±1.5
			±1.5
			±1.5
			±1.0
			±2.0
			±3.0
			±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

QF-TS12-04-03-051060

77 D.T.1

Continuation of Calibration Certificate

Cert. No. : ACL21017
Job No. : VC64AC0031
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	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	53.9	-0.1	±1.1
49.0	48.9	-0.1	±1.1
44.0	44.0	0.0	±1.1
39.0	38.9	-0.1	±1.1
34.0	33.9	-0.1	±1.1
30.0	29.9	-0.1	±1.1
29.0	28.9	-0.1	±1.1
28.0	28.0	0.0	±1.1
27.0	26.9	-0.1	±1.1
26.0	26.0	0.0	±1.1
25.0	25.0	0.0	±1.1

QF-TS12-04-03-051060

R.T.

Continuation of Calibration Certificate

Cert. No. : ACL21017
Job No. : VC64AC0031
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	±0.5

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
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.4	-1.0	±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	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

QF-TS12-04-03-051060

R.T.

Continuation of Calibration Certificate

Cert. No. : ACL21017

Job No. : VC64AC0031

Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.7	89.8	0.1	±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 _____



**ELECTRICAL AND ELECTRONICS INSTITUTE
FOUNDATION FOR INDUSTRIAL DEVELOPMENT**
975 Moo 4, Bangpoo Industrial Estate, Soi 8, Sukhumvit Road km 37,
Phraek Sa, Mueang Samut Prakan, Samut Prakan 10280
Tel: +66 2709 4860-8 Fax: +66 2324 0917-8



Certificate No.: 0147SV21
Operation No.: CP2021030034

Certificate of Calibration

Equipment: Sound Calibrator

Manufacturer: RION

Model/Type: NC-74

Serial No.: 34178121

ID No.: RYG_FS0213

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

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

Received Date: 19 March 2021

Calibrated Date: 24 March 2021

Issued Date: 25 March 2021

Calibrated by: Ms. Juntaporn Kunhakom



Approved by: _____
(Mr. Sittichai Swaksuriyawong)
Group Manager

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor $k = 2.00$,
providing a level of confidence of approximately 95%. This certificate may not be reproduced other than in full except
with the prior written approval of the Electrical and Electronics Institute, Foundation for Industrial Development.



Certificate No.: 0147/SV21

Calibration Report

Equipment: Sound Calibrator
Manufacturer: RION
Model/Type: NC-74
Serial No.: 34178121
ID No.: RYG FS0213
Ambient Temperature: (25 ± 2) °C
Relative Humidity: (50 ± 15) %
Pressure: (101.3 ± 1.5) kPa

Method of Calibration :-

IEC 60942:2017

Condition of this result of calibration

1. Reference standards instrument :-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Standard microphone	4180	2661000	AA-1013-20	12 May 2021
2) Waveform Generator	33511B	MY52402264	0100RF20	17 June 2021
3) Audio Analyzing DMM	2015-P	000136E	E1U203927	16 November 2021
4) Pressure humidity and Temperature Transmitter	PTU301	F0640002	CL1-P200051	31 May 2021
			0305TE20	29 June 2021

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

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

Reference standards instrument for Acoustic function

- National Institute of Metrology (Thailand)

Reference standards instrument for Electrical function

- Electrical and Electronics Institute, ONSC Accredited Calibration No.0119

Result of Calibration:-

1. Function : Sound pressure level

Nominal Frequency (Hz)	Specified Sound Pressure level (dB)	Measured value (dB)	Deviated value ⁽¹⁾ (dB)	Acceptance limit ⁽³⁾ (dB)
1000	94	94.16	0.16	±0.25

2. Function : Frequency

Nominal Sound Pressure level (dB)	Specified Frequency (Hz)	Measured value (Hz)	Deviated value ⁽²⁾ (%)	Acceptance limit ⁽³⁾ (%)
94	1000	1003.1	0.3	±0.7

Certificate No.: 0147/SV21

Calibration Report

3. Function : Total distortion + noise

Nominal Sound Pressure level (dB)	Nominal Frequency (Hz)	Measured value ⁽⁴⁾ (%)	Acceptance limit ⁽⁵⁾ (%)
94	1000	1.6	2.5

Uncertainty of measurement

Function	Uncertainty	Maximum-permitted uncertainty of measurement
Sound pressure level	0.10 dB	0.15 dB
Frequency	0.10 %	0.20 %
Total distortion + noise	0.40 %	0.50 %

Note: (1) The deviated value is the absolute value of the difference between the measured value

and the corresponding specified sound pressure level.

(2) The deviated value is the absolute value of the difference in percent between the measured value

and the corresponding specified frequency.

(3) The acceptance limit is for the deviated value.

(4) The measured value is the total distortion + noise, measured over the frequency range from 20 Hz to 20 kHz.

(5) The acceptance limit is for the Measured value

Remarks: 1. Using the 1/2-inch microphone adaptor NC-74-002.

2. Acceptance limit was IEC 60942:2017 Class 1.

--- End of Report ---

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



NSC-TSI-TS 17025
CALIBRATION 0199

Cert. No. : ACL21028
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00734220 / 145272 / 34370
ID No.: RYG_FS0026

Condition As Found : GOOD
Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

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

Received Date : 11 JANUARY 2021
Calibration Date : 12-15 JANUARY 2021
Date of Issue : 18 JANUARY 2021

Calibrated by : Nuthakorn Pisutpaisan

Approved by :
(Thanakul Peichurai)

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.

QF-TS17-04-03-0510001

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL21028
Job No. : VC64AC0034
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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0009-20	03-Feb-21
Waveform Generator	33511B	MY52302742	EF-0008-20	03-Feb-21
Digital Multimeter	33461A	MY53220104	EEL.BP. 199/0163	05-Feb-21
Digital Multimeter	33461A	MY53220076	EEL.BP. 200/0163	02-Feb-21
Digital Multimeter	33461A	MY53220116	EEL.BP. 201/0163	06-Feb-21
Programmable Attenuator	MAT-1070	00119	EF-0010-20	04-Feb-21
Cordenser Microphone	4180	2977900	AA-1007-20	04-Feb-21
Measuring Amplifier	NA-42KAI	34560495	AA-3005-20	06-Feb-21

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).

QF-TS12-04-03-051060

4-27

Continuation of Calibration Certificate

Cert. No. : ACL21028
Job No. : VC64AC0034
Pages : 3 of 8

Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.3	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	✓	-	0.1	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	✓	-	0.1	0.3
10. Peak C sound level	✓	-	0.1	0.35
11. Overload indication	✓	-	0.1	0.25
12. High level stability	✓	-	0.1	0.1

Continuation of Calibration Certificate

Cert. No. : ACL21028
Job No. : VC64AC0034
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.97)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.2

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.8
Flat	23.6

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)		
	Flat	C-weight	A-weight Acceptance Limits
125	0.1	0.2	±1.5
1000	-0.1	-0.1	±1.0
8000	-1.2	-1.1	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL21028
Job No. : VC64AC0034
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
63	0.0	0.0	0.0
125	0.0	0.1	0.0
250	0.0	0.0	0.0
500	0.0	0.1	0.0
1000	0.0	0.0	0.0
2000	0.0	0.1	0.0
4000	0.0	0.0	0.0
8000	0.0	0.1	0.1

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

QF-TS12-04-03-051060

7 P 1

Continuation of Calibration Certificate

Cert. No. : ACL21028
Job No. : VC64AC0034
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	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 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	38.9	-0.1	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	26.0	0.0	± 1.1
25.0	25.0	0.0	± 1.1

QF-TS12-04-03-051060

7 P 1

Continuation of Calibration Certificate

Cert. No. : ACL21028
Job No. : VC64AC0034
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	±0.5

9. Tone burst response

Time Weighting	Tone burst duration, T _b (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	134.1	0.1	±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
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	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, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.5	-0.9	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.1	0.1	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

Continuation of Calibration Certificate

Cert. No. : ACL21028
Job No. : VC64AC0034
Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle	89.6	±1.5
89.6	89.6		

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	136.9	0.1	±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)
CORPORATE SERVICES 3, EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL 0-2717-5000-27 FAX 0-2710-9483



NIST
NIST-101-1025
CALIBRATION 002

Cert.No.: 20CH1229/1
Page.: 1 of 3

Certificate of Calibration

This Certificate was issued to replace to the Certificate No. 20CH1229

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : MP 220
Serial No. : 078493M
ID No. : RYG_EN0018
Condition As-Received : Used Item
Received Date : 19 August 2020
Calibration Date : 20 August 2020
Reference : 2008-0689DSC-1
Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng,
Rayong 21140, Thailand

REVIEW BY	N.Banvit
APPROVED BY	P. Banvit
NEXT CAL DATE	2019/12/1

Ambient Temperature :
Relative Humidity :
Calibration Procedure :
In - house method :
- CP-CH5 : based on direct measurement by using standard voltage calibrator and certified reference material (CRM)
- CP-CHB : based on comparison technique by comparison with reference standard thermometer
Warakorn Lerrigetrakul

Calibrated by :

Approved by :
Warakorn Lerrigetrakul
Approved Signatory

() Pornthippa Tameyakul
() Melee Butkruea
() Sathip Meangmai
Issue Date : 22 April 2021

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 0027267



Cert.No.: 20CH1229/1
Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument :
Instrument : Document Process Calibrator
Model : 753
Serial No. : 43180066
ID No. : 130RC092
Cert. No. : 20E1369
Due Date : 15 Apr 2021
2) Ref. Standard Thermometer
Model : 1523
Serial No. : 3240076
ID No. : 60RC033
Cert. No. : 20I203
Due Date : 13 Feb 2021
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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	699313	19 July 2022
pH 6.985	CPA chem	693947	12 June 2021
pH 10.008	CPA chem	693946	21 June 2021

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)(7.10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (\pm mV)	Coverage factor k
			mV	pH		
pH Meter S/N: 078493M	pH 4.00	177.48	178	4.01	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-178	10.01	0.58	2.00

Wak

a 1051502



Cert.No.: 20CH1229/1
Page.: 3 of 3

Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (\pm)	Coverage factor k
pH Electrode S/N.: 9391665	4.008	4.00	181	0.0071	2.00
	6.985	6.99	11	0.0099	2.00
	6.985	7.00	10	0.0093	2.00
	10.008	10.01	-165	0.013	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLab Expert Go-ISM

- Serial No. : 9391665

Dimension of probe;

- Length : 120 mm.

- Diameter : 12 mm.

- Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (\pm °C)	Coverage factor k
25.0	25.004	25.0	-0.004	0.20	2.00

Remark : - 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-

Wala.

a 1051501



Certificate of Calibration

Equipment: SPECTROPHOTOMETER
Model: DR6000
Serial No. (or ID.): 1627845 (RYG-EN0037)
Manufacturer: HACH
Condition: In Condition
Certificate No.: C06200382
Issued Date: 17 July 2020
Job No.: KSPR2009924
Page: 1 of 3

Customer: ALS Laboratory Group (Thailand) Co., Ltd.
64/77, Moo 4, Highway 331 Rd., Km.91.5,
Tambol Pluak-daeng, Amphur Pluak-daeng, Rayong 21140 Thailand

Environment Condition: Temperature 25.2 °C ± 0.3 °C
Humidity 66.8 %RH ± 2.1 %RH

Calibration Place: ALS Laboratory Group (Thailand) Co., Ltd. (Wet Chem Lab)
64/77, Moo 4, Highway 331 Rd., Km.91.5,
Tambol Pluak-daeng, Amphur Pluak-daeng, Rayong 21140 Thailand

Calibration By: Mr. Chathuphon Foithong

Calibration Date: 17 July 2020

The Method used: In house method, SPOC-WI-24, base on ASTM E 275-08 and ASTM E 387-04

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

The standard for Wavelength Certificate No. 72569 and 72568

The standard for Photometric Certificate No. 72571 and 72565

The standard for Stray light Certificate No. 72566 and 72567

The standard for Spectral resolution Certificate No. 72570

SPC
บริษัท สเปคทีร่า จำกัด
SPC RT Co., Ltd.

SPC
บริษัท สเปคทีร่า จำกัด
(Mr. Dumrong Boonsopon)

Person in charge

Authorized signatory

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

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

These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of SPC RT Co., Ltd.

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SPC RT CO., LTD.

1194 ถนนวิภาวดีรังสิต 57 แขวงวิภาวดี เขตวิภาวดี กรุงเทพมหานคร 10660
Branch 00003 1194 Soi Wiphawadee 57, Wiphawadee, Bangkok, Thailand 10660
Tel: 0 2085 4333 Ext. 3305-3308 Fax: 0 2085 4424 E-mail: info.spc@spc-rt.com Website: www.spc-rt.com

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Calibration Results:
Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 2 nm and UUC at 2 nm

Standard Wavelength	Unit Under Calibration	Correction	Uncertainty
418.61	418.4	0.21	0.14
536.66	536.7	-0.04	0.13
637.98	638.3	-0.32	0.16
748.48	748.7	-0.22	0.19
807.03	807.4	-0.37	0.15

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5903	0.590	0.0003	0.0045
	0.7630	0.762	0.0010	0.0045
	1.0280	1.028	0.0000	0.0052
440 nm	0.0000	0.000	0.0000	0.0045
	0.5789	0.579	0.0009	0.0045
	0.7454	0.745	0.0004	0.0045
	1.0056	1.005	0.0006	0.0052
465 nm	0.0000	0.000	0.0000	0.0045
	0.5302	0.530	0.0002	0.0045
	0.6878	0.687	0.0008	0.0045
	0.9549	0.955	-0.0001	0.0045
516.1 nm	0.0000	0.000	0.0000	0.0045
	0.5479	0.547	0.0009	0.0045
	0.6970	0.695	0.0020	0.0045
	0.9998	0.999	0.0008	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5863	0.585	0.0013	0.0045
	0.7249	0.723	0.0019	0.0045
	1.0961	1.095	0.0011	0.0052
635 nm	0.0000	0.000	0.0000	0.0045
	0.5702	0.569	0.0012	0.0045
	0.6921	0.691	0.0011	0.0045
	1.0885	1.087	0.0015	0.0052

SPC PT CO., LTD.
Branch 00003 1194 Soi Wachiramonwong 57, Sukhumvit 107/1 Road, Bangkok, Prachinong, Bangkok 10260 Thailand
Tel: 0 2185 4333 Ext. 3300-3308 Fax: 0 2185 4424 E-mail: info.spc@spc-ri.com Website: www.spc-ri.com

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SPCC-FM-C06-10: 11 Feb 2020

Calibration Results:
Without Adjustment

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
235 nm	0.0000	0.000	0.0000	0.0080
	0.7343	0.730	0.0043	0.0080
257 nm	0.0000	0.000	0.0000	0.0080
	0.8553	0.851	0.0043	0.0080
313 nm	0.0000	0.000	0.0000	0.0080
	0.2852	0.285	0.0002	0.0080
350 nm	0.0000	0.000	0.0000	0.0080
	0.6342	0.630	0.0042	0.0080

Stray light *

Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%)	Absorbance (A)
260.78 +/- 0.11 nm	260.8	1.7	1.77
392.3 +/- 0.11 nm	392.3	1.7	1.77

The stray light transmission reference is less than 1.0 T(%) and absorbance is greater than 2.0 (A)

Spectral Resolution *

Nominal Concentration 0.02 % v/v	Peak	Trough	Ratio	SBW
Standard Wavelength (nm)	268.71	266.76	1.38	2.00
UUC: Wavelength (nm)	269.2	266.1		
Std Absorbance (A)	0.4565	0.2719		
Absorbance (A)	0.414	0.300		

* Calibration Marked * Not TISI Accredited * In This Certificate have been included for completeness.

The End of Certificate

SPC PT CO., LTD.
Branch 00003 1194 Soi Wachiramonwong 57, Sukhumvit 107/1 Road, Bangkok, Prachinong, Bangkok 10260 Thailand
Tel: 0 2185 4333 Ext. 3300-3308 Fax: 0 2185 4424 E-mail: info.spc@spc-ri.com Website: www.spc-ri.com

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SPCC-FM-C06-10: 11 Feb 2020

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2009924

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR6000

หมายเลขเครื่อง: 1627845

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
17 Jul 2020	17 Jul 2020		17 Jul 2020		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิตช์ ปิด - เปิด เครื่อง (On-Off Switch)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		Spectrophotometer			
<input type="checkbox"/>	<input type="checkbox"/>	6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	7. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control)	<input type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	656.1 = 656.1 nm
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. แหล่งกำเนิดแสง (Visible < 3,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	5.5 hours
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	403.9 hours
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. ช่องวัดหลอดตัวอย่าง (Carousel Module)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		pH Meter and Conductivity Meter			
<input type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด (Electrode and Connection Cable)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	13. ระดับสารละลายใน Electrode (Level KCL)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	14. ฝาปิดกันปลาย Electrode (Dust Protection Hood)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาตั้งอิเล็กโทรด (Stand)	<input type="checkbox"/>	<input type="checkbox"/>	
		Turbidimeter			
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่นเกิน 3.0)	<input type="checkbox"/>	<input type="checkbox"/>	
		Automatic titrator			
<input type="checkbox"/>	<input type="checkbox"/>	18. สภาพ Piston Burettes	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	19. Function Rinsing and Dosing	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	20. ระบบท่อสายยาและอุปกรณ์ประกอบ	<input type="checkbox"/>	<input type="checkbox"/>	

เซ็นเซอร์/ข้อแนะนำ:

Mr. Chaituphon Fothong

Service Engineer

บริษัท เอสพี ซีลิตี้ จำกัด
SPC RT CO., LTD.
สาขาที่ 00003 1154 ซอยสุขุมวิท 101/1 แขวงคลองเตยเหนือ เขตวัฒนา กรุงเทพฯ 10110
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SPCC-FMR31-Q1: 18 Nov 2019



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

Cert.No.: 20TW171
Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter

Manufacturer : YSI

Model : 5000-115V

Serial No. : 15E102796

ID No. : RYG_EN0032

Received Date : 19 August 2020

Test Date : 21 August 2020

Reference : 2008-0689DSC-2

Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.

Rayong Branch

Eastern Seaboard Industrial Estate (Rayong)

64/77 Moo 4, Building No.B1, Highway 331, Km91.5,

T.Pluakdaeng, A.Pluakdaeng, Rayong 21140 Thailand

Laboratory Condition : Temperature (25 ± 5) °C

Humidity (50 ± 20) %

Test Procedure : In - house method : CP-CH9

by Comparison Technique with Azide Modification Method

Calibrated by :

Walalak Sirthean

Approved by :

Wala

Approved Signatory

() Pornthippa Tameyakul

() Malee Butkruea

() Porpan Paipim

() Saithip Meangmai

Issue Date :

24 August 2020

R 0239696



Cert.No.: 20TW171
Page.: 2 of 2

Result : Dissolved Oxygen Meter Adjustment With Air 100 %
Dissolved Oxygen Probe No.: 15E100464

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2717-3006-24 FAX. 0-2719-9484



Certificate of Calibration

Certificate No.: 20T1912
Page: 1 of 2

Equipment: DO Meter With Sensor
Manufacturer: YSI
Model: 5000-115V
Serial No.: 15E102796
ID No.: RYG_EN0032
Condition As-Received: Used Item
Received Date: 19 August 2020
Calibration Date: 31 August 2020 to 01 September 2020
Reference: 2008-0689DSC
Ambient Temperature: (25 ± 3) °C
Relative Humidity: (50 ± 20) %

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.

Submitted by: ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
Eastern Seaboard Industrial Estate (Rayong) 64/77 Moo 4, Building No.B1, Highway 331, Km91.5, T.Pluakdaeng, A.Pluakdaeng, Rayong 21140 Thailand

Procedure used: Calibration were conducted using in-house calibration procedure CP-T01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into liquid bath temperature controller.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Digital Thermometer	1529	A66176	1911397	01 Nov 2020
2) Industrial Platinum Resistance Thermometer	5627	739437	1911397	01 Nov 2020

2. The 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 maintained at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by: Pliak Srimongkol
Issue Date: 03 September 2020

Approved Signatory:

[] Phalinee Prabpai
[] Chatchawan Khunpluak
[✓] Wanlop Larpkum

B 0241446

Result of Calibration:-

Without Adjustment

Function: Temperature measurement

This equipment was connected with Temperature Sensor S/N. 15E100464

Dimension of probe : Diameter 3 mm., Length 32 mm. Sheath material : Stainless Steel

Immersion Depth (mm.)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
45	19.9993	19.85	-0.1493	0.099

UUC* : Unit Under Calibration

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

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



Certificate of Calibration

Equipment : Low Temp. Incubator

Manufacturer : Memmert

Model : IPP 750

Serial No. : V818.0084

ID No. : RYG_EN0154

Submitted by :

ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
Eastern Seaboard Industrial Estate (Rayong)
64/77 Moo 4, Building No.B1, Highway 331, Km91.5,
T.Pluakdaeng, A.Pluakdaeng, Rayong 21140 Thailand
Laboratory (ALS Laboratory Group (Thailand) Co., Ltd.)

Location :

Received Order :

Calibration Date : 22 May 2020

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by :

Man Pattanapongpatboon

Approved by :

Approved Signatory

() Pornhippa Tameyakul

() Malee Bulkruea

() Suwit Injai

Issue Date :

9 June 2020

The Uncertainties are for a confidence probability of approximately 95 %

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



Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 Fax: +66 2643 8307 e-mail: service.thailand@sartorius.com



REVIEW BY *T. S. K.*
APPROVED BY *T. S. K.*
NEXT CAL. DATE 95/06/21

Model Number: MSE224S-100-DU
Description: Analytical Balance
Serial Number: 26207038
Manufacturer: Sartorius

Certificate of Calibration

Certificate No.: ST1912066
Issued Date: Friday, December 27, 2019
Reference No.: 500770
Page No.: 1 of 3

Customer Name: ALS Laboratory Group (Thailand) Co., Ltd.
Eastern Seaboard Industrial Estate (Rayong), 64/77 Moo 4, Plaokdaeng, Rayong 21140.

Calibrated Place: Weighing Room

Calibrated By: Mr. Chonchai Inthana
Calibration Date: Wednesday, December 25, 2019

Calibration Procedure No.: This calibration was conducted by Using in-house calibration procedure number (WI-003) Based on UKAS LAB 14

Metrological data:

Capacity: 220 g **Readability:** 0.0001 g **Temperature:** 24.8 °C ± 5.0 °C
Humidity: 68.0 % RH ± 10.0 % RH
Pressure: ±

Reasons for calibration

☐ New Installation ☐ Service / Repair ☒ Pre-calibration / Maintenance ☒ Good Operation ☐ Fair

Measurement Method UKAS Publication Ref: Lab 14

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 calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of tolerance came from list of Sartorius Metrological Specifications.

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 200g E2, YCS011-522-00	Sartorius	119334 D-K-1939B-01	10-Sep-2021
808H1	Thermo-Hygrometer, Testo 808-H1	SPCC	C19190674	9-Dec-2020

This certificate relate and apply this equipment only

This certificate may not be reproduced other than in full except with the prior written approval of the Verification Operation Division Sartorius (Thailand) Co., Ltd.

ISO 17025:RF-015 01/11/2018 R1

Mr. Chonchai Inthana (Technical Manager)

S T A M P



Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 Fax: +66 2643 8307 e-mail: service.thailand@sartorius.com



Certificate of Calibration

Model Number: MSE224S-100-DU
Description: Analytical Balance
Serial Number: 26207038
Manufacturer: Sartorius

Certificate No.: ST1912066
Issued Date: Friday, December 27, 2019
Reference No.: 500770
Page No.: 2 of 3

Calibration Results : Without Adjustment

Repeatability

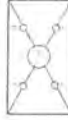
The repeatability is the ability of a weighing instrument to display nearly identical readings, under constant test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.

Nominal Value : (Low Load)	20.0000	200.0000
20 g	20.0000	200.0000
Tolerance	20.0000	200.0000
0.0001 g	19.9999	199.9999
20.0000	199.9999	199.9999
Nominal Value : (High Load)	20.0000	200.0000
200 g	20.0000	200.0000
Tolerance	20.0000	200.0000
0.0001 g	20.0000	199.9999
20.0000	199.9999	200.0000
Standard Deviation	0.00003	0.00005

Eccentricity (Off-center loading error)

The off-center loading error is predicted by the difference between the readout of the weighing pan (1) or (2) at maximum capacity, placed in the middle of the weighing pan and the readout of the weighing pan (3) or (4) at additional measurement points (positions defined according to OIML R66).

Nominal value:	50 g
Tolerance	0.0004 g
1	—
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	—



Linearity

The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear shape.

Tolerance	0.0002 g				
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty	
(g)	(g)	(g)	(g)	(g)	
Unload	0.0000	0.0000	0.0000	0.00013	
0.01	0.0100	0.0100	0.0000	0.00013	
0.05	0.0500	0.0500	0.0000	0.00013	
0.1	0.1000	0.1000	0.0000	0.00013	
0.5	0.5000	0.5000	0.0000	0.00013	
1	1.0000	1.0000	0.0000	0.00013	
2	2.0000	2.0000	0.0000	0.00013	
5	5.0000	5.0000	0.0000	0.00013	
10	10.0000	10.0000	0.0000	0.00013	
20	20.0000	20.0000	0.0000	0.00013	

ISO 17025:RF-015 01/11/2018 R1



Certificate

of Calibration

Model Number : MSE224S-100-DU
Description : Analytical Balance
Serial Number : 26207038
Manufacturer : Sartorius

Certificate No. : ST1912066

Issued Date : Friday, December 27, 2019

Reference No. : 500770

Page No. : 3 of 3

Calibration Results : Without Adjustment

Repeatability

The repeatability is the ability of a weighing instrument to display stable numerical results under constant test conditions when the same load within a measurement range is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express repeatability quantitatively.

Nominal Value : (Low Load)

20 g

Tolerance

0.0001 g

Nominal Value : (High Load)

200 g

Tolerance

0.0001 g

Standard Deviation

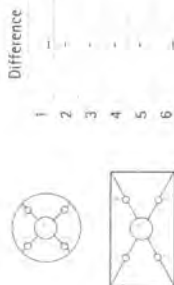
Eccentricity (Off-center loading error)

The off-center loading error is yielded by the difference between the readout of the load on 1/2 or 1/4 of the weighing capacity, placed at the middle of the weighing pan and between each of four additional measurement points, 1 positions defined according to (EN 8762).

Nominal value : 50 g

Tolerance

0.0004 g



Difference	1	2	3	4	5	6

Linearity

The linearity, also called linearity error, describes the deviation of the characteristic curve of a weighing instrument from the linear slope.

Tolerance	0.0002 g				
Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty	
(g)	(g)	(g)	(g)	(g)	(g)
50	50.0001	50.0001	0.0000	0.00014	
100	100.0001	100.0001	0.0000	0.00017	
120	120.0001	120.0001	0.0000	0.00020	
150	150.0001	150.0001	0.0000	0.00023	
200	200.0001	200.0000	-0.0001	0.00028	

End of Report

ISO 17025-RIE-015 01/11/2018 (1)



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53/44 PATTANAKARN ROAD SOI 14, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2717-3000-27 FAX: 0-2719-9484



ASQ-TS-11817/25
CALIBRATION 0008

Cart. No.: 19TM2327
Page.: 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven

Model : TS 8136

Serial No. : 200507

ID No. : RYG_EN0008

Manufacturer : Termaks

Submitted by :

ALS Laboratory Group (Thailand) Co.,Ltd.Rayong Branch
Eastern Seaboard Industrial Estate (Rayong)
64/77 Moo 4,Building No.B1, Highway 331, Km91.5,
T.Pluakdaeng, A.Pluakdaeng, Rayong 21140 Thailand

Location :

Laboratory
(ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch)

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by :

Krisada Chaitrong

Approved by :

malu
Approved Signatory

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

Issue Date :

6 November 2019

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.



Equipment : Hot Air Oven
Model : TS 8136
Serial No. : 200507
ID No. : RYG_EN0008
Manufacturer : Termaks
Received Order : 28 October 2019
Condition As-Received : Used Item
Calibration Date : 28 October 2019
Reference : 1910-0699OC-2

Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard Instrument:-

Instrument **Serial No.** **Cert. No.** **Traceable** **Due Date**
1) Data Acquisition MY41021843 19143 NIMT 03 Jan 2020

2. This certification is traceable to the SI unit.

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

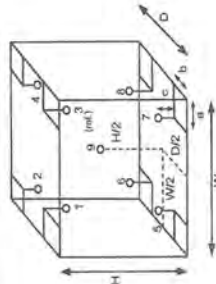
Remark : NIMT : National Institute of Metrology Thailand.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting :

Close



Probe Installation Details :

Dimension of Chamber :
a = 5.0 cm D = 0.44 m
b = 5.0 cm W = 0.52 m
c = 5.0 cm H = 0.60 m
Capacity = 0.14 m³

Environment during calibration		Ref. Std./ID No.: @ Calibration Point	
Temp. (°C)	Beginning	Finished	
REL-Humid. (%)	27	26	
AC Supply (Volt)	52	55	
	223	223	

Position :	(104) °C	(180) °C
1	18-04RTD-01	18-04TC-01
2	18-04RTD-02	18-04TC-02
3	18-04RTD-03	18-04TC-03
4	18-04RTD-04	18-04TC-04
5	18-04RTD-05	18-04TC-05
6	18-04RTD-06	18-04TC-06
7	18-04RTD-07	18-04TC-07
8	18-04RTD-08	18-04TC-08
9 (ref.)	18-04RTD-09	18-04TC-09

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a 0970619



Equipment : Hot Air Oven
Model : TS 8136
Serial No. : 200507
ID No. : RYG_EN0008
Manufacturer : Termaks
Received Order : 28 October 2019
Condition As-Received : Used Item
Calibration Date : 28 October 2019
Reference : 1910-0699OC-2

Result of Calibration :-

Function of UUC* : Temperature Source

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor k
104.0	104.0	104.0	0.082	1.2	1.9	0.42	2
180.0	184.0	184.0	0.42	2.7	4.0	1.2	2

Measured Temperature (°C)								
Position								
Calibration Point (°C)	1	2	3	4	5	6	7	8
104.0	104.940	104.289	103.547	103.537	103.584	103.217	103.653	104.257
180.0	181.731	180.751	178.489	179.550	178.313	178.810	179.954	180.622

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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Equipment : Hot Air Oven
Model : UFE 500
Serial No. : G511.1572
ID No. : RYG_EN0010
Manufacturer : Memmert
Received Order : 28 October 2019
Condition As-Received : Used Item
Calibration Date : 28 October 2019
Reference : 1910-0699OC-3
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor k
104.0	104.0	104.0	0.15	0.72	0.96	0.45	2
180.0	180.0	180.0	0.14	0.99	1.7	1.1	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.857	103.711	103.651	103.680	104.397	103.934	104.354	103.686	103.864
180.0	179.418	179.705	179.285	179.559	180.473	179.870	180.774	179.891	179.935

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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CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
53/01 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG BANGKOK 10250
TEL. 0-2717-3800-27 FAX. 0-2719-9484



Cert. No.: 19TM2328
Page.: 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven

Model : UM 400

Serial No. : B495.0899

ID No. : RYG_EN0006

Manufacturer : Memmert

Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
Eastern Seaboard Industrial Estate (Rayong)
64/77 Moo 4, Building No.81, Highway 331, Km81.5,
T.Pluakdaeng, A.Pluakdaeng, Rayong 21140 Thailand

Location : Laboratory

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Kritsada Chaltrong

Approved by :

Approved Signatory

() Pornthippa Tameyakul
(/) Malee Bulkruea
() Suwit Imjai

Issue Date : 6 November 2019

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.



Equipment : Hot Air Oven
Model : UM 400
Serial No. : B495.0899
ID No. : RYG_EN0006
Manufacturer : Memmert
Received Order : 28 October 2019
Condition As-Received : Used Item
Calibration Date : 28 October 2019
Reference : 1910-0699OC-1
Procedure Used :-

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	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY44023863	19LM3	NIST	06 Jul 2020

2. This certification is traceable to the SI unit.

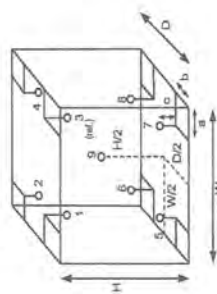
3. This result of calibration was found accurate as shown on date and place of calibration only.

Remark : NIST : National Institute of Standards and Technology, The United State of America.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details :
a = 5.0 cm
b = 5.0 cm
c = 5.0 cm
Dimension of Chamber :
D = 0.33 m
W = 0.40 m
H = 0.40 m
Capacity = 0.053 m³

Position :	Ref. Std./ID No.:
1	18-6RTD1
2	18-6RTD2
3	18-6RTD3
4	18-6RTD4
5	18-6RTD5
6	18-6RTD6
7	18-6RTD7
8	18-6RTD8
9 (ref.)	18-6RTD9

Environment during calibration		
Temp. (°C)	Beginning	Finished
REL.Humid. (%)	27	26
AC Supply (Volt)	52	54
	223	224



Equipment : Hot Air Oven
Model : UM 400
Serial No. : B495.0899
ID No. : RYG_EN0006
Manufacturer : Memmert
Received Order : 28 October 2019
Condition As-Received : Used Item
Calibration Date : 28 October 2019
Reference : 1910-0699OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor k
70.0	70.0	70.0	0.075	1.6	1.9	0.46	2
Measured Temperature (°C)							
Calibration Point (°C)	Position						
	1	2	3	4	5	6	7
	70.532	69.323	70.717	69.971	69.559	68.933	69.661
70.0	70.532	69.323	70.717	69.971	69.559	68.933	69.661

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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
55/49 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000/37 FAX. 0-2719-9184



Cert. No.: 19TM2493
Page: 3 of 3

Equipment : Water Bath
Model : WNB 22
Serial No. : L513.0648
ID No. : RYG_EN0061
Manufacturer : Memmert
Received Order : 28 October 2019
Condition As-Received : Used Item
Calibration Date : 28 October 2019
Reference : 1910-0699QC-8
Result of Calibration : (*) Without Adjustment
Function of UUC* : Temperature Source

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C)				
			Position				
			1	2	3	4	5 (ref.)
85.0	85.5	85.5	85.008	84.887	84.942	85.021	84.985

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Uncertainty (± °C)	Coverage Factor k
85.0	0.17	0.078	0.15	2

Average* : The average of 30 values in each position.
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.
Stability : One-half of the greatest maximum difference of measured temperature at any one probe.
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 %.

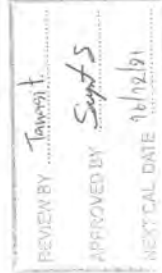
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Wdu.

Cert.No.: 20CH1913
Page: 1 of 3

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : Seven2Go
Serial No. : B628755984
ID No. : RYG_FS0392
Condition As-Received : Used Item
Received Date : 15 December 2020
Calibration Date : 16 December 2020
Reference : 2012-0446DSC-3



Submitted by : ALS Laboratory Group (Thailand) Co., Ltd. Rayong Branch
Eastern Seaboard Industrial Estate (Rayong)
64/77 Moo 4, Building No. B1, Highway 331 Km91.5
T. Pluakdaeng, A. Pluakdaeng Rayong 21140 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)
- CP-CH8 by comparison with standard thermometer

Calibrated by : Warakorn Lemgagrakul

Approved by : Approved Signatory

() Malee Bulkruea
() Sathip Meangmai
() Warakorn Lemgagrakul

Issue Date : 21 December 2020
The Uncertainties are for a confidence probability of approximately 95 %

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A 0022880



Cert.No.: 20CH1913
Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument : -
- | Instrument | Serial No. | ID No. | Cert. No. | Due Date |
|--------------------------------|------------|----------|-----------|-------------|
| 1) Document Process Calibrator | 46530031 | 130RC098 | 20E3666 | 14 Oct 2021 |
| 2) Ref. Standard Thermometer | 2189080 | 130RC044 | 20I1389 | 19 Nov 2021 |
- 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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	693945	21 June 2022
pH 6.985	CPA chem	699314	16 July 2021
pH 10.008	CPA chem	699315	16 July 2021

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 k
			mV	pH		
pH Meter S/N.: B628755984	pH 4.00	177.48	178	4.00	0.58	2.00
	pH 7.00	0.00	0	7.00	0.58	2.00
	pH 10.00	-177.48	-177	10.00	0.58	2.00

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Cert.No.: 20CH1913
Page.: 3 of 3

Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (\pm)	Coverage factor k
pH Electrode S/N.: 7491479	4.008	4.01	174	0.0071	2.00
	6.985	7.00	2	0.011	2.00
	10.008	10.01	-170	0.013	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLab Expert Go-ISM
- Serial No. : 7491479

Dimension of probe;

- Length : 120 mm.
- Diameter : 12 mm.
- Immersion Depth : 100 mm.

Calibration Point ($^{\circ}$ C)	Standard Temperature ($^{\circ}$ C)	UUC* Reading ($^{\circ}$ C)	Error ($^{\circ}$ C)	Uncertainty of measurement (\pm $^{\circ}$ C)	Coverage factor k
25.0	25.002	25.3	0.298	0.20	2.00
30.0	30.003	30.3	0.297	0.20	2.00
40.0	40.004	40.3	0.296	0.20	2.00

Remark : - 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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
534/1 PATTANAKARN ROAD 5TH FL. SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 02-2717-3600-27 FAX. 02-2719-9484



Cert.No.: 21CH452
Page.: 1 of 3

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenCompact S220
Serial No. : B520948426
Condition As-Received: BKK_ENC072
Received Date : 24 March 2021
Calibration Date : 26 March 2021
Reference : 2103-1008DSC-1
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khaeng Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand
(25 ± 2.5) °C
(50 ± 15) %
In-house method :
- CP-CH5 by direct measurement with standard
voltage calibrator and direct measurement with
certified reference material (CRM)
- CP-CH8 by comparison with standard thermometer

Ambient Temperature :
Relative Humidity :
Calibration Procedure :

Calibrated by :

Warakorn Lengagrakul

Approved by :

Malee Bukruea
Saithip Meangmai
Warakorn Lengagrakul

Approved Signatory

Issue Date :

31 March 2021

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 & Equipment Calibration and Testing Services



Cert.No.: 21CH452
Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument : -

Instrument

1) Document Process Calibrator
2) Ref. Standard Thermometer

Serial No. 1385032 130RC022
Cert. No. 20E4213
4982054 110RC044
2011233

Due Date
24 Nov 2021
15 Oct 2021

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

Buffer Solution

pH 4.008
pH 6.985
pH 10.012

Manufacturer

CPA chem
CPA chem
CPA chem

Lot No.

706694
722285
722287

Exp. date

06 Sep 2022
19 Dec 2021
19 Dec 2021

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 k
			mV	pH		
pH Meter S/N: B520948426	4.000	177.48	177.4	4.000	0.058	2.00
	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00

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A 0026590



Cert.No.: 21CH452
Page.: 3 of 3

Calibration Results

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4.7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (\pm)	Coverage factor k
pH Electrode S/N.: 9265091	4.008	4.010	150.3	0.0048	2.05
	6.985	6.989	-22.5	0.0077	2.00
	10.012	10.011	-193.7	0.013	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : InLab Expert Pro-ISM

- Serial No. : 9265091

Dimension of probe;

- Length : 120 mm.

- Diameter : 12 mm.

- Immersion Depth : 100 mm.

Calibration Point ($^{\circ}\text{C}$)	Standard Temperature ($^{\circ}\text{C}$)	UUC* Reading ($^{\circ}\text{C}$)	Error ($^{\circ}\text{C}$)	Uncertainty of measurement (\pm $^{\circ}\text{C}$)	Coverage factor k
25.0	25.003	25.2	0.197	0.20	2.00

Remark : - 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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Malu

a 1048958



Sartorius (Thailand) Co., Ltd.

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel : +66 2643 8361-9, E-mail: service.thailand@sartorius.com



NSC-TS-ITS-17025
CALIBRATION 0219



REVIEW BY
APPROVED BY
NEXT CAL. DATE

Certificate of Calibration

Model Number : MSE224S-100-DU
Description : Analytical Balance
Serial Number : 26207042
Manufacturer : Sartorius

Certificate No. : 21BCI0083
Issued Date : Friday, March 12, 2021
Reference No. : 501611
Page No. : 1 of 2

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

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

Calibrated Place : Lab Room

Calibrated By : Mr.Chonchai Inthana

Calibration Date : Wednesday, March 10, 2021

Calibration Procedure No : This calibration was conducted by Using in-house calibration procedure number (WI-003) Based on UKAS LAB 14

Metrological data :

Capacity : 220 g Readability : 0.0001 g Temperature : 23.1 $^{\circ}\text{C}$ \pm 5.0 $^{\circ}\text{C}$ Humidity : 55.2 % RH \pm 10.0 % RH Pressure : \pm

Reasons for calibration

☐ New Installation ☐ Service / Repaired ☒ Re-calibration/ Maintenance ☒ Good Operate ☐ Fair

Measurement Method UKAS Publication Ref :Lab 14

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 calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came form list of Sartorius Metrological Specifications.

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 200g E2,YCS011-522-00	Sartorius	119934 D-K-19398-011	10-Sep-2021
MHB-3825D	Humidity/Barometer/Temp Luton MHB-3875D	SFC-RT	C19203076	1-Sep-2021

This certificate relate and apply this equipment only.

This certificate may not be reproduced other than in full except with the prior written approval of the Verification Operation Division Sartorius (Thailand) Co., Ltd.

Mr.Chonchai Inthana(Technical Manager)

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Certificati

of Calibration

Model Number : MSE224S-100-DU

Certificate No.: 218CI0083

Description :	Analytical Balance
<p>1. The analytical balance is used for precise weighing of samples.</p> <p>2. It is used for the determination of the concentration of a solution.</p> <p>3. It is used for the determination of the purity of a substance.</p> <p>4. It is used for the determination of the molecular weight of a compound.</p> <p>5. It is used for the determination of the density of a liquid.</p> <p>6. It is used for the determination of the refractive index of a liquid.</p> <p>7. It is used for the determination of the optical density of a solution.</p> <p>8. It is used for the determination of the pH of a solution.</p> <p>9. It is used for the determination of the conductivity of a solution.</p> <p>10. It is used for the determination of the viscosity of a liquid.</p>	

Issued Date : Friday, March 12 2021

Serial Number : 26207042

Reference No.: 501611

Manufacturer: Sartorius

Page No. - 2 of 2

Calibration Results : Without Adjustment

Repeatability

The repeatability is the ability of a weighing instrument to display nearly identical readouts under the same test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

Nominal Value : (Low Load)	20 g	200.0000	
Tolerance	0.0001 g	20.0000	200.0000
		20.0000	200.0000
Nominal Value : (High Load)	200 g	20.0001	200.0000
		20.0000	200.0001
Tolerance	0.0001 g	20.0000	200.0001
		15.9999	200.0001
Standard Deviation		20.0000	200.0000
		0.00005	0.00005

Eccentricity (Off-center loading error)

The off-center loading error is judged by the difference between the result of the load, i.e. 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R76).

Nominal value : 50 g
Tolerance 0.0004 g

Difference

1	-
2	-0.0001
3	0.0000
4	0.0000
5	-0.0001
6	-

Linearity

The linearity, also called linearity error. Describes the deviation of the characteristic curve of a weighing instrument from the linear slope.

Tolerance	0.0002 g			
Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
0.1	0.1000	0.1000	0.0000	0.00014
0.5	0.5000	0.5000	0.0000	0.00014
1	1.0000	1.0000	0.0000	0.00014
2	2.0000	2.0000	0.0000	0.00014
5	5.0000	5.0000	0.0000	0.00014
10	10.0000	10.0000	0.0000	0.00014
20	20.0000	20.0000	0.0000	0.00014
50	50.0001	50.0000	-0.0001	0.00015
100	100.0001	100.0000	-0.0001	0.00019
200	200.0001	200.0000	-0.0001	0.00029

End of Report.



Metrological Center

SCI ECO Services Company Limited

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

Saraburi Tel: +66 3627 3096 Fax: +66 3627 3100

Bangkok Tel : +66 2586 5792-4 Fax : +66 2586 5109

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



Certificate No. T202014I01 "Substitute for Calibration Certificate Number T202014" Page 1 of 3

Certificate of Calibration

Equipment : Liquid Bath (Water)

Manufacturer : MEMMERT

Model : WNB29

Serial No. : L611-0135

Customer Code : BKK EN0148

ID No. : T6455A4

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

104 Patthanakan 40, Patthanakan Rd., Khwaeng Patthanakan,

Khet Suan Luang, Bangkok 10250

Customer Location : ORGANIC PREPARATION LAB

Date of Receipt : 3 September 2020

Calibrated By : Watcharapon Sangtong (Technician)

Boonchai Suriyawong / Boonchai Suriyawong (Site Calibration Manager)

Date of Issue: 01 OCT 2020

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 be reproduced other than in full except with the prior written approval of the Metrological Center.

FM-L)4-T16/01-04-58



Certificate No. T202014101

Page 2 of 3

Calibration Report

Equipment : Liquid Bath (Water)
Date of Calibration : 9-10 September 2020
Environment : Temperature : 22.4-23.9 °C
Line Voltage : 221.4-225.4 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert five resistance thermometer detectors into its water bath , the other one thermocouple type T use for ambient temperature measurement . The calibration was done in according to Wt-T36 (based on ASTM E715-80 (Reapproved 2001)).
All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
RTD	100 OHM	M34 (CH1-CH5)	T192453	16 October 2020
DATA LOGGER	34970A	T63	T192453	16 October 2020

3. This certificate is traceable to :
National Institute of Metrology (Thailand) through Metrological Center (NSC-TIS-TIS 17025 CALIBRATION 0244)

4. Condition of calibrated item : good

Equipment Description :

Time Constant 3 Hour - Minute At 60 °C

5. Adjustment :
(X) without adjustment () after adjustment

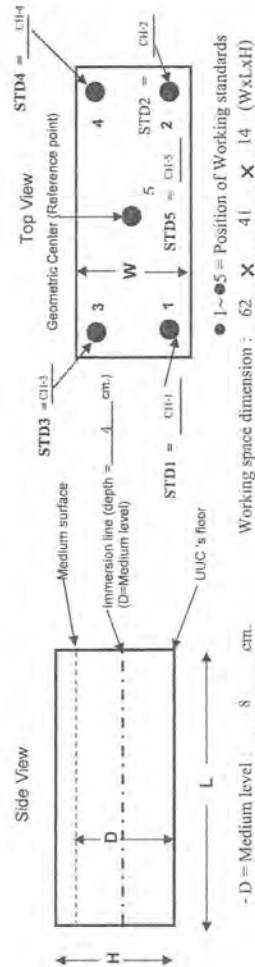
Approved By.



Certificate No. T202014101

Page 3 of 3

Calibration Report



- D = Medium level : 8 cm.
- UUC's medium : Water
- Working standards are located at 2.5 cm. away from each center and walls.

Measurement Results:

Calibration Point	Average Standard Reading at each position (°C)				
	CH-1	CH-2	CH-3	CH-4	CH-5
60	59.97	59.87	59.94	59.72	59.90
80	80.45	79.97	80.09	79.53	80.10
95	94.45	94.21	94.08	93.92	94.28

Temperature Distribution

Setting (°C)	Reading (°C)		Average (°C)	Stability (± °C)	Uniformity (± °C)	Uncertainty (± °C)	Coverage Factor k
	Min	Max					
61.1	61.1	61.1	59.88	0.17	0.29	0.29	2.11
81.1	81.1	81.1	80.03	0.48	0.86	0.49	2.00
95.0	94.9	95.4	94.19	0.23	0.48	0.65	2.43

* The quoted uncertainty exclude "uniformity"

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 which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By.



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL. 0-2717-8000/27 FAX. 0-2719-9484



NEC-18-181228
CALIBRATION 100%

Cert. No.: 20TM1323
Page.: 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven
Manufacturer : Memmert
Model : UFE 500
Serial No. : G511.1574
ID No. : BKK_EN0007

Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khaeng Phatthanakan, Khat Suan Luang,
Bangkok 10250 Thailand
Location : Oven Room

Received Order : 1 July 2020
Calibration Date : 1 July 2020
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Tawatchai Pama

Approved by :
() Ponthippa Tameyakul
() Malee Buikrua
(✓) Suwit Imjai

Issue Date : 13 July 2020

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 0016472



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2007-0003OC-3
Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-
Instrument Serial No. Cert. No. Traceable Due Date
1) Data Acquisition MY57013711 20LM7 NIST, NIMT 18 May 2021
2. This certificate is traceable to the SI unit.
3. This certificate is valid only to the item calibrated on date and place of calibration.

Remark : NIST : National Institute of Standards and Technology, The United State of America.

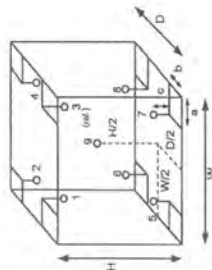
NIMT : National Institute of Metrology Thailand.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Environment during calibration		
Temp. (°C)	Beginning	Finished
REL.Humid. (%)	28	26
AC Supply (Volt)	52	42
	224	223



Probe Installation Details :
a = 5.0 cm
b = 5.0 cm
c = 5.0 cm
Dimension of Chamber :
D = 0.40 m
W = 0.56 m
H = 0.48 m
Capacity = 0.11 m³

Ref. Std./ID No.: @ Calibration Point		
Position :	(104) °C	(121, 175, 180) °C
1	18-18RTD-01	18-18TC-01
2	18-18RTD-02	18-18TC-02
3	18-18RTD-03	18-18TC-03
4	18-18RTD-04	18-18TC-04
5	18-18RTD-05	18-18TC-05
6	18-18RTD-06	18-18TC-06
7	18-18RTD-07	18-18TC-07
8	18-18RTD-08	18-18TC-08
9 (ref.)	18-18RTD-09	18-18TC-09

Signature

a 1007993



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2007-0003OC-3
Result of Calibration :-
Function of Calibration : Temperature Source

Cert. No.: 20TM1323
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 k
104.0	104.0	104.0	0.052	0.35	0.55	0.42	2
121.0	121.0	121.0	0.10	0.75	0.84	1.1	2
175.0	175.0	175.0	0.11	1.5	1.6	1.1	2
180.0	180.0	180.0	0.11	1.7	1.8	1.1	2

Measured Temperature (°C)								
Position								
Calibration Point (°C)	1	2	3	4	5	6	7	8
104.0	104.143	103.999	104.073	104.197	104.003	103.730	104.035	103.855
121.0	121.133	120.975	121.181	121.121	121.311	120.894	121.389	120.743
175.0	174.830	174.626	174.847	174.805	175.239	174.641	175.720	174.505
180.0	179.784	179.543	179.817	179.787	180.262	179.618	180.881	179.521

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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Signature

a 1004569



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.: 20TW271
Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : YSI
Model : 5000-230V
Serial No. : 09J101147
ID No. : BKK_EN0017
Received Date : 28 December 2020
Test Date : 29 December 2020
Reference : 2012-0821WSC-1



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

Laboratory Condition : Temperature (25 ± 5) °C

Humidity (50 ± 20) %

Test Procedure : In - house method : CP-CH9
by Comparison Technique with Azide Modification Method

Calibrated by : Walalak Sirthean

Signature

Approved by : Approved Signatory

(✓) Malee Bulkruea
() Sathip Meangmai
() Warakorn Lerngagrakul

Issue Date : 5 January 2021

B 0250840



Cert.No.: 20TW271
Page.: 2 of 2

Result : Dissolved Oxygen Meter Adjustment With Air 100 %
Dissolved Oxygen Probe No.: 16K100498

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.00	7.99	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

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Wala

a 1035559



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
53/04 PATTANAKARN ROAD SOI 18, SUAN LIANG, SUAN LIANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



TEC-TS-1517925
CALIBRATION 0098

Cert. No.: 21TM91
Page.: 1 of 2

Certificate of Calibration

Equipment : DO Meter with Sensor
Manufacturer : YSI
Model : 5000-230V
Serial No. : 09J101147
ID No. : BKK_EN0017
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 : 28 December 2020
Calibrated Date : 4 January 2021
Ambient Temperature : $(26 \pm 10) ^\circ\text{C}$
Relative Humidity : $(50 \pm 30) \%$
AC Line Voltage : $(220 \pm 22) \text{ V}$
Calibrated by : Suwit Imjai
Approved by : *Wala*
() Pornthippa Tameyakul
(☒) Malee Bulkruea
Issue Date : 7 January 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 0023424



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2012-0821WSC-2
Cert. No.: 21TM91
Page: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPT) 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 1502A A52847 201246 14 Oct 2021
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 maintained at:-
- National Institute of Metrology Thailand (NIMT)

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with thermistor sensor , ID No.: 16K100498

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
20.00	60	20.010	19.94	-0.070	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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Wala

a 1035900



Metrological Center
SCI ECO Services Company Limited

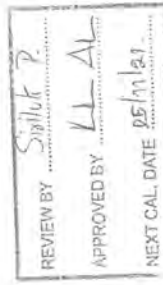
33/2 Moo 3, T.Banpa, A.Kaengkhloi, Saraburi 18110, Thailand.
Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100
Bangkok Tel : +66 2586 5792-4 Fax : +66 2586 5109
Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T201150

Page 1 of 4

Certificate of Calibration

Equipment : Chamber (Incubator)
Manufacturer : SHEL LAB
Model : 2020-2E
Serial No. : 802899
Customer Code : BKK_EN0005
ID No. : T7499A0
Customer : ALS Laboratory Group (Thailand) Co.,Ltd.



104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan,

Khet Suan Luang, Bangkok 10250

Customer Location : Wet Chemistry Lab2

Date of Receipt : 21 May 2020

Calibrated By : Atiphong Rongrat (Technician)

Approved By : / Sujjar Naknakred (Site Calibration Manager)

Date of Issue : 29 MAY 2020

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.

FM-L14 116/01-04-58



Metrological Center

SCI ECO Services Company Limited

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



Certificate No. T201150

Page 2 of 4

Calibration Report

Equipment : Chamber (Incubator)
Date of Calibration : 27 May 2020
Environment : Temperature : 25.4-26.9 °C
Line Voltage : 221.4-230.2 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert 12 resistance thermometer detectors into its chamber , the other one resistance thermometer detector use for ambient temperature measurement . The calibration was done in according to WI-T20 (based on ASTM E145-94 (Reapproved 2001) and AS2853-1986).

All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
RTD	100 ohm	30-(CH1-10)	T192929	14 January 2021
RTD	100 ohm	32-(CH1-10)	T192929	14 January 2021
DATA LOGGER	34970A	T137	T192929	14 January 2021

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 : 1 Hour
Fresh Air Damper : ☐ Open ☐ Min ☐ Medium ☐ Max

☐ Close ☒ Not Available

5. Adjustment :

(X) without adjustment

() after adjustment

Approved By : _____



Approved By : _____



Metrological Center

SCI ECO Services Company Limited

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

Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100

Bangkok Tel : +66 2586 5792-4 Fax : +66 2586 5109

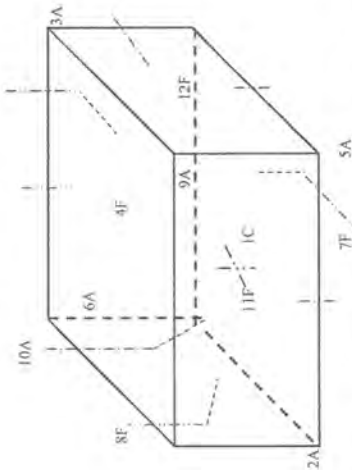
Website : www.scieco.co.th E-Mail : calibrate@scg.co.th



Certificate No. T201150

Page 3 of 4

Calibration Report



C = Centre , F = Centre of Face , A = Corner , E = Centre of Edge

1C = 30-CH1	7F = 30-CH7
2A = 30-CH2	8F = 30-CH8
3A = 30-CH3	9A = 30-CH9
4F = 30-CH4	10A = 30-CH10
5A = 30-CH5	11F = 32-CH1
6A = 30-CH6	12F = 32-CH2



Metrological Center

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Metrological Center

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

Certificate No. T201150

Page 4 of 4

Calibration Report

Measurement Results :

Calibration Point	Average Standard Reading at each position (°C)									
	30-CH1	30-CH2	30-CH3	30-CH4	30-CH5	30-CH6	30-CH7	30-CH8	30-CH9	30-CH10
20	19.94	19.87	19.95	19.96	20.02	20.37	19.94	20.09	19.90	19.85
32-CH1	32-CH2									
20.49	20.27									

Calibration Point	30-CH1	30-CH2	30-CH3	30-CH4	30-CH5	30-CH6	30-CH7	30-CH8	30-CH9	30-CH10
	25.00	24.69	24.88	25.02	24.77	25.42	24.85	25.06	24.97	24.78
25										
32-CH1	32-CH2									
25.53	25.16									

Chamber (Incubator)		Temperature Distribution					Coverage Factor k
		Reading (°C)	Average (°C)	Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	
Setting (°C)							
20.3	Min , Max	Average	20.3	0.10	0.48	0.40	2.02
25.3	Min , Max	Average	25.3	0.10	0.47	0.40	2.02

* The Accredited uncertainty exclude "uniformity"

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 which for a t-distribution, providing

a level of confidence of approximately 95 % .

Approved By: _____

(Signature)

PM-LIS 11601-04-58

Certificate No. T210717

Page 1 of 5

Certificate of Calibration

Equipment : HOT BLOCK

Manufacturer : Environmental Express

Model : B300 240

Serial No. : 2017CODW116

Customer Code : BKK_EN0222

ID No. : T6769A4

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

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

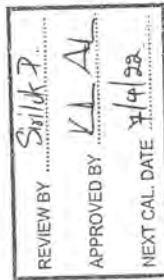
Customer Location : Environmental Control & IP Room

Date of Receipt : 1 April 2021

Calibrated By : Atiphong Rongrat (Technician)

Approved By : *(Signature)* Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 22 Apr 2021



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.

PM-LI2 109/30-05-57



Metrological Center

SCI ECO Services Company Limited

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

Certificate No. T210717

Page 2 of 5

Calibration Report

Equipment : HOT BLOCK

Date of Calibration : 7 April 2021

Environment : Temperature : 16.4-17.9 °C

Line Voltage : 222.7-227.8 V

Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert 20 standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20. All data show below were final values and the initial data from customer request.

The temperature scale used was based on ITS - 90 .

2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN91-TN100	T202053	24 September 2021
TC	TYPE T	TN101-TN110	T202053	24 September 2021
DATA LOGGER	34970A	T121	T202053	24 September 2021

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 - Hour 40 Minute At 150 °C
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
☐ Close ☒ Not Available

5. Adjustment : (X) without adjustment () after adjustment

Approved By: *[Signature]*



Metrological Center

SCI ECO Services Company Limited

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

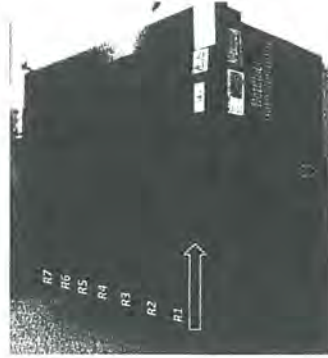
Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

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

Certificate No. T210717

Page 3 of 5

Calibration Report



H: STANDARD THERMOCOUPLE TYPE T

H1	=	TN91	H9	=	TN99	H17	=	TN107	H25	=	TN95	H33	=	TN103	H41	=	TN91	H49	=	TN99
H2	=	TN92	H10	=	TN100	H18	=	TN108	H26	=	TN96	H34	=	TN104	H42	=	TN92	H50	=	TN100
H3	=	TN93	H11	=	TN101	H19	=	TN109	H27	=	TN97	H35	=	TN105	H43	=	TN93	H51	=	TN101
H4	=	TN94	H12	=	TN102	H20	=	TN110	H28	=	TN98	H36	=	TN106	H44	=	TN94	H52	=	TN102
H5	=	TN95	H13	=	TN103	H21	=	TN91	H29	=	TN99	H37	=	TN107	H45	=	TN95	H53	=	TN103
H6	=	TN96	H14	=	TN104	H22	=	TN92	H30	=	TN100	H38	=	TN108	H46	=	TN96	H54	=	TN104
H7	=	TN97	H15	=	TN105	H23	=	TN93	H31	=	TN101	H39	=	TN109	H47	=	TN97	H55	=	TN105
H8	=	TN98	H16	=	TN106	H24	=	TN94	H32	=	TN102	H40	=	TN110	H48	=	TN98	H56	=	TN106

Approved By: *[Signature]*



Metrological Center

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Certificate No. T210717

Page 4 of 5

Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)															
		TN91	TN92	TN93	TN94	TN95	TN96	TN97	TN98	TN99	TN100						
Point Setting 150	Max	150.72	150.68	150.86	150.83	150.66	150.66	149.34	149.71	150.37	149.63						
	Min	150.54	150.47	150.66	150.68	150.54	150.57	149.25	149.54	149.44	149.44						
	Average	150.65	150.61	150.77	150.77	150.61	150.61	149.30	149.62	150.30	149.55						
	Max	150.25	150.40	150.40	150.73	150.41	150.80	150.55	150.63	149.48	150.75						
	Min	150.10	150.30	150.25	150.63	150.33	150.72	150.47	150.50	149.27	150.60						
	Average	150.18	150.35	150.37	150.69	150.37	150.75	150.57	150.57	149.38	150.69						
	Max	151.05	150.70	150.59	150.14	150.87	150.71	150.73	149.62	150.77	150.06						
	Min	150.90	150.53	150.40	150.01	150.74	150.56	150.63	149.53	150.60	149.88						
	Average	150.96	150.61	150.50	150.08	150.80	150.62	150.68	149.57	150.68	149.98						
	Max	149.78	149.65	149.81	150.14	150.71	150.90	150.21	150.82	149.21	151.05						
	Min	149.64	149.57	149.68	150.01	150.59	150.79	150.07	150.71	149.10	150.93						
	Average	149.69	149.61	149.74	150.08	150.65	150.83	150.15	150.76	149.16	150.98						
	Max	150.94	150.28	150.68	150.74	150.36	150.29	150.35	150.18	149.27	149.72						
	Min	150.67	150.13	150.50	150.57	150.24	150.11	150.20	150.09	149.18	149.62						
	Average	150.83	150.22	150.59	150.65	150.37	150.22	150.30	150.14	149.22	149.67						
	Max	149.29	150.12	150.25	150.39	150.91	150.36										
	Min	149.07	149.94	150.16	150.21	150.73	150.27										
	Average	149.20	150.06	150.20	150.30	150.83	150.32										

Approved By: *Banlari*

FM-L13 108/30-05-57



Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhroi, 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. T210717

Page 5 of 5

Calibration Report

Measurement Results

HOT BLOCK		Temperature Distribution		
		Setting (°C)	Reading (°C)	Uncertainty (± °C)
		Min, Max	Average	
		149.5, 149.7	149.6	
			150.37	
			0.20	0.87

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: *Banlari*

FM-L13 108/30-05-57



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



Certificate of Calibration

Number of Page(s) 1 of 3

Certificate No. BSCC-UV-306/20
Equipment UV/Vis Spectrophotometer
Model UV-1800
Manufacturer Shimadzu
Serial No. A11454908533CD
ID No. BKK EN0018
Date of receipt 16 October 2020
Date of calibration 16 October 2020
Date of issue 19 October 2020

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

Address 104 Soi Phattanakarn 40, Phattanakarn Road, Suan Luang, Bangkok 10250

Temperature (20.6-20.9) °C (On site)
Humidity (70.7-71.2) %RH (On site)

Equipment condition Good Operation

Calibration Location Organic Prep

Calibration Procedure In-house method WI-UV-702-01 based on ASTM E275-01

Traceability
Wavelength Accuracy is traceable to certificate No. 78927 and 78928
Photometric Accuracy is traceable to certificate No. 78926 and 78940
Stray Light is traceable to certificate No. 78929
The above certificate are traceable to SI unit through Sarna Scientific Ltd
(UKAS accredited calibration laboratory NO 0659)

Calibrated by Mr Pannaphong Phannakakul

Approved by

Mr. Kanchit Choothop
Technical Manager

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Silom Bangkok Bangkok Thailand 10500
Tel : 02-6324300 Fax : 02-6375496-7
www.barascientific.com



Certificate of Calibration

Number of Page(s) 2 of 3

Certificate No. BSCC-UV-306/20

Calibration Results:

1. Wavelength Accuracy

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty (±nm)
241.70	241.50	-0.20	0.18
334.02	333.80	-0.22	0.18
418.53	418.50	-0.03	0.18
572.99	572.97	-0.02	0.18
879.41	879.18	-0.24	0.18

2. Photometric Accuracy (UV)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
235	0.0000	0.0000	0.0000	0.0075
	0.7334	0.7334	0.0000	0.0075
257	0.0000	0.0000	0.0000	0.0075
	0.8516	0.8517	0.0001	0.0075
313	0.0000	0.0001	0.0001	0.0075
	0.2860	0.2858	-0.0002	0.0075
350	0.0000	0.0001	0.0001	0.0075
	0.6321	0.6328	0.0007	0.0075

*CNR = Customer not request

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Silom Bangkok Bangkok Thailand 10500
Tel : 02-6324300 Fax : 02-6375496-7
www.barascientific.com



Certificate of Calibration

Certificate No. BSCC-UV-306120 3 of 3

Calibration Results:

3. Photometric Accuracy (Visible)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty (±A)
420.0	0.0000 0.5507 0.7548 1.0781	0.0000 0.5501 0.7535 1.0758	0.0000 -0.0006 -0.0014 -0.0023	0.0042 0.0042 0.0042 0.0042
440.0	0.0000 0.5409 0.7372 1.0529	0.0000 0.5401 0.7351 1.0508	0.0000 -0.0008 -0.0011 -0.0021	0.0042 0.0042 0.0042 0.0042
465.0	0.0000 0.4915 0.6802 0.9703	0.0000 0.4908 0.6791 0.9685	0.0000 -0.0007 -0.0011 -0.0018	0.0042 0.0042 0.0042 0.0042
546.1	0.0000 0.5057 0.6894 0.9820	0.0000 0.5058 0.6894 0.9817	0.0000 0.0001 0.0000 -0.0003	0.0042 0.0042 0.0042 0.0042
590.0	0.0000 0.5344 0.7192 1.0216	0.0000 0.5347 0.7196 1.0217	0.0000 0.0003 0.0004 0.0000	0.0042 0.0042 0.0042 0.0042
635.0	0.0000 0.5194 0.6869 0.9750	0.0000 0.5197 0.6873 0.9749	0.0000 0.0003 0.0004 -0.0001	0.0042 0.0042 0.0042 0.0042

*CNR = Customer not request

4. Stray Light*

Standard	Wavelength (nm)	Transmission (%)	Absorbance (A)
201.44±0.11nm	199.95	0.9562	2.0151

The Stray light transmission reference is less than 1.0% and Stray light absorbance reference is greater than 2.00A

*Stray Light not NISC-ONSC Accredited.

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

End of Certificate

The above results are valid exclusively for the calibrated item(s) as stated in this report / Certificate. Attaching the report / Certificate and validity of the results are confirmed and also shall not be reproduced except in full without written approval of the Bara Scientific Co., Ltd.



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
334/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 02-2717-3006/27 FAX: 02-2719-0484



Cert No.: 21CH50
Page: 1 of 2

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : SevenGo pH/mV S2
Serial No. : B617388431
ID No. : BKK_LG0004
Condition As-Received :
Received Date : 15 January 2021
Calibration Date : 18 January 2021
Reference : 2101-0428WSC-1
Submitted by : ALS Laboratory Group (Thailand) Co., Ltd.
104 Phathanakan 40, Phathanakan Rd.,
Khaeng Phathanakan, 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)

Calibrated by : Warakorn Lemgagrakul

Approved by : Approved Signatory

(✓) Malee Bulkruea
() Sathip Meangmal
() Warakorn Lemgagrakul

Issue Date : 25 January 2021

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.: 21CH50
Page.: 2 of 2

Condition of this calibration result

- Reference Standard Instrument :
Instrument Serial No. ID No. Cert. No. Due Date
1) Document Process Calibrator 46530031 13ORC098 20E3666 14 Oct 2021
This certification is traceable to the International System of Unit maintained at:-
- Traceable to National Institute of Metrology (Thailand), NIMT
- Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	699313	16 July 2022
pH 6.985	CPA chem	706696	06 Sep 2021
pH 10.008	CPA chem	706695	06 Sep 2021

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 k
			mV	pH		
pH Meter S/N.: B617388431	4.00	177.48	177	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 Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (±)	Coverage factor k
pH Electrode S/N.: 0415711	4.008	4.01	178	0.0079	2.00
	6.985	6.99	4	0.0099	2.00
	10.008	10.01	-173	0.013	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-

Malee Butkruea

a 1037377



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
53/44 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2717-3000-27 FAX: 0-2719-9484



ACCREDITED TO ISO 17025
CALIBRATION 0006

Cert. No.: 21TM164
Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter with Sensor
Manufacturer : Mettler Toledo
Model : SevenGo pH/mV S2
Serial No. : B617388431
ID No. : BKK_LG0004
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 : 15 January 2021
Calibrated Date : 21 January 2021
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V

Calibrated by : Kritisada Chaitrong

Approved by : *Malee Butkruea*
Approved Signatory

() Pornthippa Tameyakul
(/) Malee Butkruea
() Suwit Injai

Issue Date : 28 January 2021

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 & Equipment Calibration and Testing Service.

A 0023176



Equipment : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2101-0428WSC-2
Cert. No.: 21TM164
Page: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPT) 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 201389 20 Nov 2021

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 maintained at:-

- National Institute of Metrology Thailand (NIMT)

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement

This instrument was connected with temperature sensor, S/N.: 0415711

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
20.0	100	20.003	20.2	0.197	0.16	2.00
25.0	100	25.005	25.2	0.195	0.16	2.00
30.0	100	30.003	30.2	0.197	0.16	2.00
35.0	100	35.001	35.3	0.299	0.16	2.00
40.0	100	40.003	40.3	0.297	0.16	2.00
45.0	100	45.004	45.3	0.296	0.16	2.00
50.0	100	49.997	50.3	0.303	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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MTOC : L-1101/2020

Report No. : ALS-416

TOC-L Maintenance Report

Instrument : Total Organic Carbon Analyzer Measuring : TC 0 ~ 30000 mg/L
Model : TOC-LCSH Place of Installation :-
Serial No. : H54425300416 Department : LABORATORY
Manufacture : Shimadzu
Customer : ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaen Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand

Date of Maintenance : 29 / 10 / 2020

Ambient Condition : Temperature 22 ± 5 °C

: Humidifier 63 ± 15 %RH

Maintenance By : *T. Somsri*
(Mr. Tawatchai Somsri)
Technician

Approved By : *M. Nipon*
(Mr. Nipon Phungsomsak)
Technician Manager

User Name : _____
(_____)

SHIMADZU ANALYZER
1/4

REVIEW BY	<i>Sutthik P.</i>
APPROVED BY	<i>K.L. A.</i>
NEXT CAL. DATE	29/10/2021



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website : www.automation.co.th

MTOC : L-1101/2020

Report No. : ALS-416

Maintenance Sheet

Customer : ALS Laboratory Date : 29 / 10 / 2020
Model : TOC-LCSH Serial No. H54425300416

Item	Carry out maintenance work	Result	Exchange	Comment
1.	Check functionality of the device			
	Check furnace temperature (Standard cat. 680 °C / for TN cat. 720 °C)	O.K.		
	Check dehumidifier temperature (1 °C)	O.K.		
	Check the entire flow line related to leakage	O.K.		
	Check baseline status (OK)	O.K.		
	Check carrier gas pressure (200 ±10 kPa)	O.K.		
	Check carrier gas flow rate (150 mL/min)	O.K.		
2.	Tubes			
	Check all tubing for contamination, if necessary clean them	O.K.		
3.	Check all tubing for tight connection			
	Container and Drainage	O.K.		
	Fill up humidifier with pure water to max. level	O.K.		
	Check filling of dilution water and acid container	O.K.		
	Rinse Drain Pot, after wards refill again with pure water	O.K.		
4.	Check if outlet flow is in proper conditions TC and IC Injection			
	Clean Injector Block	O.K.		
	Check Injector Block for wear	O.K.		
	Check Injection tube adjustment	O.K.		
	Check injection for leakage	O.K.		
	Check injection for clogging	O.K.		
5.	IC Measurement (N-type)			
	Check acidification in syringe			
	Check sparging in syringe			
6.	Eye check of 8-Port valve, for sample residues or moist spots that indicate possible leakage	O.K.		
7.	Check and if necessary exchange consumable, Maintenance parts	O.K.		See list of consumable, maintenance parts

Inspection by : *T. Som*
(Mr. Tawatthai Somsri)
Technician

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2/4

MTOC : L-1101/2020

Report No. : ALS-416

Item	Carry out maintenance work	Result	Exchange	Comment
8.	Due to instrument condition, clean the instrument inside and outside.	O.K.		
9.	After checking the system and exchanging of consumable and maintenance parts a new 1-3 point calibration have to be done.	O.K.		Addition test 1.
10.	After wards the calibration perform check sample measurement.	O.K.		Addition test 2.

Addition test

Test no.	Test conditions	Meas. value	Result
1.	Calibration TC standard solution at 0, 0.1, 0.5, 1, 5, 10, 20 injection volume 50 µL No. of measurement 2 times (Max.3) Criteria : R ² = 0.995 or more	0.9996	Attachment : ALS-416 Page 1/5 - 3/5 Pass
2.	Measurement of reagent water and TC standard solution at 5.0 mg/L Injection volume 50 µL No. of measurement 2 times (Max.3) and calculate accuracy by Meas. of TC standard - Meas. of Reagent water Criteria : Accuracy %Recovery 10% or less	5.042 - 0.07155 = 4.9705 ppm	Attachment : ALS-416 Page 4/5 - 5/5 Pass

Inspection by : *T. Som*
(Mr. Tawatthai Somsri)
Technician

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3/4



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MTOC : L-1101/2020

Report No. : ALS-416

List of Consumable, Maintenance parts

Pos.	Part Number	Part Name	Result	Exchange	Recommended Interval
1.	036-11209-84	O-ring, 4D P10A (Viton , for TC,IC Slider)	O.K.	✓	1 time per year, Depending on condition
2.	036-11219-84	O-ring, 4D P20 (for sealing TC-Combustion tube)	O.K.	✓	1 time per year, Depending on condition
3.	036-11408-84	O-ring, Teflon P10 (for TC,IC-Slider)	O.K.	✓	1 time per year, Depending on condition
4.	630-00105-01	Platinum net, (2pcs-set) (to support catalyst)	O.K.	✓	6 month same time as catalyst exchange
5.	630-00557	Silica Wool (to support catalyst)	O.K.	✓	6 month same time as catalyst exchange
6.	630-00992	Halogen Scrubber	O.K.	✓	6 month
7.	630-00996	High Sensitivity TC Catalyst (When Installed)	N/A		Depending on condition
8.	638-60116	Regular Catalyst (33g) (When Installed)	O.K.	✓	6 month
9.	638-56251-01	8-Port valve rotor	O.K.		1 time per year
10.	638-41323	TC-Combustion Tube	O.K.	✓	6 month same time as catalyst exchange
11.	631-43404-01	Packing, gasket slider (for TC-Injection tube)	O.K.		1 time per year, Depending on condition
12.	638-59296	Syringe 5mL	O.K.		Depending on condition
13.	638-59296-01	Plunger Tip (for syringe 5mL)	O.K.	✓	6 month
14.	042-00405-11	IC reagent supply pump head	O.K.		1 time per year
15.	630-00999	CO2-Absorber (for cell space purge)	O.K.	✓	1 time per year
16.	630-00964	Molecular Sieves 13x	O.K.	✓	3-6 month

Note. Table indicates the guidelines replacement periods when NPOC measurement is performed on sample that are comparatively as clean as tap water ,use standard catalyst and at a rate of about 500 sample per month (operating five days a week)

Inspector By

T. Somsri

(Mr. Tawatchai Somsri)
Technician

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4/4