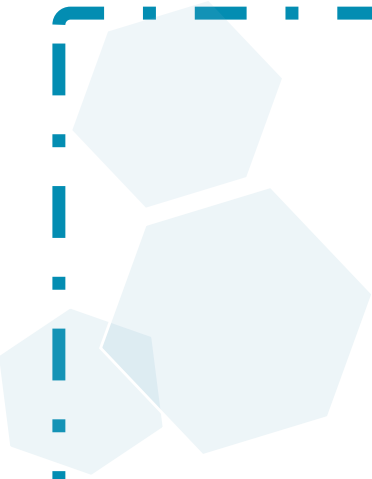
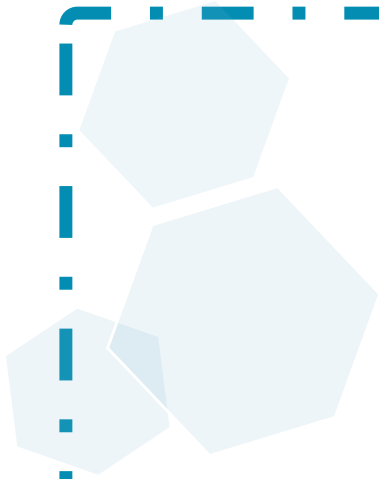




ภาคผนวก จ

หนังสือรับรองการสอบเทียบเครื่องมือ





ภาคผนวก จ-1

บริษัท อินทิเกรทเต็ด รีเซิร์ช เซ็นเตอร์ จำกัด



CERTIFICATE OF CALIBRATION

Certificate No. : COF-013-67

Page 2 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER
MODEL/TYPE
SERIAL NUMBER
ID NUMBER
CONDITION AS-RECEIVED
CUSTOMER

: Top Load Orifice
: TSCB
: TE-5025A
: 2926
: -
: Used item
: Integrated Research Center Company Limited,
122 Moo 2, Thathoom, Srimahaphote, Prachinburi 25140, Thailand.

Calibration procedure:
The Orifice gas flow device was calibrated against Standard Rotary Displacement Meter (Roots Meter) Model G55/14C/WR200. The WP-C1-004 was used as a calibration guideline.
Traceability:
This certificate provides a traceability of the measurement to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number MW-0063-23.

Uncertainty of Measurement:
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor $k=2$. Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'.

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

: 10 May 2024
: 05 Jun 2024
: 06 Jun 2024

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follows:

Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1010 ± 10 hPa

CALIBRATION CONDITION:

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are 22.9 °C and 53.2 %RH.

NOTED: The certificate is valid only to the item calibrated on date and place of calibration.

TABULATION OF RESULTS:

The table on next page give the measured values.

Table 1: The results of Q Standard calibration data

Plate	Flow rate m ³ /min	Pressure [Pa] mmHg	Temperature [T _a] °C	Temperature [T _m] °C	Ap_meter mmHg	Ap_Orifice inH ₂ O	γ	Standard Flow [Q _s] m ³ /min
1	0.703	754.942	22.82	22.17	58.515	1.094	1.046	0.651
2	1.001	754.951	22.99	22.44	44.435	2.340	1.510	0.944
3	1.117	754.835	23.23	22.73	38.752	2.954	1.216	1.050
4	1.170	754.975	23.31	22.88	35.376	3.257	1.304	1.116
5	1.411	755.078	23.55	23.13	24.261	4.921	2.216	1.365

Slope (m): 1.63522
Intercept (b): -0.01711
Correlation coefficient (r): 0.99975
Uncertainty (k=2): 0.015 m³/min

Table 2: The results of Q actual calibration data

Plate	Flow rate m ³ /min	Pressure [Pa] mmHg	Temperature [T _a] °C	Temperature [T _m] °C	Ap_meter mmHg	Ap_Orifice inH ₂ O	γ	Standard Flow [Q _s] m ³ /min
1	0.703	754.942	22.82	22.17	58.515	1.094	0.655	0.650
2	1.001	754.951	22.99	22.44	44.435	2.340	0.958	0.944
3	1.117	754.835	23.23	22.73	38.752	2.948	1.076	1.061
4	1.170	754.975	23.31	22.88	35.376	3.257	1.131	1.117
5	1.411	755.078	23.55	23.13	24.261	4.921	1.391	1.367

Slope (m): 1.02416
Intercept (b): -0.01068
Correlation coefficient (r): 0.99975
Uncertainty (k=2): 0.015 m³/min

End of Certificate of Calibration

Calibrated by:
☒ Mr. Sogwin Thachalad
☐ Miss Jiraporn Lertsomphol



Approved signature:
Mr. Parinya Booncharoen
Calibration Department Manager



THIS CERTIFICATE REPORT MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0177

MTC No. EEL. BP. 13/0167

CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

Address : 122 Moo 2, T.Thathoom, A.Srimahaphote, Prachinburi, 25140

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter
Manufacturer : ACO
Model : 6236
Serial No. : 212014
Microphone : 7052NR No.76235
Preamplifier : -

Ambient Environment

Temperature : (23 ± 3) °C
Relative Humidity : (50 ± 15) %
Ambient Pressure : (101.325 ± 1.5) kPa

Standards used :

1. Band Pass Filter Wavetek 752A S/N 90010494.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 3 Jan. 2024

Date of Calibration : 29 Jan. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0177

MTC No. EEL. BP. 13/0167

9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

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

Date of Calibration : 29 Jan. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0177

MTC No. EEL. BP. 13/0167

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.93	113.8	113.9	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 114.1 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
23.8	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	17.0	0.10	N/A
C-Weight	25.8	0.10	N/A
Flat	30.4	0.10	N/A

Date of Calibration : 29 Jan. 2024

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Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpal@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtg@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th



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Request No. 21-67/0177

MTC No. EEL. BP. 13/0167

5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 29 Jan. 2024

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Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpal@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
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Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
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Request No. 21-67/0177

MTC No. EEL. BP. 13/0167

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.6	0.4	0.4	1.5	0.45	0.6
1 000	-0.9	-0.8	-0.8	1.0	0.45	0.6
8 000	0.9	0.8	1.1	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.3	0.1	1.7	2.0	0.20	0.6
125	0.1	0.1	1.7	1.5	0.20	0.6
250	0.1	0.0	1.7	1.5	0.20	0.6
500	0.1	0.1	1.8	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.1	-0.1	0.0	2.0	0.20	0.6
4 000	-0.4	-0.3	-0.1	3.0	0.20	0.6
8 000	2.4	-0.6	-0.2	5.0	0.20	0.7

Date of Calibration : 29 Jan. 2024

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Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
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Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpal@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
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Amphoe Muang Changwat Samutprakan 10280, Thailand
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Request No. 21-67/0177

MTC No. EEL. BP. 13/0167

7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
123	123.0	0.0	1.1	0.30	0.3
122	122.0	0.0	1.1	0.30	0.3
121	121.0	0.0	1.1	0.30	0.3
120	120.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.1	0.1	1.1	0.30	0.3
69	69.1	0.1	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	54.0	0.0	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3

Date of Calibration : 29 Jan. 2024

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Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpal@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtg@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
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Request No. 21-67/0177

MTC No. EEL. BP. 13/0167

7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
34	34.1	0.1	1.1	0.30	0.3
33	33.2	0.2	1.1	0.30	0.3
32	32.2	0.2	1.1	0.30	0.3
31	31.3	0.3	1.1	0.30	0.3
30	30.3	0.3	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	94.0	94.0	0.0	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	94.0	0.0	1.1	0.30	0.3
20-100	94.0	94.0	0.0	1.1	0.30	0.3

Date of Calibration : 29 Jan. 2024

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35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtg@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.8	0.4	3.0	0.20	0.35
Positive half cycle	124.4	124.2	-0.2	2.0	0.20	0.35
Negative half cycle	124.4	124.2	-0.2	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
133.0	133.0	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by :

Wittawat Supanich
(Mr. Wittawat Supanich)

Approved by :

Prinwate Klaiyap
(Mr. Prinwate Klaiyap)
Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 29 Jan. 2024

Date of Issue : 30 Jan. 2024

Ref : 2011267010300008004

End of Certificate

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35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
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E-mail : mtg@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

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Request No. 21-67/0177

MTC No. EEL. BP. 13/0167

8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45	45.0	0.0	1.1	0.30	0.3
30-120	35	35.0	0.0	1.1	0.30	0.3
20-110	25	25.4	0.4	1.1	0.30	0.3
20-100	25	25.2	0.2	1.1	0.30	0.3
20-90	25	25.0	0.0	1.1	0.30	0.3
20-80	25	25.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb(ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.8	-0.2	±1.0	0.20	0.3
	2	98.2	-0.8	+1.0; -2.5	0.20	0.3
	0.25	89.5	-0.5	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3
SEL	200	109.9	-0.1	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 29 Jan. 2024

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Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
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E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

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Office
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Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

FABL.MTC.002 Rev.



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0177

MTC No. EEL. BP. 12/0167

CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

Address : 122 Moo 2, T.Thatoom, A.Srinaphaphote, Prachinburi, 25140

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial No. : 192016

Microphone : 7052NR No.73305

Preamplifier : -

Standards used :

1. Band Pass Filter Wavecok 752A S/N 90010494.
2. Condenser Microphone Brüel&Kjaer 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DP-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjaer 2636 S/N 1537484.

Date of Receipt : 3 Jan. 2024

Date of Calibration : 29 Jan. 2024

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Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
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Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtg@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
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9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

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

Date of Calibration : 29 Jan. 2024

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0177

MTC No. EEL. BP. 12/0167

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.5	0.5	0.4	1.5	0.45	0.6
1 000	-0.9	-0.9	-0.8	1.0	0.45	0.6
8 000	1.9	2.4	2.5	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.1	0.1	0.0	2.0	0.20	0.6
125	0.0	0.1	0.0	1.5	0.20	0.6
250	0.1	0.1	0.0	1.5	0.20	0.6
500	0.0	0.1	0.1	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.2	0.0	0.0	2.0	0.20	0.6
4 000	-0.4	-0.4	-0.1	3.0	0.20	0.6
8 000	-0.7	-0.6	-0.2	5.0	0.20	0.7

Date of Calibration : 29 Jan. 2024

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Fax. (66) 0 2577 9009
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Office/Laboratory
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Amphoe Muang, Changwat Samutprakan 10280, Thailand
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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0177

MTC No. EEL. BP. 12/0167

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value(dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.93	112.2	113.9	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 115.8 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
24.5	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	15.5	0.10	N/A
C-Weight	20.2	0.10	N/A
Flat	24.2	0.10	N/A

Date of Calibration : 29 Jan. 2024

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35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
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Thailand
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Request No. 21-67/0177

MTC No. EEL. BP. 12/0167

5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 29 Jan. 2024

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
123	123.0	0.0	1.1	0.30	0.3
122	122.0	0.0	1.1	0.30	0.3
121	121.0	0.0	1.1	0.30	0.3
120	120.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.1	0.1	1.1	0.30	0.3
69	69.1	0.1	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	54.0	0.0	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3

Date of Calibration : 29 Jan. 2024

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35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
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Fax. (66) 0 2577 9009
E-mail : numpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

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8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45	45.0	0.0	1.1	0.30	0.3
30-120	35	35.0	0.0	1.1	0.30	0.3
20-110	25	25.3	0.3	1.1	0.30	0.3
20-100	25	25.2	0.2	1.1	0.30	0.3
20-90	25	25.1	0.1	1.1	0.30	0.3
20-80	25	25.0	0.0	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb(ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.7	-0.3	±1.0	0.20	0.3
	2	98.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	89.8	-0.2	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
SEL	200	109.9	-0.1	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 29 Jan. 2024

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35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : numpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
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E-mail : mtc@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
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E-mail : sumalee@tistr.or.th

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7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
34	34.1	0.1	1.1	0.30	0.3
33	33.2	0.2	1.1	0.30	0.3
32	32.2	0.2	1.1	0.30	0.3
31	31.3	0.3	1.1	0.30	0.3
30	30.4	0.4	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	94.0	94.0	0.0	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	94.0	0.0	1.1	0.30	0.3
20-100	94.0	94.0	0.0	1.1	0.30	0.3

Date of Calibration : 29 Jan. 2024

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Fax. (66) 0 2577 9009
E-mail : numpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.8	0.4	3.0	0.20	0.35
Positive half cycle	124.4	124.3	-0.1	2.0	0.20	0.35
Negative half cycle	124.4	124.3	-0.1	2.0	0.20	0.35

11. Overload indication

Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle			
133.0	133.0	0.0	1.5	0.20

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by : 
(Mr. Wittawat Supanich)

Approved by : 
(Mr. Pravee Kluayap)
Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 29 Jan. 2024

Date of Issue : 29 Jan. 2024

Ref : 2011267010300008003

End of Certificate

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Office/Laboratory
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FMBLMTC.002 Rev



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0177

MTC No. EEL. BP. 14/0167

CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.
Address : 122 Moo 2, T.Thatoom, A.Srimahaphote, Prachinburi, 25140
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :
Description : Sound Level Meter
Manufacturer : ACO
Model : 6236
Serial No. : 212015
Microphone : 7052NR No.76236
Preamplifier : -
Ambient Environment
Temperature : $(23 \pm 3) ^\circ\text{C}$
Relative Humidity : $(50 \pm 15) \%$
Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$

- Standards used :**
1. Band Pass Filter Wavetek 752A S/N 90010494.
 2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
 3. Decade Attenuator Ando AL-205 S/N 00464602.
 4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
 5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
 6. Digital Multimeter Fluke 8520A S/N 4985007.
 7. Pistonphone Rion NC-72 S/N 00402446.
 8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 3 Jan. 2024

Date of Calibration : 30 Jan. 2024

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FM.BLMTC.002 Rev.4

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Request No. 21-67/0177

MTC No. EEL. BP. 14/0167

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB) Before adjust	Measured value (dB) After adjust	Deviation value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
113.93	113.8	113.9	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 113.9 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
24.6	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	18.7	0.10	N/A
C-Weight	20.7	0.10	N/A
Flat	26.3	0.10	N/A

Date of Calibration : 30 Jan. 2024

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FM.BLMTC.002 Rev.4

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtic@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sunalee@tistr.or.th



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0177

MTC No. EEL. BP. 14/0167

9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

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

Date of Calibration : 30 Jan. 2024

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.5	0.6	0.4	1.5	0.45	0.6
1 000	-1.0	-1.0	-0.8	1.0	0.45	0.6
8 000	0.6	0.6	0.7	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response curve(dB)			Acceptance limit	Uncertainty	Maximum-permitted uncertainty
	A-weight	C-weight	Flat	class 2 (±dB)	(±dB)	of measurement (±dB)
63	0.1	0.0	-0.1	2.0	0.20	0.6
125	-0.1	0.1	0.0	1.5	0.20	0.6
250	0.0	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.1	-0.1	0.0	2.0	0.20	0.6
4 000	-0.4	-0.4	-0.1	3.0	0.20	0.6
8 000	-0.6	-0.6	-0.2	5.0	0.20	0.7

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5. Long-term stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

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E-mail : mtg@tistr.or.th

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MTC No. EEL. BP. 14/0167

7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
34	34.1	0.1	1.1	0.30	0.3
33	33.1	0.1	1.1	0.30	0.3
32	32.1	0.1	1.1	0.30	0.3
31	31.2	0.2	1.1	0.30	0.3
30	30.2	0.2	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	94.0	94.0	0.0	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	94.0	0.0	1.1	0.30	0.3
20-100	94.0	94.0	0.0	1.1	0.30	0.3

Date of Calibration : 30 Jan. 2024

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35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
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Fax. (66) 0 2577 9009
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7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
123	123.0	0.0	1.1	0.30	0.3
122	122.0	0.0	1.1	0.30	0.3
121	121.0	0.0	1.1	0.30	0.3
120	120.1	0.1	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.1	0.1	1.1	0.30	0.3
69	69.1	0.1	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	54.0	0.0	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3

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35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
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Fax. (66) 0 2577 9009
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Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
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Fax. (66) 0 2323 9165
E-mail : mtg@tistr.or.th

Office
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Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
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8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45	45.0	0.0	1.1	0.30	0.3
30-120	35	35.0	0.0	1.1	0.30	0.3
20-110	25	25.4	0.4	1.1	0.30	0.3
20-100	25	25.4	0.4	1.1	0.30	0.3
20-90	25	25.2	0.2	1.1	0.30	0.3
20-80	25	25.2	0.2	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb(ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.8	-0.2	±1.0	0.20	0.3
	2	98.8	-0.2	+1.0; -2.5	0.20	0.3
	0.25	89.6	-0.4	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.6	-0.4	+1.0; -5.0	0.20	0.3
SEL	200	110.0	0.0	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2(±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.8	0.4	3.0	0.20	0.35
Positive half cycle	124.4	124.3	-0.1	2.0	0.20	0.35
Negative half cycle	124.4	124.3	-0.1	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated	Acceptance	Uncertainty	Maximum-permitted uncertainty
Positive one-half cycle	Negative one-half cycle	value (dB)	limit class 2(±dB)	(±dB)	of measurement (±dB)
133.0	133.0	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by:

Wittawat Supanich

(Mr. Wittawat Supanich)

Approved by:

(Mr. Piewwut Klusaypa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 30 Jan. 2024

Date of Issue : 31 Jan. 2024

Ref : 2011267010300008005

End of Certificate

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35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumplai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Sol 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
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Agilent 5100, 5110 Preventive Maintenance Checklist

From Insight to Outcome

Introduction

Customer Information

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

Agilent CrossLab Start Up Services

Agilent 5100 5110 ICP-OES Preventive Maintenance

Agilent Preventive Maintenance provides factory recommended service for your analytical instruments to assure reliable operation and the accuracy of your results

Delivered by highly trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides what you need to reduce unplanned downtime and keep your systems operating at their peak performance.

This checklist is used as a guide for completing the preventive maintenance tasks. A signed copy of this checklist is provided for your records.

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Document Number: G8014-90075
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Agilent 5100, 5110 Preventive Maintenance Checklist

From Insight to Outcome

Important Customer Web Links

- To access **Agilent University**, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- To access the **Agilent Resource Center** web page, visit <https://www.agilent.com/en-us/agilentresources>. The following information topics are available:
 - Sample Prep and Containment
 - Chemical Standards
 - Analysis
 - Service and Support
 - Application Workflows
- The **Agilent Community** is an excellent place to get answers, collaborate with others about applications and Agilent products, and find in-depth documents and videos relevant to Agilent technologies. Visit <https://community.agilent.com/welcome>
- Videos about specific preparation requirements for your instrument can be found by searching the **Agilent YouTube** channel at <https://www.youtube.com/user/agilent>
- Need to place a service call?** Flexible Repair Options | Agilent

Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Only select those pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
- Check "Service not applicable" check boxes to indicate services/tasks not delivered, as appropriate.
- Complete the Preventive Maintenance services in the most logical order relevant to the individual system service in the order of the tasks listed.
- Complete the **Service Review** section together with the customer.
- Complete the fields for page numbers at the foot of each selected page
- Add relevant page numbers to selected pages and complete the total number of pages field in the Service Completion section
- **Ask the customer to sign the Service Verification section including the customer's and your signature.**

Preparation

- ☒ Discuss any specific issues with the customer before starting.
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors etc.
- ☒ Check system for required installation of components and implementation of Service Notes
- ☒ Check for required firmware/software updates and verify with customers if they would like them installed.
- (N/A) ☐ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it.
- ☒ Ask the customer to remove any samples from the ICP-OES sample introduction area, auto sampler or around the ICP-OES.

Instrument Maintenance

System Information

- ☐ Check this box if an instrument configuration report is attached instead of completing the table.

Instrument System Name and ID	5110 ICP-OES
Instrument System Site and Location	Integrated Research Center

List System Component Product Numbers	List the Serial Numbers of each Component
1. G 9015 A	MY 19351008
2. G 3212 A	1903 - 00426
3.	
4.	
5.	
6.	
7.	
8.	
9.	

ICP-OES Configuration Table	Circle the type or write in the type if other
Nebulizer Type	(SeaSpray) OneNeb Conikal Other
Spray Chamber	Cyclonic Single Pass (Cyclonic Double Pass) Other
Torch	Radial (Dual View) Other
Torch Type	One Piece (Semi Demountable) Fully Demountable Other
Injector Diameter	2.4mm (1.8mm) 1.4mm 0.8mm Other
Injector Material	(Quartz) Ceramic Other

Preventive Maintenance Procedures

Record Pre-PM Instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table – Pre-PM.

Clean and inspect ICP-OES system

- ☒ Look for any obvious external damage or problems.
- ☒ Inspect water cooling hoses, gas lines and power cord for excessive wear or damage.
- ☒ Perform a general internal inspection of the system for excessive dust accumulation, clean if necessary.
- ☒ Inspect sample introduction components and record any required maintenance in the Service Engineer Comments and notify the customer as the required actions required.
- ☒ Record the instrument operating conditions in the ICP-OES Status Results Table.
- ☒ Replace the polychromator purge filter.
- ☒ Replace the radial pre-optics window
- ☒ Replace the axial pre-optics window for SVDV and VDV instruments.
- ☒ Check exhaust flow for the correct positive extraction at the exhaust duct to insure they meet minimum specifications.
- ☒ Replace air inlet dust filter.
- (N/A) ☐ Replace high capacity air inlet dust filter element if installed.
- ☒ Remove and clean instrument water inlet filter.

Agilent Water Recirculator

- ☐ Service not applicable
- ☒ Drain cooling fluid and remove any particles from the chiller reservoir
- ☒ Remove, clean and reinstall water inlet metal mesh filter if present.
- ☒ Re fill with Agilent Cool Clear cooling fluid.
- ☒ Clean the cooling system Air filter and the condenser.

SPS 3 Auto Sampler

- ☒ **Service not applicable**
- ☐ Power cycle the autosampler and verify successful initialization.
- ☐ Inspect X and Z axis belts for wear. Replace is necessary.
- ☐ Clean X and Z axis slide shafts.
- ☐ Using customer's racks and the Agilent software move the sample probe to the 4 outermost corners and rinse port, ensure that the probe is approximately centered in the vial.

SPS 4 Auto sampler

- ☒ **Service not applicable**
- ☐ Clean the spill tray, rack location mat, end frames and chassis with a damp soft cloth and diluted mild detergent.
- ☐ Clean the auto sampler cover panels, if cover kit is installed, with domestic window cleaner.
- ☐ Check the X-axis and Z-axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
- ☐ Check the X-axis, Theta-axis and Z-axis FFC cables for cracks, incorrect positioning, damaged edges or damaged connectors.
- ☐ Pump Tubing Replacement. Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles.
- ☐ Test using customer's tray and move the sample probe to the sample vial 1, wash vial and rinse port and ensure that the probe is centered in the vial. If not use calibration wizard and calibrate the position.

AVS 4, 6, 7 Advanced Valve System

- ☒ **Service not applicable**
- ☐ Replace valve rotor seal
- ☐ Check fittings for signs of leaks
- ☐ Check tubing including autosampler tubing for kinks or excessive wear
- ☐ Check high flow pump for signs of leaks

Restore Instrument

- (N/A) ☐ For HF applications, ask the customer to reinstall their sample introduction system.
- ☒ Leave system in an idle state: on and purging.
- ☒ Guidance: If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

Service Review

- ☒ Attach available reports/printouts of all tests to this documentation.
- ☒ Record the Preventive Maintenance service activity in the customer's records/logbook.
- ☒ Record the PM event in the Smart Alerts logbook, if applicable.
- ☒ Update/reset instrument maintenance counters as appropriate.
- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☒ Complete the Service Engineer Comments section if there are additional comments.
- ☒ Review this service, parts replaced, and test results obtained with the customer.
- ☒ If the instrument firmware was updated, record the details of the change in the Service Engineer's Comments box. Systems in a compliant environment may need additional documentation.
- ☒ **Complete the Signature Page with both Service Engineer and Customer signatures.**

ICP-OES adjustment

- ☒ Check position of Zn peak, adjust if required.
- ☒ Check Argon Ratio, adjust to specified value if required.
- ☒ Perform Detector Calibration.
- ☒ Perform Instrument Calibration.

Record Post-PM instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table - Post PM.
- ☒ For systems using ICP Expert version 7.3 and above, run the following instrument tests
- ☒ Subsystem Communications Test
 - ☒ Air Flow
 - ☒ Water Flow
 - ☒ Gas Flows
 - ☒ RF Generator
 - ☒ Camera Test
 - ☒ Optics Test
 - ☒ Nebulizer Test

- ☒ Record the result in the Instrument Test Results Table

Test Results

Instrument Performance Test Results Table

Note: These measurements do not form part of any specification and are for reference only.

	Pre PM Sensitivity Check		Post PM Sensitivity Check	
	Radial	Axial *	Radial	Axial*
Zn 213.857 nm SRBR	1503.1	4353.1	1878.3	6963.0
Mn 257.610 nm SRBR	7167.4	25078.8	8919.6	38366.4
Al 396.152 nm SBR	7.7	19.1	9.0	35.3
K 766.491 nm SBR	7.2	101.4	5.7	118.7

* Axial result is not applicable for G8016AA, G8012AA Radial View instruments.

Instrument Test Results Table

Note: The Instrument Test results are for systems using ICP Expert version 7.3 and above only.

Instrument Test	Result
Subsystem Communications Test	Pass
Air Flow	Pass
Water Flow	Pass
Gas Flows	Pass
RF Generator	Pass
Camera Test	Pass
Optics Test	Pass
Nebulizer test	Pass

Calibration Report of Mettler Toledo SEVEN EASY Ph Meter

MPC Control #: EV3700 Serial Number: 1232025225
Asset ID: WL-058/11 Calibration Date: October 31, 2024

Measurement Results

Buffer Solution

STD Test Point @ 25°C	Lower Limit	Measured Value		Upper Limit	Result	Uncertainty (±)
		AS Found	AS Left			
4.01 pH	3.91 pH	4.01 pH	4.01 pH	4.11 pH	PASS	0.013 pH
7.01 pH	6.91 pH	7.01 pH	7.01 pH	7.11 pH	PASS	0.013 pH
10.01 pH	9.91 pH	10.01 pH	10.01 pH	10.11 pH	PASS	0.013 pH

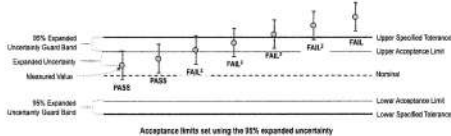
Note : Accuracy by Customer : ± 0.10 pH

Statements of Pass or Fail Conformance

The uncertainty of measurement has been taken into account when determining compliance with specification.
All measurements and test results passed to ensure the probability of false-accept does not exceed 2% in compliance with ANSI/ISO 17025:2017

The status of compliance with the acceptance criteria is reported as:

- PASS — Compliant with specification.
- PASS? — The measured value is within the acceptance limits. However, a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.
- FAIL? — The measured value is not within the acceptance limits. However, a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.
- FAIL — Not compliant with specification.



The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95%, unless otherwise stated.

This calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO 17025:2017, Method 5 — Guard Bands Based on Expanded Uncertainty.

End of Calibration Report

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Page 1 of 1
TQDG-FM-002 rev05

Certificate of Calibration

Date: Nov 11, 2024

Cert No. 5523631031362691

Customer:

DOUBLE A (1991) PUBLIC COMPANY LIMITED
1 MOO2 KLONGRUNG-PRACHINBURI ROAD
THATOOM, SRIMAHAPHOT
PRACHINBURI PRACHINBURI 25140

Work Order #: THAI-PT-00735

MPC Control #: EV3701

Serial Number: 1232025828

Asset ID: WL-058/11

Department: N/A

Gage Type: CONDUCTIVITY METER

Performed By: JAKRAPONG ARYACHAT

Manufacturer: METTLER TOLEDO

Received Condition: IN TOLERANCE

Model Number: SEVEN EASY

Returned Condition: IN TOLERANCE

Size: N/A

Cal. Date: October 31, 2024

Temp/RH: 25.0°C / 52.0%

Cal. Interval: 12 MONTHS

Location: Calibration performed at Customer's facility

Cal. Due Date: October 31, 2025

Calibration Notes:

Please refer to the attached Calibration Report (1 page)

Standards Used to Calibrate Equipment

I.D.	Description	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
AW2456	CONDUCTIVITY SOLUTION	190724	TRM-S-2019	REAGECON	Jan 22, 2025	TRM-S-2019 / NIMT

Procedures Used in this Event

Procedure Name	Description
MPC-PHM-001 Rev. 06	pH Meters, General, Rev.06, May-24-2024

Calibrating Technician:

JAKRAPONG ARYACHAT

QC Approval:

PADUNG SRASUAY

STATEMENTS OF PASS OR FAIL CONFORMANCE: The uncertainty of measurement has been taken into account when determining compliance with specification. All measurements and test results passed to ensure the probability of false-accept does not exceed 2% in compliance with ISO/IEC 17025:2017.

THE CALIBRATION REPORT STATES:
PASS: The test value and measurement uncertainty is given, and the measurement result is PASS.
PASS?: The test value and measurement uncertainty is given, and the measurement result is PASS? (The test value and measurement uncertainty is within the acceptance limits, but a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.)
FAIL?: The test value and measurement uncertainty is given, and the measurement result is FAIL? (The test value and measurement uncertainty is not within the acceptance limits, but a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.)
FAIL: The test value and measurement uncertainty is given, and the measurement result is FAIL. (The test value and measurement uncertainty is not within the acceptance limits.)

The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95%, unless otherwise stated.

This calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO 17025:2017, Method 5 — Guard Bands Based on Expanded Uncertainty.

Page 1 of 1

(CERT. Rev.9)

Calibration Report of Mettler Toledo SEVEN EASY Conductivity Meter

MPC Control #: EV3701 Serial Number: 1232025828
Asset ID: WL-058/11 Calibration Date: October 31, 2024

Measurement Results

Nominal	Unit	Temp.	STD. Test Point @ Temp	Lower Limit	UUC Reading	Upper Limit	Result	Uncertainty (±)
1413	µS/cm	25.0°C	1413	1403	1412	1423	PASS?	16

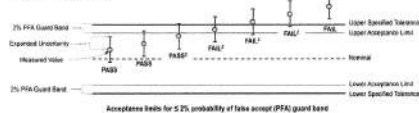
Note : Accuracy by Customer : ± 0.5 %

Statements of Pass or Fail Conformance

The uncertainty of measurement has been taken into account when determining compliance with specification.
All measurements and test results passed to ensure the probability of false-accept does not exceed 2% in compliance with ANSI/ISO 17025:2017

The status of compliance with the acceptance criteria is reported as:

- PASS — Compliant with specification.
- PASS? — The measured value is within the acceptance limits. However, a portion of the expanded uncertainty of measurement at 95% exceeds the specified tolerance.
- FAIL? — The measured value is not within the acceptance limits. However, a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.
- FAIL — Not compliant with specification.



The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95%, unless otherwise stated.

This calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO 17025:2017, Method 5 — Guard Bands Based on Test Uncertainty Ratio.

End of Calibration Report

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Page 1 of 1
TQDG-FM-002 rev05

Certificate of Calibration

Date: Nov 11, 2024

Cert No. 5523631031362694

Customer:

DOUBLE A (1991) PUBLIC COMPANY LIMITED
1 MOO2 KLONGRUNG-PRACHINBURI ROAD
THATOOM, SRIMAHAPHOT
PRACHINBURI PRACHINBURI 25140

Work Order #: THAI-PT-00735

MPC Control #: EV3702

Serial Number: B932068736

Asset ID: WL-PHM/03

Department: N/A

Gage Type: PH/DO METER

Performed By: CHANKIAT PHOLKAM

Manufacturer: METTLER TOLEDO

Received Condition: IN TOLERANCE

Model Number: SEVEN GO DUO

Returned Condition: IN TOLERANCE

Size: N/A

Cal. Date: October 31, 2024

Temp/RH: 25.0°C / 52.0%

Cal. Interval: 12 MONTHS

Location: Calibration performed at Customer's facility

Cal. Due Date: October 31, 2025

Calibration Notes:

Please refer to the attached Calibration Report (1 page)

Standards Used to Calibrate Equipment

I.D.	Description	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
AW2318	PH BUFFER SOLUTION	PH 4.00	1040525C	REAGECON	Aug 28, 2026	4C23H1 / REAGECON
AW2319	PH BUFFER SOLUTION	PH 7.00	1070525C	REAGECON	Jul 28, 2026	725C3G1 / REAGECON
AW2320	PH BUFFER SOLUTION	PH 10.00	1100525C	REAGECON	May 28, 2025	1125C2B1 / REAGECON

Procedures Used in this Event

Procedure Name	Description
MPC-PHM-001 Rev. 06	pH Meters, General, Rev.06, May-24-2024

Calibrating Technician:

CHANKIAT PHOLKAM

QC Approval:

PADUNG SRASUAY

STATEMENTS OF PASS OR FAIL CONFORMANCE: The uncertainty of measurement has been taken into account when determining compliance with specification. All measurements and test results passed to ensure the probability of false-accept does not exceed 2% in compliance with ISO/IEC 17025:2017.

THE CALIBRATION REPORT STATES:
PASS: The test value and measurement uncertainty is given, and the measurement result is PASS.
PASS?: The test value and measurement uncertainty is given, and the measurement result is PASS? (The test value and measurement uncertainty is within the acceptance limits, but a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.)
FAIL?: The test value and measurement uncertainty is given, and the measurement result is FAIL? (The test value and measurement uncertainty is not within the acceptance limits, but a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.)
FAIL: The test value and measurement uncertainty is given, and the measurement result is FAIL. (The test value and measurement uncertainty is not within the acceptance limits.)

The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95%, unless otherwise stated.

This calibration report complies with ISO/IEC 17025:2017 and ANSI/ISO 17025:2017, Method 5 — Guard Bands Based on Test Uncertainty Ratio.

Page 1 of 1

(CERT. Rev.9)

Calibration Report of Dixell XR06CX-5N0C2 Cool Room

MPC Control #:	EV3706	Serial Number:	LIOGBXB500
Asset ID:	DARC-TE15028	Calibration Date:	October 31, 2024

Measurement Results

Section 1 : Temperature Distribution

Temperature @ 4 °C

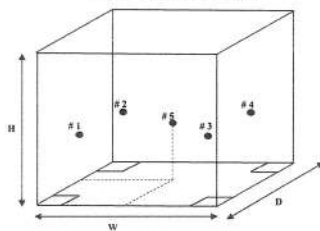
Sensor No.	UUC Setting (°C)	Lower Limit (°C)	STD Reading (°C)		Upper Limit (°C)	Result	Uncertainty (°C)
			As Found	As Left			
Sensor#1	4.00	2.00	4.53	4.53	6.00	PASS	± 0.35
Sensor#2	4.00	2.00	4.66	4.66	6.00	PASS	± 0.35
Sensor#3	4.00	2.00	4.61	4.61	6.00	PASS	± 0.35
Sensor#4	4.00	2.00	4.67	4.67	6.00	PASS	± 0.35
Sensor#5	4.00	2.00	4.62	4.62	6.00	PASS	± 0.35

Section 2 : Chamber Performance

Setting Temp (°C)	Indicating Temp (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
4.0	4.0	0.29	1.2	2.5

Accuracy By : Customer Specification ± 2 °C

Sensor Installation Location



Page 1 of 2

Calibration Report of Dixell XR06CX-5N0C2 Cool Room

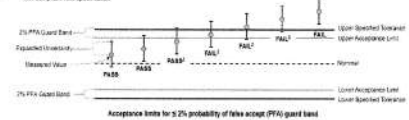
MPC Control #:	EV3706	Serial Number:	LIOGBXB500
Asset ID:	DARC-TE15028	Calibration Date:	October 31, 2024

Statements of Pass or Fail Conformance

The uncertainty of measurement has been taken into account when determining compliance with specification.
All measurements and their results passed based on the probability of false accept does not exceed 5% in compliance with ANSI/NCSL Z540-3:2006

The status of compliance with the acceptance criteria is reported as:

- PASS — Compliant with specification
PASS? — The measured value is within acceptance limits
However, a portion of the expanded uncertainty of measurement at 95% exceeds the specified tolerance
FAIL? — The measured value is not within the acceptance limits
However, a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance
FAIL — Not compliant with specification



The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a normal distribution corresponds to a coverage probability of approximately 95% (within of reference stated).
The calibration report complies with ISO/IEC 17025:2017 and ANSI/NCSL Z540-3:2006, Method 4 -- Guard Bands Based on Test Uncertainty Ratio.

End of Calibration Report

Page 2 of 2

MICRO PRECISION CALIBRATION LABORATORY (THAILAND) CO., LTD.
411 BONGNIT STREET ROAD, THABKUL BANGPODCHAPHOT, PHRACHINBURI, NORTHEASTERN
THAILAND 31120 THAILAND
95 2 983 9839

Certificate of Calibration

Cert No. 5523631031362699

Date: Nov 11, 2024

Customer:

DOUBLE A (1991) PUBLIC COMPANY LIMITED
1 MOO2 KLONGRUNG-PRACHINBURI ROAD
THATOOM, SRIMAHAPHOT
PRACHINBURI PRACHINBURI 25140

Work Order #: THAI-PT-00735

MPC Control #: EV3705
Asset ID: WL-INC/02
Gage Type: INCUBATOR
Manufacturer: ACCUPLUS
Model Number: I250
Size: N/A
Temp/RH: 23.5°C / 55.0%
Location: Calibration performed at Customer's facility

Serial Number: 0213-0004
Department: N/A
Performed By: JAKRAPONG ARIYACHAT
Received Condition: IN TOLERANCE
Returned Condition: IN TOLERANCE
Cal. Date: October 31, 2024
Cal. Interval: 12 MONTHS
Cal. Due Date: October 31, 2025

Calibration Notes:

Please refer to the attached Calibration Report (3 pages)

Standards Used to Calibrate Equipment

I.D.	Description	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
EOG187	DATA ACQUISITION SWITCH UNIT	34970A	N/A	AGILENT	Mar 13, 2025	5523631030779300 / MP-T11

Procedures Used in this Event

Procedure Name	Description
THAI LAB ACC G-20	Guidelines for Calibration and Checks of Temperature Controlled Enclosures Publication Reference

Calibrating Technician:

JAKRAPONG ARIYACHAT

QC Approval:

PADUNG SRASUAY

STATEMENT OF PASS OR FAIL CONFORMANCE: The uncertainty of measurement has been taken into account when determining compliance with specification. All measurements and their results passed based on the probability of false accept does not exceed 5% in compliance with ANSI/NCSL Z540-3:2006

THE CALIBRATION REPORT STATE:

PASS: The test and/or measurement complies with specification and the measurement result is PASS.
PASS?: The test and/or measurement complies with specification and the measurement result is PASS.
However, a portion of the expanded uncertainty of measurement at 95% exceeds the specified tolerance.
FAIL?: The test and/or measurement complies with specification and the measurement result is PASS.
However, a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.
FAIL: The test and/or measurement does not comply with specification and the measurement result is FAIL.

The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a normal distribution corresponds to a coverage probability of approximately 95% (within of reference stated).
The calibration report complies with ISO/IEC 17025:2017 and ANSI/NCSL Z540-3:2006, Method 4 -- Guard Bands Based on Test Uncertainty Ratio.

and the expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a normal distribution corresponds to a coverage probability of approximately 95% (within of reference stated).

Page 1 of 1

(CERT, Rev B)

Calibration Report of Accuplus I250 Incubator

MPC Control #:	EV3705	Serial Number:	0213-0004
Asset ID:	WL-INC/02	Calibration Date:	October 31, 2024

Measurement Results

Section 1 : Temperature Distribution

Temperature @ 20 °C

Sensor No.	UUC Setting (°C)	Lower Limit (°C)	STD Reading (°C)		Upper Limit (°C)	Result	Uncertainty (°C)
			As Found	As Left			
Sensor#1	20.00	19.00	19.71	19.71	21.00	PASS	± 0.35
Sensor#2	20.00	19.00	19.70	19.70	21.00	PASS	± 0.35
Sensor#3	20.00	19.00	19.75	19.75	21.00	PASS	± 0.35
Sensor#4	20.00	19.00	19.80	19.80	21.00	PASS	± 0.35
Sensor#5	20.00	19.00	19.82	19.82	21.00	PASS	± 0.35
Sensor#6	20.00	19.00	19.77	19.77	21.00	PASS	± 0.35
Sensor#7	20.00	19.00	19.73	19.73	21.00	PASS	± 0.35
Sensor#8	20.00	19.00	19.77	19.77	21.00	PASS	± 0.35
Sensor#9	20.00	19.00	19.71	19.71	21.00	PASS	± 0.35

Temperature @ 29 °C

Sensor No.	UUC Setting (°C)	Lower Limit (°C)	STD Reading (°C)		Upper Limit (°C)	Result	Uncertainty (°C)
			As Found	As Left			
Sensor#1	29.00	28.00	28.45	28.45	30.00	PASS	± 0.35
Sensor#2	29.00	28.00	28.50	28.50	30.00	PASS	± 0.35
Sensor#3	29.00	28.00	28.51	28.51	30.00	PASS	± 0.35
Sensor#4	29.00	28.00	28.52	28.52	30.00	PASS	± 0.35
Sensor#5	29.00	28.00	28.47	28.47	30.00	PASS	± 0.35
Sensor#6	29.00	28.00	28.45	28.45	30.00	PASS	± 0.35
Sensor#7	29.00	28.00	28.50	28.50	30.00	PASS	± 0.35
Sensor#8	29.00	28.00	28.42	28.42	30.00	PASS	± 0.35
Sensor#9	29.00	28.00	28.47	28.47	30.00	PASS	± 0.35

Page 1 of 3

Calibration Report of Accuplus I250 Incubator

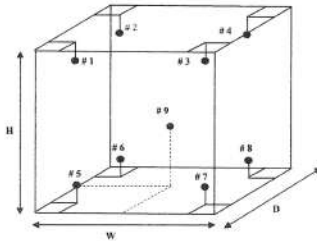
MPC Control #:	EV3705	Serial Number:	0213-0004
Asset ID:	WL-INC/02	Calibration Date:	October 31, 2024

Section 2 : Chamber Performance

Setting Temp (°C)	Indicating Temp (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
20.0	20.0	0.36	0.57	1.15
29.0	29.0	0.21	0.32	0.66

Accuracy By : Customer Specification $\pm 1^{\circ}\text{C}$

Sensor Installation Location



Calibration Report of Accuplus I250 Incubator

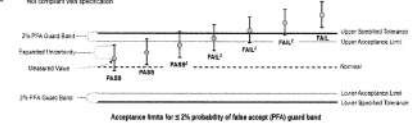
MPC Control #:	EV3705	Serial Number:	0213-0004
Asset ID:	WL-INC/02	Calibration Date:	October 31, 2024

Statements of Pass or Fail Conformance

The uncertainty of measurement has been taken into account when determining compliance with specification.
All measurements and test results passed to ensure the probability of false-accept does not exceed 2% in accordance with ANSI/NCSL Z540-3:2006.

The status of compliance with the acceptance criteria is reported as:

PASS	Compliant with specification
PASS?	The measured value is within acceptance limits. However, a portion of the expanded uncertainty of measurement at 95% exceeds the specified tolerance.
FAIL?	The measured value is not within the acceptance limits. However, a portion of the expanded uncertainty of measurement at 95% is within the specified tolerance.
FAIL	Not compliant with specification



The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%, unless otherwise stated.
The calibration report complies with ISO/IEC 17025:2017 and ANSI/NCSL Z540-3:2006, Method A – Guard Bands Based on Test Uncertainty Ratio.

End of Calibration Report

MICRO PRECISION CALIBRATION LABORATORY (THAILAND) CO., LTD.
413 BONGSTREET ROAD, TAMBOL, BANPODCHAMPHONG PHRACHIN, NONTABURI 11122 THAILAND
66 2 593 8854

Certificate of Calibration



Cert No. 5523631031354570

Date: Nov 7, 2024

Customer:
DOUBLE A (1991) PUBLIC COMPANY LIMITED
1 MOO2 KLONGRUNG-PRACHINBURI ROAD
THATOOM, SRIRMAHAPHOT
PRACHINBURI PRACHINBURI 25140

Work Order #: THAI-32268995

MPC Control #: EV3398
Asset ID: WL-TMM/01
Gage Type: THERMOMETER
Manufacturer: PRECISION
Model Number: N/A
Size: N/A
Temp/RH: 23.0°C / 50.0%
Location: Calibration performed at MPC facility

Serial Number: 19009
Department: N/A
Performed By: KHOMSAN SAENGKAEW
Received Condition: OPERATIONAL
Returned Condition: REPORT OF VALUE
Cal. Date: November 06, 2024
Cal. Interval: 12 MONTHS
Cal. Due Date: November 06, 2025

Calibration Notes:

The user shall determine the suitability of the equipment for its intended use. The calibration status is defined as Report of Value.
Please refer to the attached Calibration Report (1 page)

Standards Used to Calibrate Equipment

I.D.	Description	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
AS9541	PLATINUM RESISTANCE THERMOMETER	182C	957	ROSEMOUNT ANALYTICAL INC.	Jun 3, 2026	552363103124625 1 / MP-GV

Procedures Used in this Event

Procedure Name	Description
MPC-TEM-001	Temperature Sensors, Indicators, and Controlled Unenclosed Temperature Devices, Rev.07, May-17-2024

Calibrating Technician:

Khomsan S.
KHOMSAN SAENGKAEW

QC Approval:

Padung Srasuay
PADUNG SRASUAY

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with GUM: Publication and NIST Technical Note 1297, 1994 Edition. Services rendered comply with ISO/IEC 17025:2017, ANSI/NCSL Z540-1:1994, ANSI/NCSL Z540-3:2006, MPC Quality Manual, MPC CSD and with customer purchase order instructions.

Calibration cycles and resulting due dates were submitted/approved by the customer. Any number of factors may cause an instrument to drift out of tolerance before the next scheduled calibration. Recalibration cycles should be based on frequency of use, environmental conditions and customer's established systematic accuracy. The information on this report, pertains only to the instrument identified.

All standards are traceable to SI through the National Institute of Standards and Technology (NIST) and/or recognized national or international standards laboratories. Services rendered include proper manufacturer's service instruction and are warranted for no less than thirty (30) days. This report may not be reproduced in part or in whole without the prior written approval of the issuing MPC lab.

Calibration Report of Precision Thermometer

MPC Control #:	EV3398	Serial Number:	19009
Asset ID:	WL-TMM/01	Calibration Date:	November 6, 2024

Measurement Results

STD Setting (°C)	LUUC Reading (°C)		Correction (°C)	Uncertainty (°C)
	As Found	As Left		
0.00	0	0	0.00	± 0.047
50.00	50	50	0.00	± 0.049
100.00	100	100	0.00	± 0.049

LUUC : Unit Under Calibration, Immersion Type : Total Immersion

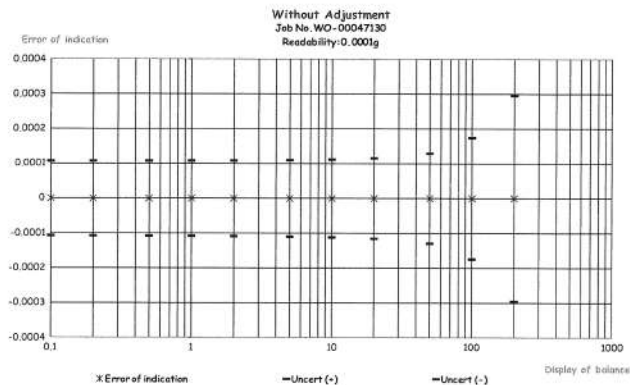
The user shall determine the suitability of the equipment for its intended use. The calibration status is defined as Report of Value.

The expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%, unless otherwise stated.

End of Calibration Report

Page 1 of 1

CAI-FM-C01-14 12 Sep 2022



ใบตรวจสอบสภาพเครื่องชั่ง

ชนิดเครื่องมือ: Balance

รุ่น: BSA224S-CW

เลขที่ใบงาน: WO-00047130

หมายเลขเครื่อง: 34490341

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
30 Oct 2024			30 Oct 2024		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
General					
☒	☐	1. สายไฟ/Adapter, power supply 220/110V	☒	☐	
☒	☐	2. ความสมบูรณ์ชุดกระถังกันชน (Cover)	☒	☐	
☒	☐	3. ความสมบูรณ์ชุดของระดับน้ำ	☒	☐	
☒	☐	4. การปรับระดับของขาตั้งเครื่อง	☒	☐	
☒	☐	5. การทดสอบของเบรค	☒	☐	
☒	☐	6. ความสมบูรณ์ของ Display	☒	☐	
☒	☐	7. การแสดงผลของ Display หลังวางน้ำหนัก	☒	☐	
☒	☐	8. ชุดรองจานชั่ง (Stopper) / pan support	☒	☐	
☒	☐	9. การทำงานของ Function Internal / External	☒	☐	
☒	☐	10. ความสะอาดของตัวเครื่องภายนอกและถาด load cell	☒	☐	
☒	☐	11. สภาวะแวดล้อม สถานที่ตั้งเครื่อง	☒	☐	

หมายเหตุเพิ่มเติม/ข้อแนะนำ :

Mr. Piyapat Saidoung
Service Engineer

บริษัท ดีเคเอสเอ เอเชีย (ไทย) จำกัด
DKSH Technology Limited
2533 หมู่ 9 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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Certificate of Calibration

Equipment: SPECTROPHOTOMETER Certificate No.: C06240473
Model: DR3900 Issued Date: 06 November 2024
Serial No. (or ID.): 1918120 Job No.: WO-00047130
Manufacturer: HACH Page: 1 of 3
Condition: In Condition

Customer: Integrated Research Center Co.,Ltd. (Pulp Laboratory)
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition: Temperature 24.8 °C ± 0.2 °C
Humidity 67.2 %RH ± 1.7 %RH

Calibration Place: Double A (1991) Public Company Limited. (Water Laboratory IP1)
1 Moo 2, Thatoom, Srimahaphot,
Prachinburi 25140 Thailand.

Calibration By: Mr.Piyapat Saidoung
Calibration Date: 29 October 2024
The Method used: In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04
Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Starna Scientific Limited.
The standard for Wavelength Certificate No. 121284 and 121285
The standard for Photometric Certificate No. 121289
The standard for Stray light Certificate No. 121282

(Mr. Piyapat Saidoung)
Person in charge

(Miss Kaewkan Suradech)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.
GfE: 19/10/2024
DKSH Technology Limited
2533 หมู่ 9 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C06-16; 11 Mar 2024

Calibration Results:
Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 5 nm and UUC at 5 nm				
Standard Wavelength	Unit Under Calibration	Correction	Uncertainty	
418.40	418.0	0.40	0.13	
459.30	459.0	0.30	0.13	
638.00	638.0	0.00	0.13	
585.56	586.0	-0.44	0.13	
747.61	748.0	-0.39	0.13	
807.04	807.0	0.04	0.13	
Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5895	0.588	0.0015	0.0045
	0.7610	0.761	0.0000	0.0045
	1.0253	1.023	0.0023	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.5783	0.578	0.0003	0.0045
	0.7430	0.743	0.0000	0.0045
	1.0022	1.000	0.0022	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.5280	0.530	-0.0020	0.0045
	0.6851	0.687	-0.0019	0.0045
	0.9509	0.952	-0.0011	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5446	0.545	-0.0004	0.0045
	0.6932	0.695	-0.0018	0.0045
	0.9952	0.995	0.0002	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5824	0.582	0.0004	0.0045
	0.7208	0.721	-0.0002	0.0045
	1.0917	1.090	0.0017	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.5660	0.566	0.0000	0.0045
	0.6662	0.668	0.0002	0.0045
	1.0846	1.084	0.0006	0.0045

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DKSH Technology Limited
2533 หมู่ 9 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C06-16; 11 Mar 2024

Calibration Results:
Without Adjustment

Stray light *	Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%T)	Absorbance (A)
	391.57 +/- 0.11 nm	392	3.9	1.409

* Calibration Marked "Not TISI Accredited" in this Certificate have been included for completeness.

The End of Certificate

บริษัท ดีเคเอสเอช ประเทศไทย จำกัด
DKSH Technology Limited
2533 สุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
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CAL-FM-C06-16; 11 Mar 2024

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00047130

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR3900

หมายเลขเครื่อง: 1918120

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
29 Oct 2024			29 Oct 2024		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
☒	☐	1. ความสมบูรณ์เครื่อง	☒	☐	
☒	☐	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	☒	☐	
☒	☐	3. สวิตช์ ปิด – เปิด เครื่อง (On-Off Switch)	☒	☐	
☒	☐	4. ปุ่มกด (Keypad)	☒	☐	
☒	☐	5. หน้าจอ (Display, Screen Contrast)	☒	☐	
		Spectrophotometer			
☐	☐	6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC	☐	☐	
☐	☐	7. ควบคุมแสงความยาวคลื่น (Wavelength Control)	☐	☐	
☒	☐	8. ความยาวคลื่น (Wavelength Check)	☒	807nm=807.2nm	
☐	☐	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	☐	☐	
☒	☐	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	☒	☐	
☐	☐	11. ขอรัดหลายตัวอย่าง (Carousel Module)	☐	☐	
		pH Meter and Conductivity Meter			
☐	☐	12. อิเล็กโทรด (Electrode and Connection Cable)	☐	☐	
☐	☐	13. ระดับสารละลายใน Electrode (Level KCl)	☐	☐	
☐	☐	14. ฝาปิดกันละออง Electrode (Dust Protection Hood)	☐	☐	
☐	☐	15. ขาจับยึดอิเล็กโทรด (Stand)	☐	☐	
		Turbidimeter			
☐	☐	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	☐	☐	
☐	☐	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่นเกิน 3.0)	☐	☐	
		Automatic titrator			
☐	☐	18. สลัก Piston Burettes	☐	☐	
☐	☐	19. Function Rinsing and Dosing	☐	☐	
☐	☐	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	☐	☐	

เพิ่มเติมข้อมูลนำเข้า :

Mr.Piyapat Saidoung
Service Engineer

บริษัท ดีเคเอสเอช ประเทศไทย จำกัด
DKSH Technology Limited
2533 สุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Phraekhong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-R31-03; 20 Jul 2022



Certificate of Calibration

Equipment:	SPECTROPHOTOMETER	Certificate No.:	C06240474
Model:	DR3900	Issued Date:	06 November 2024
Serial No. (or ID.):	2006400	Job No.:	WO-00047130
Manufacturer:	HACH	Page:	1 of 3
Condition:	In Condition		

Customer: Integrated Research Center Co.,Ltd. (Pulp Laboratory)
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition:	Temperature	23.4	°C	±	0.3	°C
	Humidity	68.2	%RH	±	0.4	%RH

Calibration Place: Double A (1991) Public Company Limited. (Water Laboratory IP1)
1 Moo 2, Thatoom, Srimahaphot,
Prachinburi 25140 Thailand.

Calibration By: Mr.Piyapat Saidoung
Calibration Date: 29 October 2024
The Method used: In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04
Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Starna Scientific Limited.

The standard for Wavelength Certificate No. 121284 and 121285
The standard for Photometric Certificate No. 121289
The standard for Stray light Certificate No. 121282

(Mr. Piyapat Saidoung)
Person in charge

(Miss Kaewkan Suradech)
Authorized signatory

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

บริษัท ดีเคเอสเอช ประเทศไทย จำกัด
DKSH Technology Limited
2533 สุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Phraekhong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C06-16; 11 Mar 2024

Calibration Results:
Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 5 nm and UUC at 5 nm				
Standard Wavelength	Unit Under Calibration	Correction	Uncertainty	
418.40	418.0	0.40	0.13	
459.30	459.0	0.30	0.13	
638.00	638.0	0.00	0.13	
585.56	586.0	-0.44	0.13	
747.61	748.0	-0.39	0.13	
807.04	807.0	0.04	0.13	
Photometric Accuracy (Absorbance)				
Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5895	0.588	0.0015	0.0045
	0.7610	0.759	0.0020	0.0045
	1.0253	1.022	0.0033	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.5783	0.577	0.0013	0.0045
	0.7430	0.741	0.0020	0.0045
	1.0022	0.999	0.0032	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.5280	0.529	-0.0010	0.0045
	0.6851	0.686	-0.0009	0.0045
	0.9509	0.951	-0.0001	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5446	0.544	0.0006	0.0045
	0.6932	0.694	-0.0008	0.0045
	0.9952	0.994	0.0012	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5824	0.582	0.0004	0.0045
	0.7208	0.721	-0.0002	0.0045
	1.0917	1.090	0.0017	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.5660	0.565	0.0010	0.0045
	0.6882	0.686	0.0002	0.0045
	1.0846	1.084	0.0006	0.0045

บริษัท ดีเคเอสเอช ประเทศไทย จำกัด
DKSH Technology Limited
2533 สุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Phraekhong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C06-16; 11 Mar 2024

Calibration Results:
Without Adjustment

Stray light *	Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%T)	Absorbance (A)
	391.57 +/- 0.11 nm	392	4.6	1.337

* Calibration Marked * Not TISI Accredited * in this Certificate have been included for completeness.

The End of Certificate

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Phraekhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C06-16: 11 Mar 2024

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00047130

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR3900

หมายเลขเครื่อง: 2008400

ตรวจสอบ (รับ)		รายการตรวจเช็ค		ตรวจสอบ (ส่ง)		หมายเหตุ
29 Oct 2024				29 Oct 2024		
ปกติ	ไม่ปกติ			ปกติ	ไม่ปกติ	
General						
☒	☐	1. ความสมบูรณ์เครื่อง		☒	☐	
☒	☐	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายในนอกเครื่อง)		☒	☐	
☒	☐	3. สวิตช์ ปิด – เปิด เครื่อง (On-Off Switch)		☒	☐	
☒	☐	4. ปุ่มกด (Keypad)		☒	☐	
☒	☐	5. หน้าจอ (Display, Screen Contrast)		☒	☐	
Spectrophotometer						
☐	☐	6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC		☐	☐	
☐	☐	7. ความแม่นยำความยาวคลื่น (Wavelength Control)		☐	☐	
☒	☐	8. ความยาวคลื่น (Wavelength Check)		☒	☐	807nm=806.7nm
☐	☐	9. แหล่งกำเนิดแสง (UV < 3,000 hour)		☐	☐	
☒	☐	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)		☒	☐	
☐	☐	11. ช่องวัดหลายตัวอย่าง (Carousel Module)		☐	☐	
pH Meter and Conductivity Meter						
☐	☐	12. ขั้ววัดโทรด (Electrode and Connection Cable)		☐	☐	
☐	☐	13. ระดับสารละลายใน Electrode (Level KCl)		☐	☐	
☐	☐	14. ฝาปิดกันฝุ่น Electrode (Dust Protection Hood)		☐	☐	
☐	☐	15. ขาจับขั้ววัดโทรด (Stand)		☐	☐	
Turbidimeter						
☐	☐	16. ค่าความขุ่นที่ต่ำสุด (No Sample)		☐	☐	
☐	☐	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่นเกิน 3.0)		☐	☐	
Automatic titrator						
☐	☐	18. สภาพ Piston Burettes		☐	☐	
☐	☐	19. Function Rinsing and Dosing		☐	☐	
☐	☐	20. ระบบทอสายยางและอุปกรณ์ประกอบ		☐	☐	

เพิ่มเติมข้อมูล:

Mr.Piyapat Saidoung
Service Engineer

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Phraekhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-R31-03: 20 Jul 2022

Certificate of Calibration

Certificate No.: C07240536 Page 2 of 3



Equipment: pH METER
Model: SevenGo S2
Serial No. (or ID.): B63386757
Manufacturer: Mettler Toledo
Electrode Serial No.: 3474864
Condition: In Condition

Certificate No.: C07240536
Issued Date: 6 November 2024
Job No.: WO-00047130
Page: 1 of 3
Model: InLabExpertGo-ISM Brand: Mettler Toledo

Customer: Integrated Research Center Co.,Ltd. (Pulp Laboratory)
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition: Temperature 24.7 °C ± 0.1 °C
Humidity 65.6 %RH ± 0.2 %RH

Calibration Place: Double A (1991) Public Company Limited. (Water Laboratory IP1)
1 Moo 2, Thatoom, Srimahaphot,
Prachinburi 25140 Thailand.

Calibration By: Mr.Piyapat Saidoung

Calibration Date: 30 October 2024

The Method used: In house method, CAL-WI-58, base on ASTM E 70-07

Traceability: This certificate is traceable to SI Units. Sample Test is assured through primary measurement method Hamed cell, through CPAchem Ltd. (ISO/IEC 17034) Certificate No. 980701, 980704, 938378 And pH scale traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through Industrial Foundation Electrical and Electronics Institute Certificate No. CA20240349EA

(Mr. Piyapat Saidoung)
Person in charge

(Miss Kaewkan Suradech)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
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DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Phraekhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C07-14: 9 Apr 2024

Calibration Results:

pH Scale

Input	pH Meter Reading			Uncertainty of Measurement (mV)	Coverage Factor (k)
	(mV)	Error (mV)	(pH)		
414.12	414	-0.12	0.02	0.58	2.00
354.96	355	0.04	1.02	0.58	2.00
295.8	295	-0.80	2.02	0.58	2.00
236.64	236	-0.64	3.02	0.58	2.00
177.48	177	-0.48	4.01	0.58	2.00
118.32	118	-0.32	5.00	0.58	2.00
59.16	60	0.84	6.00	0.58	2.00
0	0	0.00	7.00	0.58	2.00
-59.16	-59	0.16	8.00	0.58	2.00
-118.32	-118	0.32	9.00	0.58	2.00
-177.48	-177	0.48	10.01	0.58	2.00
-236.64	-236	0.64	11.01	0.58	2.00
-295.8	-295	0.80	12.02	0.58	2.00
-354.96	-355	-0.04	13.03	0.58	2.00
-414.12	-414	0.12	14.03	0.58	2.00

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Phraekhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C07-14: 9 Apr 2024

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00047130

Practical slope and zero point*

The three-point calibration using three standard buffer solutions; pH 4.008 , pH 6.986 and pH 9.997
-During calibration, display of pH meter reading; pH 4.01 , pH 7.00 and pH 10.01
The practical slope of the pH electrode; 58.34 (mV/pH), 98.61%
The zero point of the pH electrode; 7.12 (pH)

Sample Test Results

Standard Buffer Solution (pH)	Unit Under Calibration (pH)	Difference (pH)	Uncertainty of Measurement (pH)	Coverage Factor (k)
4.008	4.01	0.002	0.0079	2.00
6.986	7.00	0.014	0.010	2.00
9.997	10.01	0.013	0.014	2.00

* Calibration Marked * Not TISI Accredited * in this Certificate have been included for completeness.

The End of Certificate

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2533 Sukhumvit Road, Bangkok, Phra Khanong, Bangkok 10260
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Delivering Growth - in Asia and Beyond.

CAL-FM-C07-14: 9 Apr 2024

ชนิดเครื่องมือ: pH METER

รุ่น: Seven2Go S2

หมายเลขเครื่อง: B633886757

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
30 Oct 2024			30 Oct 2024		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
General					
☒	☐	1. ความสมบูรณ์เครื่อง	☒	☐	
☒	☐	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	☒	☐	
☒	☐	3. สวิตช์ ปิด – เปิด เครื่อง (On-Off Switch)	☒	☐	
☒	☐	4. ปุ่มกด (Keypad)	☒	☐	
☒	☐	5. หน้าจอ (Display, Screen Contrast)	☒	☐	
Spectrophotometer					
☐	☐	6. แบตเตอรี่ไฟฟ้า (Battery Backup) >= 2.5 VDC	☐	☐	
☐	☐	7. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control)	☐	☐	
☐	☐	8. ความยาวคลื่น (Wavelength Check)	☐	☐	
☐	☐	9. แสงอัลตราไวโอเลต (UV < 3,000 hour)	☐	☐	
☐	☐	10. แสงที่มองเห็น (Visible < 5,000 hour)	☐	☐	
☐	☐	11. ช่องรับหลายตัวอย่าง (Carousel Module)	☐	☐	
pH Meter and Conductivity Meter					
☒	☐	12. อิเล็กโทรด (Electrode and Connection Cable)	☒	☐	
☐	☐	13. ระดับสารละลายใน Electrode (Level KCl)	☐	☐	
☒	☐	14. ฝาปิดกันปลาย Electrode (Dust Protection Hood)	☒	☐	
☐	☐	15. ขาตั้งอิเล็กโทรด (Stand)	☐	☐	
Turbidimeter					
☐	☐	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	☐	☐	
☐	☐	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่นเกิน 3.0)	☐	☐	
Automatic titrator					
☐	☐	18. สภาพ Piston Burettes	☐	☐	
☐	☐	19. Function Rinsing and Dosing	☐	☐	
☐	☐	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	☐	☐	

เพิ่มเติมข้อเสนอแนะ :

Mr.Piyapat Saidoung
Service Engineer

บริษัท ดีเคเอส อีเซีย จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตวัฒนา กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Phra Khanong, Bangkok 10260
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CAL-FM-R31-03: 20 Jul 2022



Certificate of Calibration

Certificate No.: C15241037

Page: 2 of 2

Equipment : Digital Thermometer with Probe

Certificate No. : C15241037

Model : Seven2Go S2

Issued Date : 06 November 2024

Serial No. : B633886757

Job No. : WO-00047130

Manufacturer : Mettler Toledo

Page : 1 of 2

ID No. : -

Condition : In Condition

Customer : Integrated Research Center Co.,Ltd. (Pulp Laboratory)

122 Moo 2, Tambol Thaloem,

Amphur Srimahaphote, Prachinburi 25140 Thailand

Reference standard equipment:

Equipment	Certificate no	Cal. date	Next Cal. date
Digital Thermometer with Probe	QR24-2043	21 August 2024	21 August 2025

Calibration Results:

Without Adjustment

Sensor Type: RTD		Electrode Serial No.: 3474864		Channel: -	
Diameter (mm): 12		Length (mm): 120		Immersion (mm): 110	
Calibrate Point.(°C)	STD. Reading (°C)	UUC. Reading (°C)	Correction of UUC (°C)		Uncertainty (± °C)
25.0	24.961	25.2	-0.239		0.20

The End of Certificate

Environment Condition : Temperature: 30 °C ± 10 °C
Humidity: 55 %RH ± 25 %RH
Voltage: 220 VAC ± 10 %

Calibration Place : Double A (1991) Public Company Limited. (Water Laboratory IP1)
1 Moo 2, Thaloem, Srimahaphot,
Prachinburi 25140 Thailand.

Calibration By : Mr. Piyapat Saidoung

Calibration Date : 30 October 2024

The Method used : In house method, CAL-WI-69, by comparison with standard thermometer

Traceability : This certificate is traceable to the International System of Unit maintained by:
Quality Reborn Co.,Ltd. (QR)

(Mr. Piyapat Saidoung)
Person in charge(Mr. Tweewong Thaitiang)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
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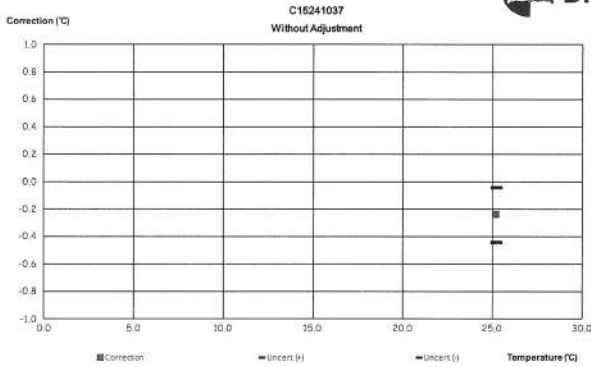
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CAL-FM-C15-14: 06 Dec 2022

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2533 Sukhumvit Road, Bangkok, Phra Khanong, Bangkok 10260
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CAL-FM-C15-14: 06 Dec 2022



ใบตรวจสอบสภาพเครื่องมือวัดอุณหภูมิ

Equipment : Digital Thermometer with Probe
Serial No. : B633886757

Certificate No. : C15241037
Model : Seven2Go S2

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
30-Oct-2024			30-Oct-2024		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
General					
☐	☐	1. สายไฟ	☐	☐	ไม่มี
☐	☐	2. Adapter / Power supply 220 / 110 VAC	☐	☐	ไม่มี
☒	☐	3. การทำงาน Main Switch	☒	☐	
☒	☐	4. การทำงาน Selector Key	☒	☐	
☒	☐	5. การแสดงค่า Display	☒	☐	
☒	☐	6. Battery	☒	☐	
☒	☐	7. สภาพตัวเครื่อง	☒	☐	
☒	☐	8. สภาพ Sensor (In / Ex)	☒	☐	

ข้อเสนอแนะ :

Mr. Piyapat Saidoung
Service Engineer

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DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Prachinburi, Bangkok 10260
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Certificate of Calibration

Certificate No.: C17240184

Page: 2 of 5

Equipment: COD Reactor
Model: DRB200
Serial No. (or ID.): 19070C0337
Manufacturer: Hach
Condition: In Condition
Covers: Open (Max) Locations heating Block: Left and Right

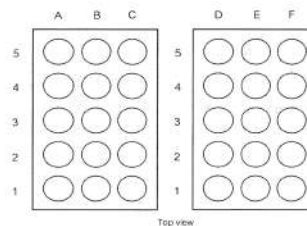
Certificate No.: C17240184
Issued Date: 05 November 2024
Job No.: WO-0047130
Page: 1 of 5

Customer: Integrated Research Center Co., Ltd.
122 Moo 2, Tambol Thathoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

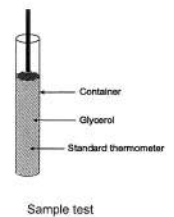
Environment Condition: Temperature: 24 °C ± 0.7 °C
Humidity: 60 %RH ± 5.0 %RH
Voltage: 231 VAC ± 2.2 VAC

Calibration Place: Double A (1991) Public Company Limited. (Water Laboratory IP1)
1 Moo 2, Thathoom, Srimahaphot,
Prachinburi 25140 Thailand.

Calibration By: Mr. Suphanimit Khamnonphoom
Calibration Date: 29 October 2024
The Method used: In house method, CAL-WI-59, base on Direct Measurement with Standard Thermometer
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited.
Certificate No. C10240013



Location of standard



Sample test

Standard Installation Locations

The standard thermometer touches the lower end of the boring

Definitions

- Indicating Temperature:** The average reading of indicating device which forms the integral part of the unit under calibration.
- Measured Temperature:** The average reading of standards at any positions or location.
- Measured Stability:** The one-half of greatest maximum difference of measured temperatures at any one probe.

(Mr. Suphanimit Khamnonphoom)
Person in charge

(Mr. Udon Srithana)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
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2533 Sukhumvit Road, Bangkok, Prachinburi, Bangkok 10260
Phone : +66 2039 7000 Email : info.calibration@dksh.com Website : www.dksh.com/certificatethailand
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CAL-FM-C17-08: 20 Jul 2022

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2533 Sukhumvit Road, Bangkok, Prachinburi, Bangkok 10260
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CAL-FM-C17-08: 20 Jul 2022

Calibration Results:

Pre-Calibration

Locations heating Block:	Setting (°C)	Unit Under Calibration (°C)
Left	150	150
Right	150	150

Location heating Block:	A1	A2	A3	A4	A5
Measured Temperature (°C)	151.35	152.80	152.42	151.74	150.79

Location heating Block:	B1	B2	B3	B4	B5
Measured Temperature (°C)	153.02	151.63	153.12	150.71	151.26

Location heating Block:	C1	C2	C3	C4	C5
Measured Temperature (°C)	153.25	154.09	153.21	152.89	152.97

Location heating Block:	D1	D2	D3	D4	D5
Measured Temperature (°C)	154.68	154.68	153.08	153.12	150.80

Location heating Block:	E1	E2	E3	E4	E5
Measured Temperature (°C)	153.01	152.45	152.84	151.30	150.94

Location heating Block:	F1	F2	F3	F4	F5
Measured Temperature (°C)	151.13	152.61	153.18	150.99	152.40

Calibration Results:

Without Adjustment

Measured temperature at the spread locations:

Locations heating Block:	Setting (°C)	Unit Under Calibration (°C)
Left	150	150
Right	150	150

Location heating Block:	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	149.29	-0.71	0.66
A2	150.77	0.77	0.66
A3	150.40	0.40	0.65
A4	149.73	-0.27	0.65
A5	148.81	-1.19	0.65
B1	151.00	1.00	0.66
B2	149.56	-0.44	0.66
B3	151.12	1.12	0.65
B4	148.76	-1.24	0.65
B5	149.28	-0.72	0.65
C1	151.20	1.20	0.66
C2	152.05	2.05	0.66
C3	151.21	1.21	0.65
C4	150.89	0.89	0.65
C5	151.00	1.00	0.65
D1	152.65	2.65	0.65
D2	152.65	2.65	0.65
D3	151.07	1.07	0.65
D4	151.12	1.12	0.65
D5	148.79	-1.21	0.65
E1	150.97	0.97	0.66
E2	150.44	0.44	0.65
E3	150.81	0.81	0.65
E4	149.32	-0.68	0.65
E5	148.97	-1.03	0.65
F1	149.13	-0.87	0.65
F2	150.59	0.59	0.65
F3	151.15	1.15	0.65
F4	148.99	-1.01	0.65
F5	150.36	0.36	0.66

Characterization of the unit under calibration:

Locations heating Block:	Desired (°C)	Unit Under Calibration (°C)		Measured Temperature (°C)
		Setting	Reading	Stability (±°C)
Left	150	150	150	0.11
Right	150	150	150	0.13

The End of Certificate

ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: WO-00047130

ชนิดเครื่องมือ: COD Reactor

รุ่น: DRB200

หมายเลขเครื่อง: 19070C0337

ตรวจสอบ (วัน)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
☒	☐	1. สายไฟ	☒	☐	
☒	☐	2. การทำงาน Main Switch	☒	☐	
☒	☐	3. การทำงาน Selector Key	☒	☐	
☒	☐	4. การแสดงผล Display	☒	☐	
☒	☐	5. สภาพ Hole	☒	☐	
☒	☐	6. สภาพฝาปิด	☒	☐	
☐	☒	7. สภาพตัวเครื่อง	☐	☒	*
☒	☐	8. สภาวะแวดล้อม ณ สถานที่ตั้งเครื่อง	☒	☐	

ข้อแนะนำ: *สภาพตัวเครื่องมีรอยแตกบริเวณตัวเครื่อง

Mr. Suphanimit Khamnonphoem
Service Engineer

Certificate of Calibration

Equipment: COD Reactor
Model: DRB200
Serial No. (or ID.): 19050C0191
Manufacturer: Hach
Condition: In Condition
Covers: Open (Max) Locations heating Block: Left and Right

Certificate No.: C17240185
Issued Date: 05 November 2024
Job No.: WO-00047130
Page: 1 of 5

Customer: Integrated Research Center Co., Ltd.
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition: Temperature: 24 °C ± 0.7 °C
Humidity: 60 %RH ± 5.0 %RH
Voltage: 231 VAC ± 2.2 VAC

Calibration Place: Double A (1991) Public Company Limited. (Water Laboratory IP1)
1 Moo 2, Thatoom, Srimahaphot,
Prachinburi 25140 Thailand.

Calibration By: Mr. Suphanimit Khamnonphoem
Calibration Date: 29 October 2024
The Method used: In house method, CAL-WI-59, base on Direct Measurement with Standard Thermometer
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited.
Certificate No. C10240013

(Mr. Suphanimit Khamnonphoem)
Person in charge

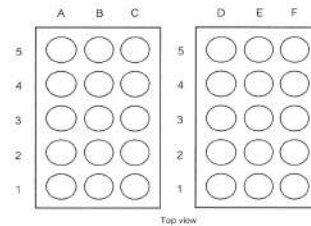
(Mr. Udon Srichana)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor ($k=2$) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
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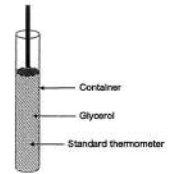
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CAL-FM-C17-08: 20 Jul 2022



Location of standard



Sample test

Standard Installation Locations

The standard thermometer touches the lower end of the boring

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the unit under calibration.
Measured Temperature: The average reading of standards at any positions or location.
Measured Stability: The one-half of greatest maximum difference of measured temperatures at any one probe.

Calibration Results:

Pre-Calibration

Locations heating Block:	Setting (°C)	Unit Under Calibration (°C)
Left	150	150

Location heating Block:	A1	A2	A3	A4	A5
Measured Temperature (°C)	151.75	150.99	151.10	151.04	150.79

Location heating Block:	B1	B2	B3	B4	B5
Measured Temperature (°C)	152.46	151.03	152.21	151.03	151.05

Location heating Block:	C1	C2	C3	C4	C5
Measured Temperature (°C)	151.41	152.96	152.96	152.22	151.47

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DKSH Technology Limited
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Delivering Growth - In Asia and Beyond.

CAL-FM-C17-08: 20 Jul 2022

Calibration Results:

Without Adjustment

Measured temperature at the spread locations:

Locations heating Block:	Setting (°C)	Unit Under Calibration (°C)
Left	150	150
Right	150	150

Location heating Block:	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	149.69	-0.31	0.66
A2	148.90	-1.10	0.66
A3	148.97	-1.03	0.66
A4	148.92	-1.08	0.66
A5	148.73	-1.27	0.66
B1	150.43	0.43	0.66
B2	148.95	-1.05	0.66
B3	150.11	0.11	0.66
B4	148.97	-1.03	0.66
B5	148.97	-1.03	0.66
C1	149.36	-0.64	0.66
C2	150.93	0.93	0.66
C3	150.93	0.93	0.66
C4	150.14	0.14	0.65
C5	149.42	-0.58	0.66
D1	150.97	0.97	0.66
D2	151.80	1.80	0.65
D3	153.05	3.05	0.66
D4	150.80	0.80	0.66
D5	149.19	-0.81	0.66
E1	150.85	0.85	0.65
E2	149.43	-0.57	0.66
E3	150.20	0.20	0.67
E4	149.08	-0.92	0.67
E5	149.16	-0.84	0.66
F1	148.97	-1.03	0.69
F2	149.54	-0.46	0.66
F3	149.20	-0.80	0.67
F4	149.17	-0.83	0.68
F5	149.94	-0.06	0.66

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DKSH Technology Limited
2533 สุขุมวิท ถนน, กรุงเทพฯ, ประเทศไทย 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C17-08: 20 Jul 2022

Characterization of the unit under calibration:

Locations heating Block	Desired	Unit Under Calibration (°C)		Measured Temperature (°C)
	(°C)	Setting	Reading	
Left	150	150	150	0.11
Right	150	150	150	0.21

The End of Certificate

ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: WO-00047130

ชนิดเครื่องมือ: COD Reactor

รุ่น: DRB200

หมายเลขเครื่อง: 19050C0191

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
29 Oct 2024			29 Oct 2024		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
☒	☐	1. สายไฟ	☒	☐	
☒	☐	2. การทำงาน Main Switch	☒	☐	
☒	☐	3. การทำงาน Selector Key	☒	☐	
☒	☐	4. การแสดงผล Display	☒	☐	
☒	☐	5. สภาพ Hole	☒	☐	
☒	☐	6. สภาพฝาปิด	☒	☐	
☐	☒	7. สภาพตัวเครื่อง	☐	☒	*
☒	☐	8. สภาพแวดล้อม ณ สถานที่ตั้งเครื่อง	☒	☐	

ข้อแนะนำ : *สภาพตัวเครื่อง มีรอยแตกบริเวณตัวเครื่อง

Mr. Suphanimit Khamnonphoem
Service Engineerบริษัท ดีเคเอส อีเซีย จำกัด
DKSH Technology Limited
2533 หมู่ 2 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Prathanakong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C-17-08: 20 Jul 2022

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DKSH Technology Limited
2533 หมู่ 2 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Prathanakong, Bangkok 10260
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Certificate of Calibration

Certificate No.: C31242209

Page: 2 of 4

Equipment:	Oven	Certificate No.:	C31242209
Model:	ED 115	Issued Date:	05 November 2024
Serial No.(or ID):	950360	Job No.:	WO-00047130
Manufacturer:	Binder	Page:	1 of 4
Condition:	In Condition	Ventilation Valve:	Closed
Shelves(pc.):	2		

Customer: Integrated Research Center Co.,Ltd.
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition:	Temperature:	24 °C ± 0.6 °C
	Humidity:	63 %RH ± 4.5 %RH
	Voltage:	231 VAC ± 2.6 VAC

Calibration Place: Double A (1991) Public Company Limited. (Water Laboratory IP1)
1 Moo 2, Thatoom, Srimahaphot,
Prachinburi 25140 Thailand.

Calibration By: Mr. Suphanimit Khamnonphoem

Calibration Date: 30 October 2024

The Method used: In house method, CAL-WI-16, base on TLAS-G20

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited.
Certificate No. C10240013(Mr. Suphanimit Khamnonphoem)
Person in charge(Mr. Udon Srichana)
Authorized signatory

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

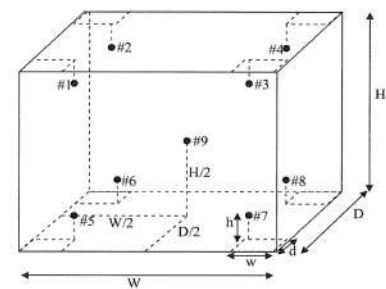
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

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

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2533 Sukhumvit Road, Bangkok, Prathanakong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C31-10: 12 Sep 2022



Standard Installation Locations

Volume (Calibration Zone) = 55 (Liters)

Inside chamber: W = 60 (cm) D = 40 (cm) H = 48 (cm)

Standard Locations (#1, #2, #3, #4): w = 6 (cm) d = 5 (cm) h = 5 (cm)

Standard Locations (#5, #6, #7, #8): w = 6 (cm) d = 5 (cm) h = 5 (cm)

#9: Geometric center of the chamber

Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Channel of Logger	201	202	203	204	205	206	207	208	209

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.**Measured Temperature:** The average reading of standards at any positions or location.**Measured Uniformity:** The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the chamber at steady-state. The reference probe is preferably located in the geometric center of the chamber.**Measured Stability:** The one-half of greatest maximum difference of measured temperatures at any one probe.**Overall Variation:** The difference of maximum and minimum measured temperatures throughout observation time.บริษัท ดีเคเอส อีเซีย จำกัด
DKSH Technology Limited
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2533 Sukhumvit Road, Bangkok, Prathanakong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

Delivering Growth - in Asia and Beyond.

CAL-FM-C31-10: 12 Sep 2022

Calibration Results:

Certificate No.: C31242209 Page: 3 of 4

Pre-Calibration

Setting: 181 Indicating: 181 #1: 178.50 #2: 178.97 #3: 178.64 #4: 178.89 #5: 178.84 #6: 178.97 #7: 178.44 #8: 178.43 #9: 178.26

Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 104 °C

Locations	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
#1	103.92	-0.08	0.67
#2	103.86	-0.14	0.67
#3	104.13	0.13	0.68
#4	104.05	0.05	0.67
#5	103.75	-0.25	0.67
#6	103.82	-0.18	0.75
#7	103.49	-0.51	0.67
#8	103.57	-0.43	0.68
#9	103.83	-0.17	0.67

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
			#1	#2	#3	#4	#5	#6	#7	#8	#9	
104	104	104	103.92	103.86	104.13	104.05	103.75	103.82	103.49	103.57	103.83	0.75

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
104	0.41	0.31	0.88

Note: * Maximum uncertainty of the each position

Without adjustment (Cont.)

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 182 °C

Locations	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
#1	179.50	-2.50	0.71
#2	179.97	-2.03	0.71
#3	179.64	-2.36	0.71
#4	179.89	-2.11	0.74
#5	179.84	-2.16	0.70
#6	179.97	-2.03	0.79
#7	179.44	-2.56	0.70
#8	179.43	-2.57	0.72
#9	179.26	-2.74	0.72

Temperature Distribution

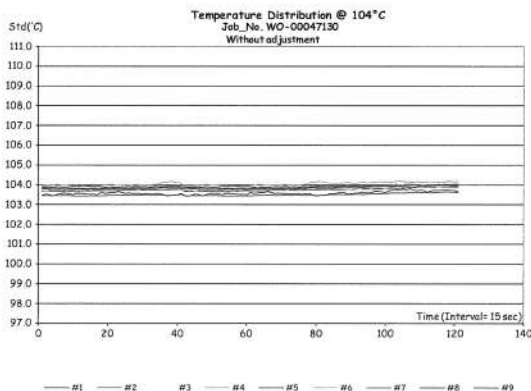
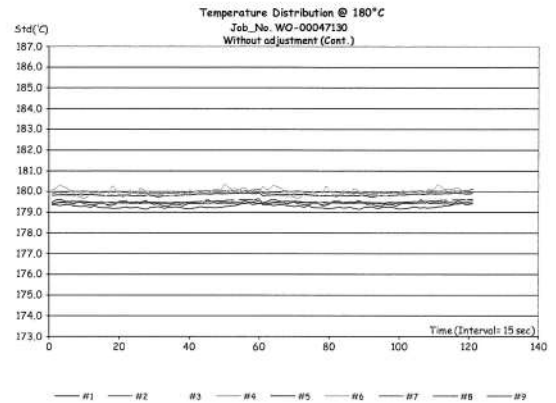
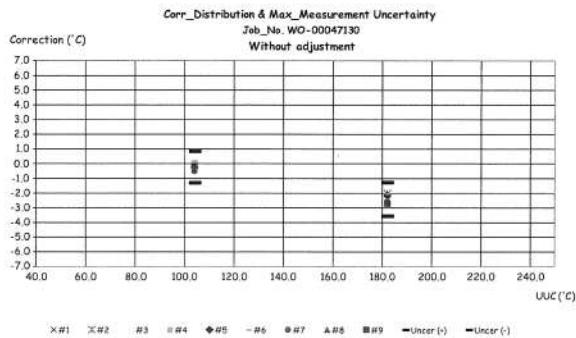
Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
			#1	#2	#3	#4	#5	#6	#7	#8	#9	
180	182	182	179.50	179.97	179.64	179.89	179.84	179.97	179.44	179.43	179.26	0.79

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
182	1.97	0.32	1.18

Note: * Maximum uncertainty of the each position

The End of Certificate



ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: WO-00047130

ชนิดเครื่องมือ: Oven
หมายเลขเครื่อง: 950360

รุ่น: ED 115

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
30 Oct 2024			30 Oct 2024		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
☒	☐	1. สายไฟ	☒	☐	
☒	☐	2. การทำงาน Main Switch	☒	☐	
☒	☐	3. การทำงาน Selector Key	☒	☐	
☒	☐	4. การแสดงผล Display	☒	☐	
☐	☐	5. การทำงาน พัดลม	☐	☐	ไม่มี
☒	☐	6. สภาพ Lever of Ventilation valve	☒	☐	
☒	☐	7. สภาพ Lever door open / close	☒	☐	
☒	☐	8. สภาพ Door seal	☒	☐	
☒	☐	9. การทำงานของระบบ Safety	☒	☐	
☐	☐	10. การทำงานของระบบทำความเย็น	☐	☐	ไม่มี
☐	☐	11. การทำงานของระบบทำความร้อน	☐	☐	ไม่มี
☐	☒	12. สภาพตัวเครื่อง	☐	☒	*
☒	☐	13. สภาพแวดล้อม ณ สถานที่ตั้งเครื่อง	☒	☐	

ข้อแนะนำ : *สภาพตัวเครื่องที่แนกภายในเครื่องโค้งงอ

Mr. Suphanimit Khamnonphoem
Service Engineerบริษัท ดีเคเอสเอ เอเชีย จำกัด
DKSH Technology Limited
2533 หมู่ 9 ถนนสุขุมวิท แขวงคลองตัน เขตคลองเตย กรุงเทพมหานคร 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/calcertific-thailand

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Certificate of Calibration

Equipment: Oven
Model: ED 115
Serial No.(or ID): 20190000012946
Manufacturer: Binder
Condition: In Condition
Shelves(pc.): 2

Certificate No.: C31242210
Issued Date: 05 November 2024
Job No.: WO-00047130
Page: 1 of 4
Ventilation Valve: Closed

Customer: Integrated Research Center Co.,Ltd.
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition: Temperature: 24 °C ± 0.8 °C
Humidity: 63 %RH ± 4.5 %RH
Voltage: 231 VAC ± 2.6 VAC

Calibration Place: Double A (1991) Public Company Limited. (Water Laboratory IP1)
1 Moo 2, Thatoom, Srimahaphot,
Prachinburi 25140 Thailand.

Calibration By: Mr. Suphanimit Khamnonphoem
Calibration Date: 31 October 2024

The Method used: In house method, CAL-WI-16, base on TLAS-G20

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited.
Certificate No. C10240013

(Mr. Suphanimit Khamnonphoem)

Person in charge

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 DKSH Technology Limited.

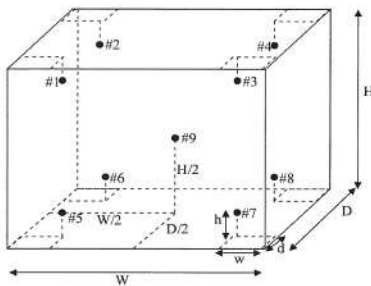
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DKSH Technology Limited
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CAL-FM-C31-10: 12 Sep 2022

Certificate No.: C31242210

Page: 2 of 4



Standard Installation Locations

Volume (Calibration Zone)= 48 (Liters)

Inside chamber: W = 52 (cm) D = 40 (cm) H = 48 (cm)

Standard Locations (#1, #2, #3, #4): w = 5 (cm) d = 5 (cm) h = 5 (cm)

Standard Locations (#5, #6, #7, #8): w = 5 (cm) d = 5 (cm) h = 5 (cm)

#9: Geometric center of the chamber

Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Channel of Logger	301	302	303	304	305	306	307	308	309

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.**Measured Temperature:** The average reading of standards at any positions or location.**Measured Uniformity:** The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the chamber at steady-state. The reference probe is preferably located in the geometric center of the chamber.**Measured Stability:** The one-half of greatest maximum difference of measured temperatures at any one probe.**Overall Variation:** The difference of maximum and minimum measured temperatures throughout observation time.บริษัท ดีเคเอสเอ เอเชีย จำกัด
DKSH Technology Limited
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Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/calcertific-thailand

Delivering Growth - in Asia and Beyond.

CAL-FM-C31-10: 12 Sep 2022

Certificate No.: C31242210

Page: 3 of 4

Calibration Results:

Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 104 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	105.54	1.54	0.82
#2	105.79	1.79	0.82
#3	105.77	1.77	0.82
#4	106.02	2.02	0.82
#5	104.16	0.16	0.82
#6	104.08	0.08	0.87
#7	103.95	-0.05	0.86
#8	103.88	-0.12	0.83
#9	103.93	-0.07	0.83

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
			#1	#2	#3	#4	#5	#6	#7	#8	#9	
104	104	104	105.54	105.79	105.77	106.02	104.16	104.08	103.95	103.88	103.93	0.87

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
104	2.16	0.24	2.35

Note: * Maximum uncertainty of the each position

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DKSH Technology Limited
2533 หมู่ 9 ถนนสุขุมวิท แขวงคลองตัน เขตคลองเตย กรุงเทพมหานคร 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/calcertific-thailand

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CAL-FM-C31-10: 12 Sep 2022

Without adjustment (Cont.)

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 180 °C

Locations	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
#1	180.52	0.52	0.91
#2	181.41	1.41	0.91
#3	180.98	0.98	0.91
#4	181.63	1.63	0.91
#5	180.23	0.23	0.94
#6	180.20	0.20	0.94
#7	179.15	-0.85	0.95
#8	179.03	-0.97	0.96
#9	179.12	-0.88	0.95

Temperature Distribution

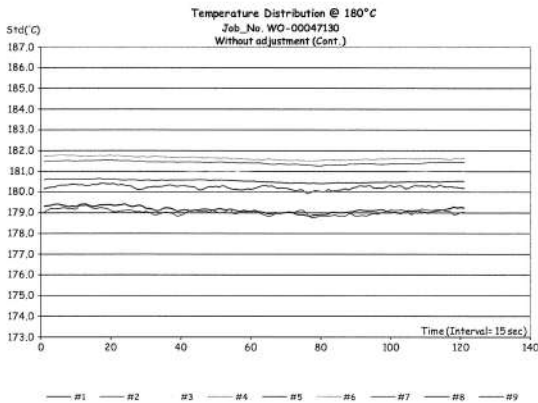
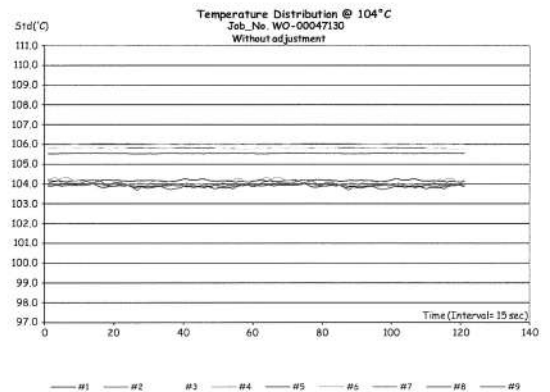
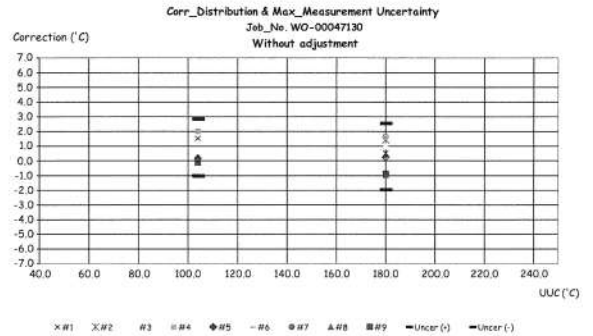
Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty
			#1	#2	#3	#4	#5	#6	#7	#8	#9	(± °C)*
180	180	180	180.52	181.41	180.98	181.63	180.23	180.20	179.15	179.03	179.12	0.96

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
180	2.67	0.29	3.01

Note: * Maximum uncertainty of the each position

The End of Certificate



ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: WO-00047130

ชนิดเครื่องมือ: Oven

รุ่น: ED 115

หมายเลขเครื่อง: 20190000012946

ตรวจสอบ (วัน)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
31 Oct 2024	ปกติ		31 Oct 2024	ปกติ	
		General			
☒	☐	1. สายไฟ	☒	☐	
☒	☐	2. การทำงาน Main Switch	☒	☐	
☒	☐	3. การทำงาน Selector Key	☒	☐	
☒	☐	4. การแสดงผล Display	☒	☐	
☐	☐	5. การทำงาน ฟัดลม	☐	☐	ไม่มี
☒	☐	6. สภาวะ Lever of Ventilation valve	☒	☐	
☒	☐	7. สภาวะ Lever door open / close	☒	☐	
☒	☐	8. สภาวะ Door seal	☒	☐	
☒	☐	9. การทำงานของระบบ Safety	☒	☐	
☐	☐	10. การทำงานของระบบทำความเย็น	☐	☐	ไม่มี
☐	☐	11. การทำงานของระบบทำความร้อน	☐	☐	ไม่มี
☒	☐	12. สภาวะตัวเครื่อง	☒	☐	
☒	☐	13. สภาวะแวดล้อม ณ สถานที่ตั้งเครื่อง	☒	☐	

ขอแนะนำ : _____

Mr. Suphanimit Khamnonphoem
Service Engineer



Certificate of Calibration

Certificate No.: C31242211

Page: 2 of 4

Equipment: Hot Air Oven
Model: UF110
Serial No. (or ID): B417.1014
Manufacturer: Memmert
Condition: In Condition
Shelves(pc.): 2

Certificate No.: C31242211
Issued Date: 05 November 2024
Job No.: WO-00047130
Page: 1 of 4
Ventilation Valve: Closed

Customer: Integrated Research Center Co., Ltd.
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

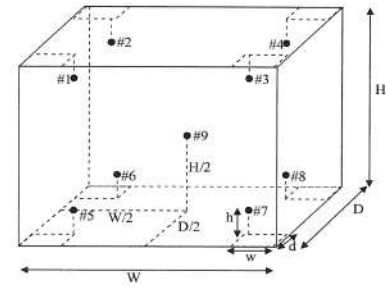
Environment Condition: Temperature: 24 °C ± 0.9 °C
Humidity: 63 %RH ± 4.5 %RH
Voltage: 231 VAC ± 2.6 VAC

Calibration Place: Double A (1991) Public Company Limited. (Water Laboratory IP1)
1 Moo 2, Thatoom, Srimahaphot,
Prachinburi 25140 Thailand.

Calibration By: Mr. Suphanimit Khamnonphoem
Calibration Date: 31 October 2024

The Method used: In house method, CAL-WI-16, base on TLAS-G20

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited.
Certificate No. C10240013



Standard Installation Locations

Volume (Calibration Zone)= 48 (Liters)

Inside chamber: W = 52 (cm) D = 40 (cm) H = 48 (cm)

Standard Locations (#1, #2, #3, #4): w = 5 (cm) d = 5 (cm) h = 5 (cm)

Standard Locations (#5, #6, #7, #8): w = 5 (cm) d = 5 (cm) h = 5 (cm)

#9: Geometric center of the chamber

Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Channel of Logger	101	102	103	104	105	106	107	108	109

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.**Measured Temperature:** The average reading of standards at any positions or location.**Measured Uniformity:** The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the chamber at steady-state. The reference probe is preferably located in the geometric center of the chamber.**Measured Stability:** The one-half of greatest maximum difference of measured temperatures at any one probe.**Overall Variation:** The difference of maximum and minimum measured temperatures throughout observation time.

(Mr. Suphanimit Khamnonphoem)
Person in charge

(Mr. Udon Srichana)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
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2533 Sukhumvit Road, Bangkok, Prachinburi, Bangkok 10260
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CAL-FM-C31-10: 12 Sep 2022

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CAL-FM-C31-10: 12 Sep 2022

Certificate No.: C31242211

Page: 3 of 4

Calibration Results:

Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 104.0 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	104.55	0.55	0.39
#2	104.30	0.30	0.39
#3	104.40	0.40	0.39
#4	103.95	-0.05	0.39
#5	103.70	-0.30	0.39
#6	103.80	-0.20	0.39
#7	103.40	-0.60	0.39
#8	104.49	0.49	0.39
#9	103.84	-0.16	0.39

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
			#1	#2	#3	#4	#5	#6	#7	#8	#9	
104.0	104.0	104.0	104.55	104.30	104.40	103.95	103.70	103.80	103.40	104.49	103.84	0.39

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
104.0	0.76	0.10	1.26

Note: * Maximum uncertainty of the each position

Certificate No.: C31242211

Page: 4 of 4

Without adjustment (Cont.)

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 180.0 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	180.98	0.98	0.59
#2	180.32	0.32	0.60
#3	181.27	1.27	0.60
#4	179.67	-0.33	0.58
#5	179.05	-0.95	0.59
#6	179.19	-0.81	0.59
#7	178.67	-1.33	0.59
#8	179.99	-0.01	0.59
#9	179.34	-0.66	0.59

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
			#1	#2	#3	#4	#5	#6	#7	#8	#9	
180.0	180.0	180.0	180.98	180.32	181.27	179.67	179.05	179.19	178.67	179.99	179.34	0.60

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
180.0	2.07	0.17	2.94

Note: * Maximum uncertainty of the each position

The End of Certificate

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2533 Sukhumvit Road, Bangkok, Prachinburi, Bangkok 10260
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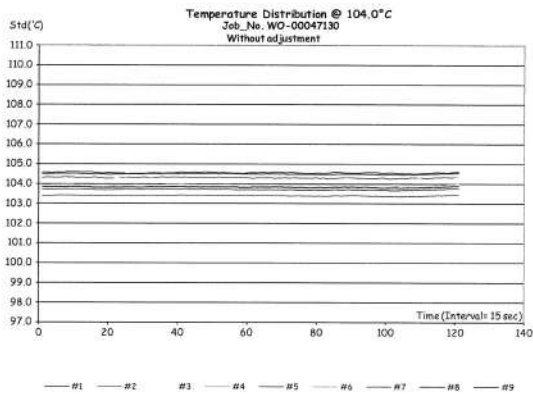
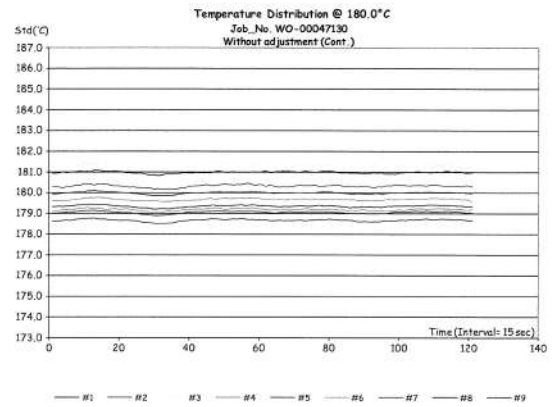
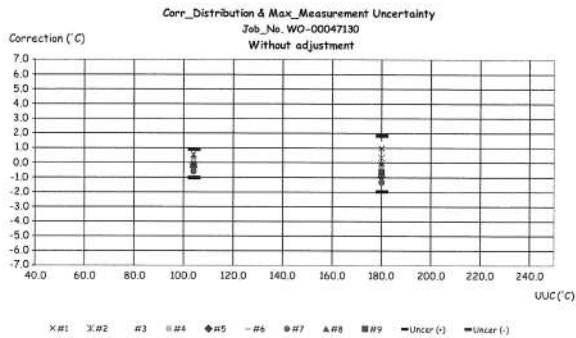
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DKSH Technology Limited
2533 หมู่ 2 ถนนพหลโยธิน แขวงสามเสน กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangkok, Prachinburi, Bangkok 10260
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Certificate of Calibration

ชนิดเครื่องมือ: Hot Air Oven
หมายเลขเครื่อง: B417.1014
เลขที่ใบงาน: WO-00047130
รุ่น: UF110

Equipment: Block Digestion Unit
Model: SC2100-35V240
Serial No. (or ID.): 2021CEP296
Manufacturer: Environmental Express
Condition: In Condition
Certificate No.: C29240033
Issued Date: 05 November 2024
Job No.: WO-00047130
Page: 1 of 4
Digestion Block: 18 holes.

Customer: Integrated Research Center Co., Ltd.
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition: Temperature: 24 °C ± 0.7 °C
Humidity: 60 %RH ± 5.2 %RH
Voltage: 231 VAC ± 2.5 VAC

Calibration Place: Double A (1991) Public Company Limited. (Water Laboratory IP1)
1 Moo 2, Thatoom, Srimahaphot,
Prachinburi 25140 Thailand.

Calibration By: Mr. Suphanimit Khamnonphoom
Calibration Date: 31 October 2024
The Method used: In house method, base on by comparison with standard
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through N.M. Technical Center Laboratory (NTL).
Certificate No.: TC24/0061

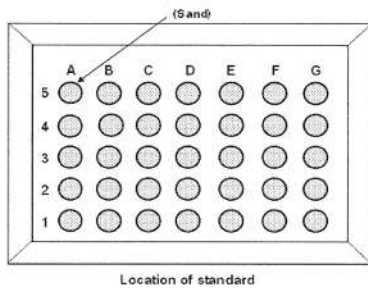
(Mr. Suphanimit Khamnonphoom)
Person in charge

(Mr. Udon Srichana)
Authorized signatory

Mr. Suphanimit Khamnonphoom
Service Engineer

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

Fig. 1.: Top view



Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the Digestion block.

Measured Temperature: The average reading of working standard at any positions or location.

Calibration Results:

Before adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	104.0	104.0	104.0	102.2	-1.8	1.4
A3				102.8	-1.2	1.4
A5				102.4	-1.6	1.4
B2				101.9	-2.1	1.4
B4				101.7	-2.3	1.4
C1				101.9	-2.1	1.4
C3				101.7	-2.3	1.4
C5				102.9	-1.1	1.4
D2				102.7	-1.3	1.4
D4				101.8	-2.2	1.4
E1				102.0	-2.0	1.4
E3				102.1	-1.9	1.4
E5				102.8	-1.2	1.4
F2				103.1	-0.9	1.4
F4				102.9	-1.1	1.4
G1				102.5	-1.5	1.4
G3				101.8	-2.2	1.4
G5				102.2	-1.8	1.4

The End of Certificate

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Calibration Results:

After adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	95.0	95.0	95.0	95.5	0.5	1.4
A3				94.8	-0.2	1.4
A5				96.0	1.0	1.4
B2				94.9	-0.1	1.4
B4				95.1	0.1	1.4
C1				95.0	0.0	1.4
C3				95.0	0.0	1.4
C5				95.4	0.4	1.4
D2				95.2	0.2	1.4
D4				94.9	-0.1	1.4
E1				95.1	0.1	1.4
E3				95.6	0.6	1.4
E5				95.5	0.5	1.4
F2				95.7	0.7	1.4
F4				95.2	0.2	1.4
G1				95.0	0.0	1.4
G3				94.7	-0.3	1.4
G5				94.9	-0.1	1.4

The End of Certificate

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Calibration Results:

After adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	104.0	104.0	104.0	104.2	0.2	1.4
A3				104.8	0.8	1.4
A5				104.4	0.4	1.4
B2				103.9	-0.1	1.4
B4				103.7	-0.3	1.4
C1				103.9	-0.1	1.4
C3				103.7	-0.3	1.4
C5				104.9	0.9	1.4
D2				104.7	0.7	1.4
D4				103.6	-0.2	1.4
E1				104.0	0.0	1.4
E3				104.1	0.1	1.4
E5				104.8	0.8	1.4
F2				105.1	1.1	1.4
F4				104.9	0.9	1.4
G1				104.5	0.5	1.4
G3				103.8	-0.2	1.4
G5				104.2	0.2	1.4

The End of Certificate

ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: WO-00047130

ชนิดเครื่องมือ: Block Digestion Unit

รุ่น: SC2100-35V240

หมายเลขเครื่อง: 2021CEP296

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
31 Oct 2024			31 Oct 2024		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
☒	☐	1. สายไฟ	☒	☐	
☒	☐	2. การทำงาน Main Switch	☒	☐	
☒	☐	3. การทำงาน Selector Key	☒	☐	
☒	☐	4. การแสดงผล Display	☒	☐	
☒	☐	5. สภาพ Hole	☒	☐	
☐	☐	6. สภาพฝาปิด	☐	☐	ไม่มี
☒	☐	7. สภาพตัวเครื่อง	☒	☐	
☒	☐	8. สภาพแวดล้อม ณ สถานที่ตั้งเครื่อง	☒	☐	

รับมอบ :

Mr. Suphanimit Khamnonphoom
Service Engineer

บริษัท ดีเคเอส อีซี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
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Certificate of Calibration

Certificate No.: C29240034

Page: 2 of 3

Equipment: Block Digestion Unit
Model: KT 20s-BS
Serial No. (or ID.): GER5720190108
Manufacturer: Gerhardt
Condition: In Condition
Certificate No.: C29240034
Issued Date: 05 November 2024
Job No.: WO-00047130
Page: 1 of 3
Digestion Block: 20 holes.

Customer: Integrated Research Center Co.,Ltd.
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition: Temperature: 25 °C ± 1.0 °C
Humidity: 65 %RH ± 5.1 %RH
Voltage: 230 VAC ± 2.6 VAC

Calibration Place: Double A (1991) Public Company Limited, (Water Laboratory IP1)
1 Moo 2, Thatoom, Srimahaphot,
Prachinburi 25140 Thailand.

Calibration By: Mr. Suphanimit Khamnonphoem
Calibration Date: 31 October 2024
The Method used: In house method, base on by comparison with standard
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through N.M. Technical Center Laboratory (NTL)
Certificate No.: TC24/0061

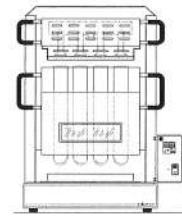
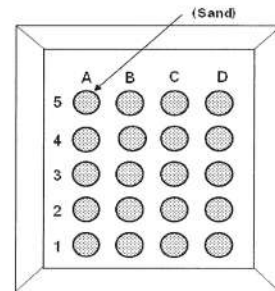


Fig. 1.: Front view



Location of standard

Fig. 2.: Digestion block

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the Digestion block.

Measured Temperature: The average reading of working standard at any positions or location.

(Mr. Suphanimit Khamnonphoem)
Person in charge

(Mr. Udorn Srichana)
Authorized signatory

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Certificate No.: C29240034

Page: 3 of 3

Calibration Results:
Without adjustment

Locations	Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
A1	380	380	380	379.6	-0.4	1.5
A2				380.1	0.1	1.5
A3				381.9	1.9	1.5
A4				382.4	2.4	1.5
A5				382.7	2.7	1.5
B1				380.6	0.6	1.5
B2				382.3	2.3	1.5
B3				382.0	2.0	1.5
B4				379.6	-0.4	1.5
B5				380.4	0.4	1.5
C1				378.3	-1.7	1.5
C2				381.4	1.4	1.5
C3				380.5	0.5	1.5
C4				378.5	-1.5	1.5
C5				379.4	-0.6	1.5
D1				375.6	-4.4	1.5
D2				375.2	-4.8	1.5
D3				379.1	-0.9	1.5
D4				378.7	-1.3	1.5
D5				378.9	-1.1	1.5

The End of Certificate

ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

ชนิดเครื่องมือ: Block Digestion Unit

รุ่น: KT 20s-BS

เลขที่ใบงาน: WO-00047130

หมายเลขเครื่อง: GER5720190108

ตรวจสอบ (วัน)	รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
		31 Oct 2024	31 Oct 2024	
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ	
General				
☑	☐	1. สายไฟ	☑	☐
☑	☐	2. การทำงาน Main Switch	☑	☐
☑	☐	3. การทำงาน Selector Key	☑	☐
☑	☐	4. การแสดงผล Display	☑	☐
☑	☐	5. สภาพ Hole	☑	☐
☐	☐	6. สภาพฝาปิด	☐	☐
☑	☐	7. สภาพตัวเครื่อง	☑	☐
☑	☐	8. สภาวะแวดล้อม ณ สถานที่ตั้งเครื่อง	☑	☐

ข้อแนะนำ :

Mr. Suphanimit Khamnonphoem
Service Engineer

บริษัท ดีเคเอส เอช จำกัด
DKSH Technology Limited
2533 ถนนพหลโยธิน แขวงจตุจักร กรุงเทพมหานคร 10200
2533 Sukhumvit Road, Bangkok, Prachinburi, Bangkok 10200
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2533 Sukhumvit Road, Bangkok, Prachinburi, Bangkok 10200
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Certificate of Calibration

Certificate No.: C31242212

Page: 2 of 3

Equipment: Cooled Incubator
Model: ESCC
Serial No. (or ID): 03021
Manufacturer: OmRon
Condition: In Condition
Shelves(pc.): 9

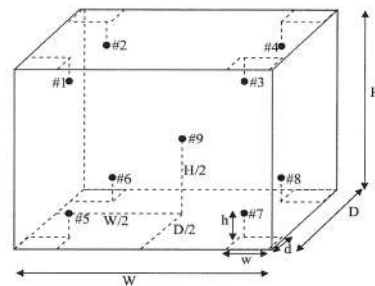
Certificate No.: C31242212
Issued Date: 05 November 2024
Job No.: WO-00047130
Page: 1 of 3
Ventilation Valve: None

Customer: Integrated Research Center Co., Ltd.
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition: Temperature: 24 °C ± 0.3 °C
Humidity: 64 %RH ± 4.3 %RH
Voltage: 231 VAC ± 2.6 VAC

Calibration Place: Double A (1991) Public Company Limited, (Water Laboratory IP1)
1 Moo 2, Thatoom, Srimahaphot,
Prachinburi 25140 Thailand.

Calibration By: Mr. Suphanimit Khamnonphoem
Calibration Date: 30 October 2024
The Method used: In house method, CAL-WI-16, base on TLAS-G20
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited.
Certificate No. C10240013



Standard Installation Locations

Volume (Calibration Zone)= 422 (Liters)

Inside chamber: W = 110 (cm) D = 60 (cm) H = 160 (cm)
Standard Locations (#1, #2, #3, #4): w = 11 (cm) d = 6 (cm) h = 30 (cm)
Standard Locations (#5, #6, #7, #8): w = 11 (cm) d = 6 (cm) h = 30 (cm)

#9: Geometric center of the chamber

Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Channel of Logger	101	102	103	104	105	106	107	108	109

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.**Measured Temperature:** The average reading of standards at any positions or location.**Measured Uniformity:** The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the chamber at steady-state. The reference probe is preferably located in the geometric center of the chamber.**Measured Stability:** The one-half of greatest maximum difference of measured temperatures at any one probe.**Overall Variation:** The difference of maximum and minimum measured temperatures throughout observation time.

(Mr. Suphanimit Khamnonphoem)

Person in charge

This certificate is issued by 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).

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CAL-FM-C31-10: 12 Sep 2022

(Mr. Udon Srichana)

Authorized signatory

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Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C31-10: 12 Sep 2022

Certificate No.: C31242212

Page: 3 of 3

Calibration Results:

Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 20 °C

Locations	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
#1	20.23	0.23	0.67
#2	20.20	0.20	0.68
#3	20.51	0.51	0.66
#4	20.38	0.38	0.66
#5	20.06	0.06	0.77
#6	20.09	0.09	0.70
#7	20.21	0.21	0.73
#8	20.56	0.56	0.67
#9	20.18	0.18	0.73

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
20	20	20	20.23	20.20	20.51	20.38	20.06	20.09	20.21	20.56	20.18	0.77

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
20	0.65	0.38	1.08

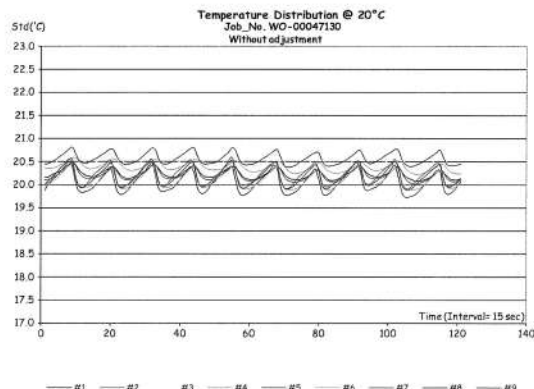
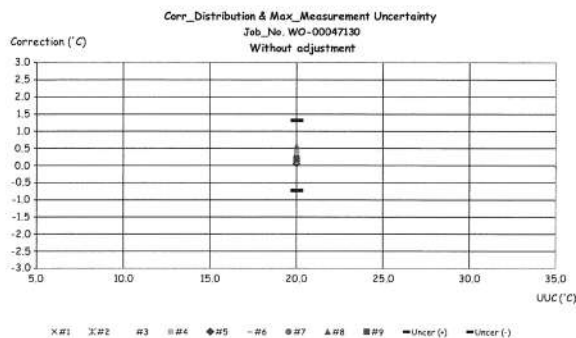
Note: * Maximum uncertainty of the each position

The End of Certificate

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CAL-FM-C31-10: 12 Sep 2022



ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: WO-00047130

ชนิดเครื่อง: Cooled Incubator

รุ่น: E5CC

หมายเลขเครื่อง: 03021

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
30 Oct 2024			30 Oct 2024		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
☒	☐	1. สายไฟ	☒	☐	
☒	☐	2. การทำงาน Main Switch	☒	☐	
☒	☐	3. การทำงาน Selector Key	☒	☐	
☒	☐	4. การแสดงผล Display	☒	☐	
☒	☐	5. การทำงาน พัดลม	☒	☐	
☐	☐	6. สภาพ Lever of Ventilation valve	☐	☐	ไม่มี
☒	☐	7. สภาพ Lever door open / close	☒	☐	
☒	☐	8. สภาพ Door seal	☒	☐	
☒	☐	9. การทำงานของระบบ Safety	☒	☐	
☒	☐	10. การทำงานของระบบทำความเย็น	☒	☐	
☐	☐	11. การทำงานของระบบทำความร้อน	☐	☐	ไม่มี
☒	☐	12. สภาพตู้เครื่อง	☒	☐	
☒	☐	13. สภาวะแวดล้อม ณ สถานที่ตั้งเครื่อง	☒	☐	

ขอแนะนำ:

Mr. Suphanimit Khamnonphoem
Service Engineer

บริษัท ดีเคเอส อีเซีย จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
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Certificate of Calibration

Equipment: Standard Weight
Model: 1 g
Serial No. (or ID.): Weight 001
Manufacturer: LS
Condition: In condition

Certificate No.: C02241986
Issued Date: 5 November 2024
Job No.: WO-00047137
Page: 1 of 2
Class: -

Customer: Integrated Research Center Co.,Ltd. (Pulp Laboratory)
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition: Temperature 22 °C ± 2 °C
Relative Humidity 50 %RH ± 10 %RH
Atmospheric Pressure 980-1030 mbar

Calibration Place: Mass Laboratory, DKSH Technology Limited.
2533 Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260 Thailand

Calibration By: Mr. Anusorn Jitborikhon

Calibration Date: 05 November 2024

The Method used: In house method, CAL-WI-48, base on OIML R111-1

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (Thailand), NIMT through DKSH Technology Limited. Certificate No. C02241860.


(Mr. Anusorn Jitborikhon)
Person in charge


(Miss Saowaruk Klayasuwan)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
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CAL-FA-C02-12: 12 Sep 2022

Certificate No.: C02241986 Page 2 of 2

Calibration Results:

Nominal Value	Marking	Conventional Mass	Uncertainty ($\pm$ mg)	MPE Class ($\pm$ mg)
1 g	None	1 g + 0.046 mg	0.030	0.10 F1

Note: These MPE Class are only conventional mass.

The End of Certificate



Certificate of Calibration

Equipment: Standard Weight
Model: 100 g
Serial No. (or ID.): Weight 002
Manufacturer: LS
Condition: In condition

Certificate No.: C02241987
Issued Date: 5 November 2024
Job No.: WO-00047137
Page: 1 of 2
Class: -

Customer: Integrated Research Center Co.,Ltd. (Pulp Laboratory)
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition: Temperature 22 °C ± 2 °C
Relative Humidity 50 %RH ± 10 %RH
Atmospheric Pressure 980-1030 mbar

Calibration Place: Mass Laboratory, DKSH Technology Limited.
2533 Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260 Thailand

Calibration By: Mr. Anusorn Jitborikhon

Calibration Date: 05 November 2024

The Method used: In house method, CAL-WI-48, base on OIML R111-1

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (Thailand), NIMT through DKSH Technology Limited. Certificate No. C02241860.


(Mr. Anusorn Jitborikhon)
Person in charge


(Miss Saowaruk Klayasuwan)
Authorized signatory

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2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
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2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
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CAL-FA-C02-12: 12 Sep 2022

Calibration Results:

Certificate No.: C02241987

Page 2 of 2

Nominal Value	Marking	Conventional Mass	Uncertainty ($\pm$ mg)	MPE Class ($\pm$ mg)
100 g	None	100 g - 0.08 mg	0.16	0.5 F1

Note: These MPE Class are only conventional mass.

The End of Certificate



Certificate of Calibration

Equipment: Standard Weight
Model: 200 g
Serial No. (or ID.): Weight 003
Manufacturer: LS
Condition: In condition

Certificate No.: C02241988
Issued Date: 5 November 2024
Job No.: WO-00047137
Page: 1 of 2
Class: -

Customer: Integrated Research Center Co., Ltd. (Pulp Laboratory)
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition: Temperature 22 °C $\pm$ 2 °C
Relative Humidity 50 %RH $\pm$ 10 %RH
Atmospheric Pressure 980-1030 mbar

Calibration Place: Mass Laboratory, DKSH Technology Limited.
2533 Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260 Thailand

Calibration By: Mr. Anusorn Jitborikhon
Calibration Date: 05 November 2024
The Method used: In house method, CAL-WI-48, base on OIML R111-1
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (Thailand), NIMT through DKSH Technology Limited. Certificate No. C02241860.

(Mr. Anusorn Jitborikhon)
Person in charge

(Miss Saowanuk Klayasuwan)
Authorized signatory

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Calibration Results:

Certificate No.: C02241988

Page 2 of 2

Nominal Value	Marking	Conventional Mass	Uncertainty ($\pm$ mg)	MPE Class ($\pm$ mg)
200 g	None	200 g - 0.45 mg	0.30	1.0 F1

Note: These MPE Class are only conventional mass.

The End of Certificate



Certificate of Calibration

Equipment: Furnace
Model: CWF 12/5
Serial No. (or ID): 2/96/521
Manufacturer: Carbolite Gero
Condition: In Condition
Voltage type: 230 VAC

Certificate No.: C14240250
Issued Date: 05 November 2024
Job No.: WO-00047130
Page: 1 of 3
Furnace type: Chamber Furnace

Customer: Integrated Research Center Co., Ltd.
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition: Temperature: 25 °C $\pm$ 1.0 °C
Humidity: 65 %RH $\pm$ 4.8 %RH
Voltage: 230 VAC $\pm$ 2.3 VAC

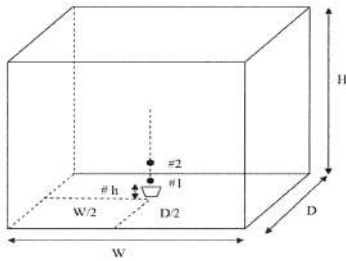
Calibration Place: Double A (1991) Public Company Limited. (Water Laboratory IP1)
1 Moo 2, Thatoom, Srimahaphot,
Prachinburi 25140 Thailand.

Calibration By: Mr. Suphanimit Khamnonphoem
Calibration Date: 30 October 2024
The Method used: In house method, CAL-WI-68, base on BS 4309
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through N.M. Technical center laboratory Co., Ltd. Certificate No. TC24/0061

(Mr. Suphanimit Khamnonphoem)
Person in charge

(Mr. Udon Srichana)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor ($k=2$) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
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Standard Installation Locations

Volume	6	(Liters)	W	D	H
Inside chamber		(cm)	15	26	15
Standard Locations			w/2	d/2	h
#1, #2		(cm)	8	13	4

Note : #1 reference, #2 cross check

Definitions

Indicating Temperature : The temperature indicated by a suitable device installed by the manufacturer or in accordance with his instructions.

Measured Temperature : The arithmetic mean of the average temperature determined over the same specified number of temperature cycles.

Temperature variation : The difference between the mean temperatures at any two points in the working space, determined over the same specified number of temperature cycles.

Temperature fluctuation : The one-half of difference between maximum temperature and minimum temperatures of reference temperature.

Calibration Results:

Before Adjustment

Setting	Indicating	#1	#2
550	550	543.8	542.9

After Adjustment

Measured temperature at the spread locations:

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (±°C)*	Cross check (°C)
550	550	550	550.2	0.2	4.0	549.0

Characterization of the unit under calibration:

Indicating (°C)	Temperature Variation (°C)	Temperature fluctuation (±°C)**
550	1.2	1.1

Note: * Maximum uncertainty of the each position

** Channel 1 is reference temperature.

The End of Certificate

ใบตรวจสอบสภาพเตาเผาควบคุมอุณหภูมิ

เลขที่ใบงาน: WO-00047130

ชนิดเครื่องมือ: Chamber Furnace

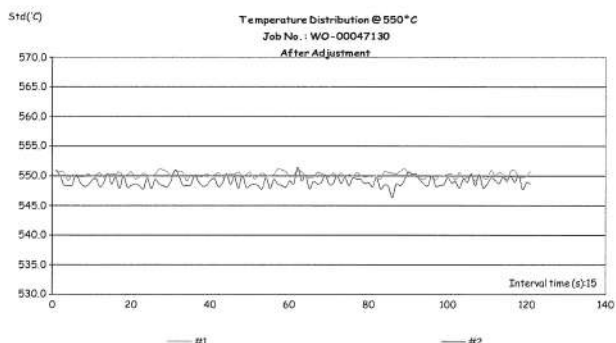
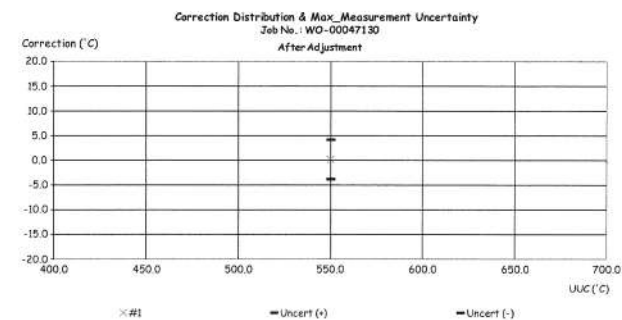
รุ่น: CWF 12/5

หมายเลขเครื่อง: 2/96/521

ตรวจสอบ (วัน)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
30 Oct 2024			30 Oct 2024		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		<i>General</i>			
☒	☐	1. สายไฟ	☒	☐	
☒	☐	2. การทำงาน Main Switch	☒	☐	
☒	☐	3. การทำงาน Selector Key	☒	☐	
☒	☐	4. การแสดงผล Display	☒	☐	
☒	☐	5. สภาพตัวเครื่อง	☒	☐	
☐	☒	6. สภาพผนังภายในตัวเครื่อง	☐	☒	*
☒	☐	7. สภาพประตูเปิด/ ปิดเครื่อง	☒	☐	
☒	☐	8. สภาพแวดล้อม ณ สถานที่ตั้งเครื่อง	☒	☐	

ข้อแนะนำ: *สภาพผนังภายในตัวเครื่องผนังด้านในผุกร่อน

Mr. Suphanimit Khamnonphoom
Service Engineer





Certificate of Calibration

Equipment: Moisture Balance
Model: MA35
Serial No. (or ID.): 26303311
Manufacturer: Sartorius
Condition: In condition

Certificate No.: C01243399
Issued Date: 06 November 2024
Job No.: WO-00047130
Page: 1 of 2

Customer: Integrated Research Center Co.,Ltd.
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition: Temperature 26 °C ± 0.6 °C
Humidity 68 %RH ± 2.4 %RH

Calibration Place: Double A (1991) Public Company Limited. (Water Laboratory IP1)
1 Moo 2, Thatoom, Srimahaphot,
Prachinburi 25140 Thailand.

Calibration By: Mr. Piyapat Saidoung

Calibration Date: 31 October 2024

The Method used: In-house method, CAL-WI-47, based on UKAS Lab 14

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Co., Ltd. Certificate No. C02231944

(Mr. Piyapat Saidoung)
Person in charge

(Mr. Adisai Maknoi)
Authorized signatory

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CAL-FM-C01-14: 12 Sep 2022

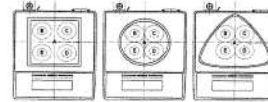
Certificate No.: C01243399

Page: 2 of 2

Calibration Results:

Without Adjustment

Eccentric Error: Weight to be 1/3 or 1/2 of Maximum capacity, taken from the center of the pan as a zero reference.



Nominal Test Value 20 (g)

Reference Points (g)				
A	B	C	D	E
-	0.000	0.000	0.000	0.000

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.001 (g)

Nominal test value (g)	Standard Deviation
2	0.0003
20	0.0004

Error of Indication from nominal or conventional mass value., Readability 0.001 (g)

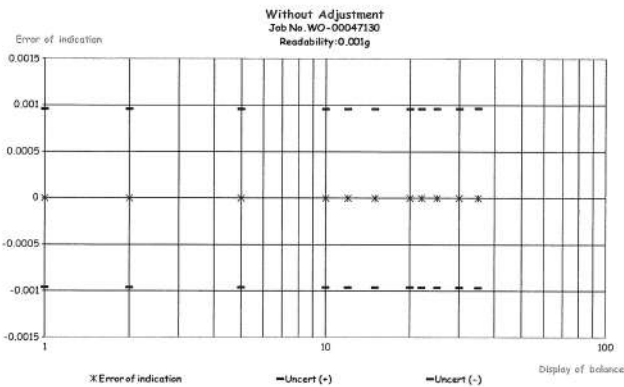
Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
1	1.0000	1.000	0.000	0.00096	2.02
2	2.0000	2.000	0.000	0.00096	2.02
5	5.0000	5.000	0.000	0.00096	2.02
10	10.0000	10.000	0.000	0.00096	2.02
12	12.0000	12.000	0.000	0.00096	2.02
15	15.0000	15.000	0.000	0.00096	2.02
20	20.0000	20.000	0.000	0.00096	2.02
22	22.0000	22.000	0.000	0.00096	2.02
25	25.0000	25.000	0.000	0.00096	2.02
30	30.0000	30.000	0.000	0.00096	2.02
35	35.0000	35.000	0.000	0.00097	2.02

The End of Certificate

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CAL-FM-C01-14: 12 Sep 2022



ใบตรวจสอบสภาพเครื่องซึ่งวิเคราะห์ความชื้น

เลขที่ใบงาน: WO-00047130

ชนิดเครื่องมือ: Moisture Balance รุ่น: MA35

หมายเลขเครื่อง: 26303311

ตรวจสอบ (รับ)		รายการตรวจสอบ	ตรวจสอบ (ส่ง)		หมายเหตุ
31 Oct 2024			31 Oct 2024		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
☒	☐	1. สายไฟ/Adapter, power supply 220/110V	☒	☐	
☒	☐	2. ความสมบูรณ์ชุดการยกกันชน (Cover)	☒	☐	
☐	☐	3. ความสมบูรณ์ชุดของระดับน้ำ	☐	☐	ไม่มี
☒	☐	4. การปรับระดับของขาตั้งเครื่อง	☒	☐	
☒	☐	5. การตอบสนองของโมดูล	☒	☐	
☒	☐	6. ความสมบูรณ์ของ Display	☒	☐	
☒	☐	7. การแสดงผลของ Display หลังวางน้ำหนัก	☒	☐	
☒	☐	8. ชุดรองจานแข็ง (Stopper) / pan support	☒	☐	
☒	☐	9. การทำงานของ Function Internal / External	☒	☐	
☒	☐	10. ความสะอาดของตัวเครื่องภายนอกและบน load cell	☒	☐	
☒	☐	11. สภาวะแวดล้อม ณ สถานที่ตั้งเครื่อง	☒	☐	

หมายเหตุเพิ่มเติม/ข้อแนะนำ :

Mr. Piyapat Saidoung
Service Engineer

DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Prachinburi 10260
Phone: +66 2630 7000 Email: info.calibration@dksh.com Website: www.dksh.com/certificate-thailand

Delivering Growth - In Asia and Beyond.



Certificate of Calibration

Equipment: Moisture Balance Certificate No.: C30240608
Model: MA35 Issued Date: 07 November 2024
Serial No. (or ID.): 26303311 Job No.: WO-00047130
Manufacturer: Sartorius Page: 1 of 3
Condition: In condition

Customer: Integrated Research Center Co., Ltd.
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition: Temperature 27 °C ± 0.9 °C
Humidity 68 %RH ± 2.4 %RH

Calibration Place: Double A (1991) Public Company Limited, (Water Laboratory IP1)
1 Moo 2, Thatoom, Srimahaphot,
Prachinburi 25140 Thailand.

Calibration By: Mr. Piyapat Saidoung
Calibration Date: 31 October 2024
The Method used: In-house method, CAL-WI-56, temperature measure in the sample chamber
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (Thailand), NIMT through DKSH Technology Co., Ltd. Certificate No. C15240321

(Mr. Piyapat Saidoung)
Person in charge

(Mr. Adisai Maknoi)
Authorized signatory

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

DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Prachinburi, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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CAL-FM-C30-12: 12 Sep 2022

Calibration Results:

Temperature Test

Without Adjustment

Unit Under Calibration			Measurement	Error	Measurement
Desired	Setting	Reading	Temperature	Temperature	Uncertainty
(°C)	(°C)	(°C)	(°C)	(°C)	(±°C)
75	75	-	74.8	0.2	1.6
105	105	-	104.6	0.4	1.7

Error Temperature = UUC Setting - Measurement Temperature

Black body sensor of STD thermometer size; Ø ~2.5 cm

Sample Test *

Determination Moisture by Standard Solution (NaCl)

Standard solution for sample test made from salt and distilled water ; 90.00% ± 0.015%

UUC Setting		UUC Reading		Standard	Error	SD	Measurement
Temperature	End of Analysis	Time	Moisture	(NaCl)			Uncertainty
(°C)	Mode	(mm:ss)	(%)**	(%)	(%)	(± %)	(± %)
160	Automatic	8.48	90.01	90.00	0.01	0.10	0.15

Determination Moisture by Reference Material Sample (RM)

Reference Material Moisture in Flour assigned value ; 12.37% ± 0.12% Standard deviation ; 0.49

Lot No. RMFF-FL01-2401-III Expired Date: June 2025

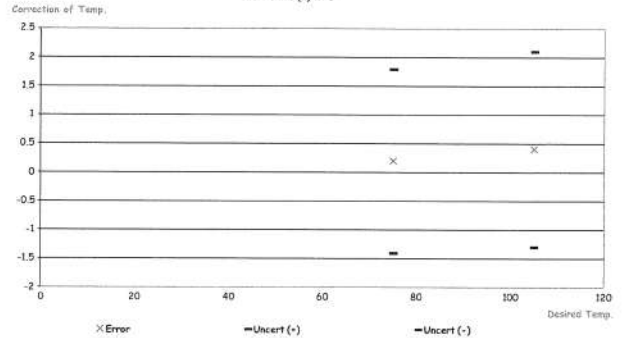
UUC Setting		UUC Reading		Standard	Error	SD	Measurement
Temperature	End of Analysis	Time	Moisture	(RM)			Uncertainty
(°C)	Mode	(mm:ss)	(%)**	(%)	(%)	(± %)	(± %)
120	Automatic	8.00	12.56	12.37	0.19	0.04	0.14

* Not TISI Accredited in this Certificate have been included for completeness.

** 1% = 10mg / g

The End of Certificate

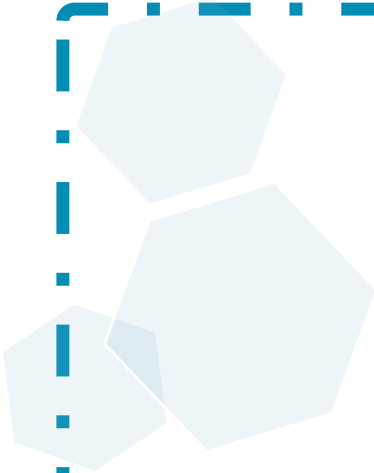
Without Adjustment
Job No.: WO-00047130
Tolerance (Δ): °C



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Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

Delivering Growth - in Asia and Beyond.

CAL-FM-C30-12: 12 Sep 2022



ภาคผนวก จ-2

บริษัท ยูไนเต็ด แอนนาลิสต์ แอนด์ เอ็นจิเนียริง คอนซัลแตนท์ จำกัด



List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Stack									
1	Pre-Test Console	Total Suspended Particulate	Apex Instruments, USA.	XC-572-V 0707048	Envi Equipment Service Co., Ltd.	E24-060049	25 Jun 24	24 Jun 25	-
2	Flue gas Analyzer	Sulphur Dioxide Oxide of Nitrogen as Nitrogen Dioxide Carbon Monoxide Carbon Dioxide	Testo	Testo 350 60899698/701	Entech Industrial Solution Co., Ltd.	G 670083	8 Feb 24	7 Feb 25	-

List of Instruments Certification for Water Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Water									
1	pH Meter	pH	Ecosence	pH100A JC04740	Technology Promotion Association (Thailand-Japan)	24CH311	13 Mar 24	12 Mar 25	-
2	Conductivity Meter	Conductivity	Horiba	LAQUA-EC210 HC9L0012	Technology Promotion Association (Thailand-Japan)	24CH321	14 Mar 24	13 Mar 25	-

CERTIFICATE OF CALIBRATION

Customer	: United Analyst and Engineering Consultant Co., Ltd.
Address	: 81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260
Description of Equipment	: Console meter
Manufacturer	: Apex Instrument
Model Number	: XC-572-V
Serial Number	: 0707048
ID/Control No.	: UAE.EFM. 154/2550
Environment Conditions	: Temperature (25 ± 2) °C Humidity (50 ± 15) % RH
Cal. Date	: 25/06/2024
Issue Date	: 25/06/2024

Calibration Method or Calibration Procedure Used

US EPA Method (United State Environmental Protection Agency)

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

Result of Calibration

This certificate may not be reproduced other than in full except with prior Written approval of the Technical Manager, Envi Equipment Service Company Limited.

These reported uncertainties of measurement are expanded by a coverage factor of k=2, providing a 95% confidence level

Calibrated by : Mr. Sanya Sangnil

Approved by :

(Mr. Mana Fuchon)

Technical Manager

เอกสารไม่ควบคุม

METHOD 5 CONSOLE CALIBRATION
USING REFERENCE WET GAS METER W-NK-2.5-B-Z No.547425
5-POINT METRIC UNIT

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	25/06/2024	09:05 AM	Std Temp	293	K
Console Serial Number	0707048	Calibration Reference No.	SER24-060019			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	754.41			K1	0.386	
DGM Serial Number	00005715	Calibration Meter Gamma	1.001			Console Leak Check	PASS	

Calibration Data											
Run Time		Metering Console					Calibration Meter				
Elapsed (Q)	DGM Orifice DI (Pa)	Volume Initial (V _{in})	Volume Final (V _{out})	Outlet Temp Initial (t _{in})	Outlet Temp Final (t _{out})	Volume Initial (V _{in})	Volume Final (V _{out})	Outlet Temp Initial (t _{in})	Outlet Temp Final (t _{out})		
min	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C	°C		
12.25	13.0	1006.591	1006.731	30	30	224.31426	224.45480	28	28		
12.30	13.0	1006.731	1006.871	30	30	224.45480	224.59514	28	28		
8.57	26.0	1006.878	1007.018	29	29	224.60216	224.74278	28	28		
8.57	26.0	1007.018	1007.158	29	29	224.74278	224.88286	28	28		
13.85	40.0	1007.166	1007.446	29	29	224.89090	225.16890	27	27		
14.03	40.0	1007.446	1007.726	30	30	225.16890	225.44958	27	27		
10.45	70.0	1007.743	1008.023	30	30	225.46640	225.74430	26	26		
10.43	70.0	1008.023	1008.303	30	30	225.74430	226.02136	26	26		
9.15	90.0	1008.315	1008.595	30	30	226.03294	226.30764	26	26		
9.15	90.0	1008.595	1008.875	30	30	226.30764	226.58212	26	26		

Calibrated by : Mr. Sanya Sangnil

Approved by :

(Mr. Mana Fuchon)

Technical Manager

เอกสารไม่ควบคุม

METHOD 5 CONSOLE CALIBRATION
USING REFERENCE WET GAS METER W-NK-2.5-B-Z No.547425
5-POINT METRIC UNIT

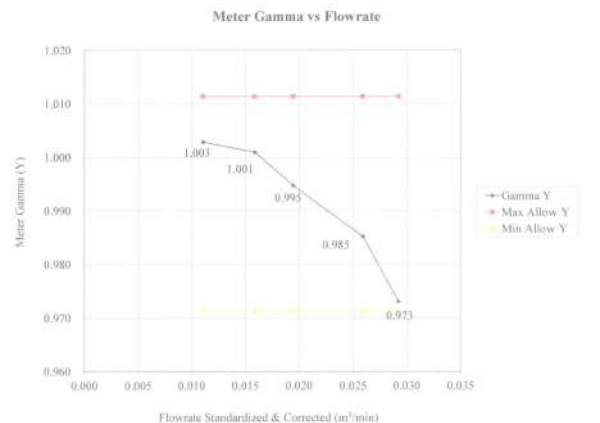
Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	25/06/2024	09:05 AM	Std Temp	293	K
Console Serial Number	0707048	Calibration Reference No.	SER24-060019			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	754.41			K1	0.386	
DGM Serial Number	00005715	Calibration Meter Gamma	1.001			Console Leak Check	PASS	

Calibration Data									
Results									
Standardized Data					Dry Gas Meter				
Dry Gas Meter		Calibration Meter		Calibration Factor	Flowrate		Std & Corr	.0212 m ³ /min	Variation
(V _{in}) _{ref}	(Q _{in}) _{ref}	(V _{out}) _{ref}	(Q _{out}) _{ref}		Value	Variation			
m ³	m ³ /min	m ³	m ³ /min	(Y)	(ΔY)		m ³ /min	mm H ₂ O	(ΔH ₂ O)
0.135	0.011	0.136	0.011	1.004	0.012		0.011	46.115	-0.256
0.135	0.011	0.136	0.011	1.002	0.011		0.011	46.625	0.254
0.136	0.016	0.136	0.016	1.003	0.011		0.016	45.168	-1.203
0.136	0.016	0.135	0.016	0.999	0.008		0.016	45.517	-0.854
0.273	0.020	0.270	0.019	0.990	-0.001		0.019	46.444	0.673
0.273	0.019	0.272	0.019	1.000	0.008		0.019	46.776	0.405
0.274	0.026	0.271	0.026	0.987	-0.005		0.026	46.419	0.848
0.274	0.026	0.270	0.026	0.984	-0.008		0.026	46.552	0.181
0.275	0.030	0.267	0.029	0.974	-0.018		0.029	47.010	0.639
0.275	0.030	0.267	0.029	0.973	-0.019		0.029	47.085	0.714
				0.991	Y Average				ΔH ₂ O Average
									46.371

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ±0.02.
For ΔH₂O, orifice pressure differential that equates to 0.75 cfm (0.0212 m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1mm) H₂O.

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	25/06/2024	09:05 AM	Std Temp	293	K
Console Serial Number	0707048	Calibration Reference No.	SER24-060019			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	754.41			K1	0.386	
DGM Serial Number	00005715	Calibration Meter Gamma	1.001			Console Leak Check	PASS	

Calibration Date: 25-6-2024 Calibration Reference No.: SER24-060019



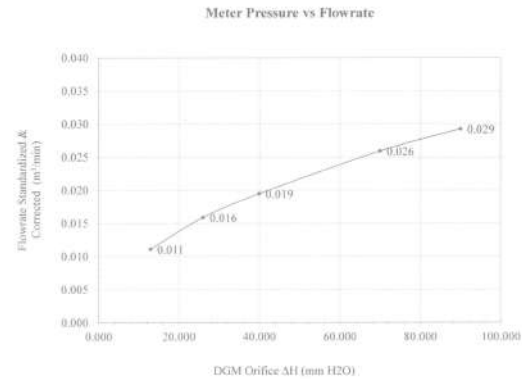
เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

Meter Console Information		Calibration Conditions		Factors/Conversions	
Console Model Number	XC-572-V	Date	25/06/2024	Std Temp	293 K
Console Serial Number	0707048	Time	09:05 AM	Std Press	760 mm Hg
DGM Model Number	SK25EX	Calibration Reference No.	SER24-060019	K ₁	0.386
DGM Serial Number	00005715	Barometric Pressure	754.41 mmHg	Console Leak Check	PASS
		Calibration Meter Gamma	1.001		

Calibration Date: 25-6-2024

Calibration Reference No: SER24-060019



Console Serial: 0707048

Console Model: XC-572-V



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THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information		Calibration Conditions	
Console Model Number	XC-572-V	Date	25/06/2024
Console Serial Number	0707048	Time	11:35 AM
DGM Model Number	SK25EX	Calibration Reference No.	SER24-060019
DGM Serial Number	00005715	Reference Thermometer	DIGICON
Meter Box Model Number	JENCO 765 KF	Serial Number	183169105
Meter Box Serial Number	JC 15588		

Results	
Console Thermocouple Simulator	
Meter Box Channel Temperature Reading (°C)	
Channel and test point	-18.0 25.0 38.0 93.0 149.0 260.0 371.0 482.0 593.0 816.0 1038.0
Stack	-18.0 25.0 37.0 92.0 147.0 256.0 365.0 476.0 585.0 805.0 1024.0
Aux	-18.0 25.0 37.0 92.0 147.0
Probe	-18.0 25.0 37.0 92.0 147.0
Filter	-18.0 25.0 37.0 92.0 147.0
Exit	-18.0 25.0 37.0

Tolerance Range	
Stack	± 1.50% Absolute
Probe	± 3.0 °C
Filter	± 3.0 °C
Meter	± 3.0 °C
Exit	± 2.0 °C



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Instrument description	Flue Gas Analyzer
Instrument model	Testo 350 New
Control unit serial no.	03099393/701
Instrument serial no.	60899698/701
ID no. or control no.	UAE-EPM.008/2560
Manufacturer	Testo SE & Co. KGaA
Probe description	-
Probe model	-
Probe serial no.	-
Customer name	UNITED ANALYST CONSULTANT CO.,LTD.
Customer address	81 SOI UDOMSUKA1, SUKHUMVIT ROAD, BANGCHAK, PRAKONG BANGKOK 10260

Total pages of certificate	2 Pages
Receiving no.	L-240430
Receiving date.	05-Feb-24
Parameter of calibration	Gas Calibration (Oxygen 2.50,10.04,21.02 %vol, Carbon Monoxide 80.14,302,1003 ppm, Nitrogen Dioxide 30.34,81.32, 201.9 ppm, Nitric Oxide 30.01, 151.5, 322.5 ppm, Sulphur Dioxide 50.36, 100.8, 600.8 ppm)
Condition of UUC.	Used
Ambient condition	All of the Measurement were carried out the stabilized laboratory Temperature : 23 ± 0.5 °C Humidity : 55 ± 15 %RH
Calibration place	17/121 Soi Nigamwongwan 47 Yeak 46, Toongsonghong, Lakki, Bangkok 10210
Calibration procedure no.:	This instrument was calibrated by comparison with Standard gas mixture according to calibration Work Instruction no. WI-CL-2B-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement Multiplied by coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.
This certificate is applied only to item under test Environmental condition.
This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory.
Calibration certificates without signature and seal not valid and the results relate only to the items tested/calibrated.
This calibration certificate documents are traceability to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 08-Feb-24

Kwanchai Kramdang
Mr. Kwanchai Kramdang
Calibration Technician

D. Wilton
Mrs. Nongluck Wangsetee
Technical Manager

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.50 % Vol	2412/23	Linde	27-Aug-27
Oxygen (O ₂) 10.04 % Vol	CG-0153-21	Nirnt	18-Nov-26
Oxygen (O ₂) 21.02 % Vol	CG-0041-22	Nirnt	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nirnt	14-Feb-27
Carbon monoxide (CO) 302 ppm	1915/23	Linde	16-Jun-25
Carbon monoxide (CO) 1003 ppm	2584/23	Linde	10-Sep-25
Nitrogen Dioxide (NO ₂) 30.34 ppm	2703/22	Linde	22-Aug-24
Nitrogen Dioxide (NO ₂) 81.32 ppm	3546/23	Linde	14-Jan-26
Nitrogen Dioxide (NO ₂) 201.9 ppm	1975/23	Linde	17-Jul-25
Nitric Oxide (NO) 30.01 ppm	CG-0014-23	Nirnt	19-Feb-25
Nitric Oxide (NO) 151.5 ppm	0161/23	Linde	22-Jan-25
Nitric Oxide (NO) 322.5 ppm	1974/23	Linde	17-Jul-25
Sulphur Dioxide (SO ₂) 50.36 ppm	2004/23	Linde	17-Jul-25
Sulphur Dioxide (SO ₂) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide (SO ₂) 600.8 ppm	2003/23	Linde	17-Jul-25

Measured room conditions

Temperature : 23.5 °C Humidity : 64.1 %RH Pressure : 1011.7 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,200 ml/min Gas pressure : 1016.4 mbar

Calibration Results (Without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O ₂ (%Vol)	2.50	2.57	0.07	0.15
O ₂ (%Vol)	10.04	10.09	0.05	0.20
O ₂ (%Vol)	21.02	21.08	0.06	0.30
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	302	302	0	6.0
CO (ppm)	1003	1002	-1	12
NO ₂ (ppm)	30.34	30.2	-0.14	8.0
NO ₂ (ppm)	81.32	82.4	1.08	8.0
NO ₂ (ppm)	201.9	202.8	0.9	12
NO (ppm)	30.01	29	-1.01	8.0
NO (ppm)	151.5	150	-1.5	8.0
NO (ppm)	322.5	320	-2.5	12
SO ₂ (ppm)	50.36	49	-1.36	6.0
SO ₂ (ppm)	100.8	100	-0.8	6.0
SO ₂ (ppm)	600.8	599	-1.8	13

Remark : 1 cmol/mol = 1 %vol, 1 µmol/mol = 1 ppm.

End of Report



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



Cert.No.: 24CH311
Page.: 1 of 3

Certificate of Calibration

Equipment : pH Meter
Manufacturer : EcoSense
Model : pH100A
Serial No. : JC04740
ID No. : UAE.EFM.062/2566(EFM.pH.05/66)
Condition As-Received: Used Item
Received Date : 12 March 2024
Calibration Date : 13 March 2024
Reference : 2403-0386WSC-4
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method
- CP-CH5 by direct measurement with DC voltage
standard and direct measurement with
certified reference material (CRM)
- CP-CH8 by comparison with temperature standard

Calibrated by : Warakorn Lernagatrakul

Approved by :

Saithip
Approved Signatory

() Pornthippa Tameyakul
() Unnopphol Harachai
(✓) Saithip Meangmai

Issue Date : 15 March 2024

The Uncertainties are for a confidence probability of approximately 95%

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

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A 0064528



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



Cert.No.: 24CH311
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	54030049	130RC116	23E2802	27 Aug 2024
2) Ref. Standard Thermometer	4982054	110RC044	23I908	26 July 2024

This certification is traceable to the International System of Unit maintained through:-
- Technology Promotion Association (Thailand-Japan)

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	940102	27 Nov 2025
pH 6.986	CPA chem	940104	02 Nov 2024
pH 9.997	CPA chem	940106	02 Nov 2024

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 Document Process Calibrator at pH (4,7)(7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement	Coverage factor
	pH	mV	mV	pH	(±mV)	k
pH Meter S/N.: JC04740	4.00	177.48	177	4.01	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-177	10.01	0.58	2.00

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a 1206339



Cert.No.: 24CH311
Page.: 3 of 3

Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement (±)	Coverage factor k
pH Electrode S/N.: 230906SIA605377	4.008	4.01	172	0.0071	2.00
	6.986	7.00	-2	0.0099	2.00
	6.986	7.00	-2	0.011	2.00
	9.997	10.01	-177	0.0096	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model :
- Serial No. : 230906SIA605377
Dimension of probe
- Length : 110 mm.
- Diameter : 12 mm.
- Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °C)	Coverage factor k
25.0	25.004	24.9	-0.104	0.13	2.00
30.0	30.002	29.9	-0.102	0.13	2.00
35.0	35.002	34.9	-0.102	0.13	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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เอกสารไม่ควบคุม

a 1206340



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



Cert.No.: 24CH321
Page.: 1 of 3

Certificate of Calibration

Equipment : Conductivity Meter
Manufacturer : Horiba
Model : LAQUA-EC210
Serial No. : HC9L0012
ID No. : UAE.EFM.008/2563(EFM.SCT.02/63)
Condition As-Received: Used Item
Received Date : 12 March 2024
Calibration Date : 14 March 2024
Reference : 2403-0387WSC-1
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In -house method
- CP-CH6 by direct measurement with
certified reference material (CRM)
- CP-CH8 by Comparison with temperature standard
Calibrated by : Warakorn Lernagatrakul
Approved by :
Saithip
Approved Signatory
() Pornthippa Tameyakul
() Unnopphol Harachai
(✓) Saithip Meangmai
Issue Date : 15 March 2024

The Uncertainties are for a confidence probability of approximately 95%

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

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A 0064531



Cert.No.: 24CH321

Page.: 2 of 3

Condition of this result of calibration

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Certificate No.	Due date
1) Thermometer	1963878	130RC095	2311051	05 Sep 2024
2) Ref. Std. Thermometer	4982054	110RC044	231908	26 July 2024

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

2. Certified Reference Materials :-

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

Conductivity Solution	Manufacturer	Lot No.	Exp. date
1413.0 $\mu\text{S/cm}$	CPA Chem	936624	19 Oct 2024
12,880 mS/cm	CPA Chem	931956	30 Sep 2024

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

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

Calibration results**Function : Conductivity Measurement**(*) After Adjustment at 1413.0 $\mu\text{S/cm}$

Conductivity Electrode Serial No.: 9B9F0278

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement ($\pm$)	Coverage factor k
1413.0 $\mu\text{S/cm}$	1340 $\mu\text{S/cm}$	1413 $\mu\text{S/cm}$	9.2 $\mu\text{S/cm}$	2.00
12,880 mS/cm	13.70 mS/cm	14.27 mS/cm	0.086 mS/cm	2.00

Remark : - UUC* = Unit Under Calibration

เอกสารไม่ควบคุม

a 1206345



Cert.No.: 24CH321

Page.: 3 of 3

Calibration Results**Function : Temperature Measurement**

This equipment was connected with Temperature Probe;

- Model : 9383

- Serial No. : 9B9F0278

Dimension of probe;

- Length : 110 mm

- Diameter : 10 mm

- Immersion Depth : 90 mm

Calibration Result : Without adjustment

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	25.002	25.0	-0.002	0.13	2.00
30.0	30.001	30.0	-0.001	0.13	2.00
35.0	35.002	35.0	-0.003	0.13	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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เอกสารไม่ควบคุม

a 1206346

List of Instruments Certification for Environmental Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Equipment for Air Quality Analysis									
1	Analytical Balance (Readability 0.1 mg)	(PM-10)	Mettler-Toledo	AB204-S/FACT / B108115858	National Food Institute, Ministry of Industry, Thailand	2402420-001-01	19 Apr 24	18 Apr 25	-
2	UV-VIS Spectrophotometer	NO2	Agilent Technologies	Cary60 G6860A / MY15410009	DOE Services Co.,Ltd.	SP24-018	9 May 24	8 May 25	-
Equipment for Water Quality Analysis									
3	Conductivity Meter	ความนำไฟฟ้า	SI Analytics	Lab955 / 16300356	DKSH (Thailand) Ltd.	C24240057	11 Mar 24	10 Mar 25	-
4	UV-VIS Spectrophotometer	สี (Color)	Agilent Technologies	Cary60 G6860A / MY15410009	DOE Services Co.,Ltd.	SP24-018	7 May 24	6 May 25	-
5	Ion Selective Electrode Meter (ISE)	คลอไรด์, ฟลูออไรด์, ไนเตรด	Orion	Star A214 / X36836	Science Tech Co.,Ltd.	FT004/24	27 May 24	26 May 25	-
6	Digestor Unit	TKN	FOSS TECATOR	DT2520 / 91794469	National Food Institute, Ministry of Industry, Thailand	2402957-001-01	23 May 24	22 May 25	-
7	Distillation Unit (Kjeldahl Method)		FOSS TECATOR	KT200 / 91790524	FOSS South East Asia	9810	9 Feb 24	7 Feb 25	-
8	Atomic Absorption Spectrophotometer (AAS)	โครเมียมไดรากลีนท์ เหล็ก	Agilent Technologies	System IDG8432A AA240FS / MY13160001	Thailand Institute of Scientific and Technological Research(TISTR)	MTCACL.No 358/67	11 Mar 24	10 Mar 25	-
9	Inductively Coupled Plasma (ICP)		Agilent Technologies	System IDG8015A G8015AA / MY18030001	Agilent Technologies (Thailand) Co.,Ltd.	Preventive Maintenance Checklist	4 Nov 24	3 Nov 25	-

Due Date of Calibration* : Based on the annual calibration plan. At least 1 time per year.

Calibration Certificate

Certificate No.: 2402420-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Prakhonong, Bangkok 10260

Page 1 of 3

Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: AB204-S/FACT
Serial No.: B108115858
ID No.: UAE.AIR.016/2555

Order No.: 2402420
Operation No.: 2402420-001
Date of Receipt: 19 April 2024
Date of Calibration: 19 April 2024

Calibrated by Mr. Pheraphet Tuanjit
Scientist
Approved by (Miss Preeyaporn Jaengkarnkit)
Vice President, Department of Laboratory Services
Responsible for the Technical Management Team
Date of Issue: 23 April 2024

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 standards laboratory. This certificate may not be reproduced other than in full, except with the prior written approval of the National Food Institute.

F-CS-009 Revision: 01 Date: 20-04-65

2008 บอการณัฐกรรณ 35 นานารณัฐกรรณ 10700
2008 So. 35, Anun Anam Road, Bang Yai Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand
Tel: +66(0) 2432 8688 Fax: +66(0) 2432 8545



Calibration Report

Certificate No.: 2402420-001-01
Equipment: Electronic Balance
Model: AB204-S/FACT
Serial No.: B108115858
Capacity: 220 g
Manufacturer: METTLER TOLEDO
Resolution: 0.0001 g
ID No.: UAE.AIR.016/2555

Date of Calibration: 19 April 2024 Page 3 of 3

Calibration Results: (Continued)

Calibration Range: 0-200 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value:

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (g)	Coverage Factor k
Unloaded	0.00000	0.0000	0.0000	0.000089	2.00
0.1	0.10000	0.1000	0.0000	0.000089	2.00
1	0.99998	1.0000	0.0000	0.000092	2.00
5	4.99997	5.0000	0.0000	0.000091	2.00
10	10.00002	10.0001	-0.0001	0.00012	2.00
20	20.00063	20.0001	-0.0005	0.00014	2.00
50	49.99998	50.0000	0.0000	0.00012	2.00
70	70.00000	69.9999	0.0001	0.00016	2.00
100	99.99997	100.0000	0.0000	0.00017	2.00
150	149.99994	149.9997	0.0002	0.00022	2.00
200	200.00001	199.9995	0.0005	0.00028	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 %.

***** End *****

F-CS-012 Revision: 01 Date: 20-04-65

2008 บอการณัฐกรรณ 35 นานารณัฐกรรณ 10700
2008 So. 35, Anun Anam Road, Bang Yai Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand
Tel: +66(0) 2432 8688 Fax: +66(0) 2432 8545



Calibration Report

Certificate No.: 2402420-001-01
Equipment: Electronic Balance
Model: AB204-S/FACT
Serial No.: B108115858
Capacity: 220 g
Manufacturer: METTLER TOLEDO
Resolution: 0.0001 g
ID No.: UAE.AIR.016/2555

Page 2 of 3

Environment Condition: Ambient Temperature: 22.1 ± 0.6 °C Relative Humidity: 49 ± 1.9 %

Place of Calibration: Room 206 Balance Room 2, UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

Condition of Equipment: Good Condition

Condition of This Results of Calibration:

1. Calibration Method: NFI Method W-MA-001 In-House Method based on UKAS Lab 14 : 2019

2. Reference Standards:

Reference Standard	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Standard Weight Class E2	1-500mg	15880	TCS	M23111815	28 November 2024
Standard Weight Class E2	1-500g	15882	TCS	M23111825	28 November 2024
Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	608-H1	NFI.BTH.019/23	Quality Reborn	Q624-0492	4 March 2025

3. This certification is traceable to SI UNIT

4. This certificate was certified only for the instrument we calibrated.

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

Calibration Results:

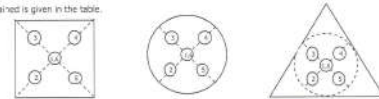
1. Repeatability of Reading:

Nominal Value (g)	Standard Deviation of Reading (g)
100	0.000057
200	0.000079

2. Off-Center Error:

A mass of 100 g was placed and moved to various position on pan.

The balance reading obtained is given in the table.



1	2	3	4	5	6	(Maximum Difference)
(g)	(g)	(g)	(g)	(g)	(g)	(g)
99.9999	99.9997	99.9996	99.9998	100.0000	99.9998	0.0003

F-CS-012 Revision: 01 Date: 20-04-65

2008 บอการณัฐกรรณ 35 นานารณัฐกรรณ 10700
2008 So. 35, Anun Anam Road, Bang Yai Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand
Tel: +66(0) 2432 8688 Fax: +66(0) 2432 8545



DQE Services Co., Ltd.
32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230
Phone: +66 (0)2 538 2054, Email: dqeservicesinfo@gmail.com

CERTIFICATE OF CALIBRATION

Certificate No.: SP24-018 Page 1 of 5

Customer: United Analyst and Engineering Consultant Co., Ltd. (Head Office)

Address: 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

Location of calibration: Laboratory 315

Equipment: UV-Vis Spectrophotometer

Manufacturer: Agilent Technologies

Model: Cary 60

Serial No.: MY15410009

ID No.: UAE.WAT.020/2558

Received Date: 7 May 2024

Calibration Date: 7 May 2024

Issue Date: 9 May 2024

Condition Instrument: Good

Calibrated by: (Mr. Tanawat Rittidach) Technical Manager

Approved by: (Ms. Chonthicha Sangern) Quality Manager

The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.

The measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the DQE Services Co., Ltd.

DQE Services Co.,Ltd.

DQE Services

32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230

Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com

ISO 17025:2017
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP24-018

Page 2 of 5

Environment Condition : Ambient Temperature 25 ± 5 °C

Relative humidity 55 ± 20 %RH

Calibration method : In-house method CP-01 Based on ASTM E275-08

Certified Reference Materials :

Material	Serial No.	Certificate No.	Due date
Absorbance Standard set	25760	115663	25 October 2025
Absorbance Standard set	25757	115638	25 October 2025
Wavelength Standard set	25806	115657	25 October 2025
Wavelength Standard set	25758	115665	25 October 2025

Traceability : This certification is traceable to the International System of Unit maintained at National -
Institute of Standards and Technology (NIST) through Starna Scientific Limited

Spectral Band Width of UUC : 1.5 nm.

Scan Speed of UUC : 60 nm/min

Scan Interval of UUC : 0.15 nm.

Resolution of UUC : Photometric 0.0001 Abs.

Wavelength 0.1 nm.

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DQE Services Co.,Ltd.

DQE Services

32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230

Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com

ISO 17025:2017
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP24-018

Page 3 of 5

Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.0000	0.0000	0.0028	2.00
	0.5780	0.5747	0.0033	0.0031	2.00
	1.0484	1.0438	0.0046	0.0029	2.00
	2.1876	2.1832	0.0044	0.0080	2.00
440	0.0000	0.0000	0.0000	0.0028	2.00
	0.5595	0.5581	0.0014	0.0034	2.00
	1.0239	1.0231	0.0008	0.0035	2.00
	2.1230	2.1219	0.0011	0.0080	2.00
465	0.0000	0.0000	0.0000	0.0028	2.00
	0.5230	0.5184	0.0046	0.0030	2.00
	0.9633	0.9614	0.0019	0.0029	2.00
	1.9753	1.9731	0.0022	0.0070	2.00
546.1	0.0000	0.0000	0.0000	0.0028	2.00
	0.5181	0.5150	0.0031	0.0031	2.00
	1.0002	0.9964	0.0038	0.0033	2.00
	1.9973	1.9914	0.0059	0.0088	2.00
590	0.0000	0.0000	0.0000	0.0028	2.00
	0.5517	0.5485	0.0032	0.0030	2.00
	1.0803	1.0772	0.0031	0.0030	2.00
	2.0373	2.0293	0.0080	0.0080	2.00
635	0.0000	0.0000	0.0000	0.0028	2.00
	0.5591	0.5565	0.0026	0.0031	2.00
	1.0518	1.0482	0.0036	0.0030	2.00
	1.9274	1.9202	0.0072	0.0079	2.00

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DQE Services Co.,Ltd.

DQE Services

32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230

Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com

ISO 17025:2017
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP24-018

Page 4 of 5

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
235	0.0000	0.0000	0.0000	0.0050	2.00
	0.7469	0.7435	0.0034	0.0057	2.00
257	0.0000	0.0000	0.0000	0.0050	2.00
	0.8674	0.8639	0.0035	0.0060	2.00
313	0.0000	0.0000	0.0000	0.0050	2.00
	0.2919	0.2907	0.0012	0.0051	2.00
350	0.0000	0.0000	0.0000	0.0050	2.00
	0.6430	0.6402	0.0028	0.0055	2.00

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DQE Services Co.,Ltd.

DQE Services

32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230

Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com

ISO 17025:2017
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP24-018

Page 5 of 5

Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.72	242.0	-0.28	0.18	2.00
279.45	279.5	-0.05	0.18	2.00
287.81	287.9	-0.09	0.18	2.00
334.06	333.9	0.16	0.18	2.00
360.93	360.5	0.43	0.18	2.00
418.59	418.1	0.49	0.18	2.00
445.94	445.6	0.34	0.18	2.00
453.66	453.3	0.36	0.18	2.00
460.02	459.8	0.22	0.18	2.00
536.59	536.0	0.59	0.18	2.00
637.98	638.7	-0.72	0.18	2.00
431.38	430.8	0.58	0.18	2.00
472.50	472.4	0.10	0.18	2.00
513.47	513.7	-0.23	0.18	2.00
528.88	529.1	-0.22	0.18	2.00
573.17	573.5	-0.33	0.18	2.00
585.35	585.2	0.15	0.20	2.00
684.40	685.1	-0.70	0.18	2.00
740.72	741.4	-0.68	0.20	2.00
748.55	749.1	-0.55	0.18	2.00
807.03	807.3	-0.27	0.18	2.00
879.28	879.3	-0.02	0.18	2.00

Remark : - UUC = Unit Under Calibration

- N/A = Not Available

- The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor k,

which for a normal distribution corresponds to a coverage probability of approximately 95%

- * Indicates non TISI accredited

- End of Certificate -

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Certificate of Calibration

Certificate No.: C24240057

Page: 2 of 2

Equipment:	CONDUCTIVITY METER	Certificate No.:	C24240057
Model:	Lab 955	Issued Date:	11 March 2024
Serial No. (or ID.):	16300356	Job No.:	WO-00020309
Manufacturer:	SI Analytic	Page:	1 of 2
Electrode Serial No.	16070067	Model:	LF413T
Condition:	In Condition	Brand:	SI Analytic

Customer: United Analyst and Engineering Consultant Company Limited
3 Soi Udomsuk 41 Sukhumvit Road,
Bangkok, Prakanong, Bangkok 10260 Thailand

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

Calibration Place: Environment Laboratory, DKSH Technology Limited.
2533 Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260 Thailand

Calibration By: Mr. Pongpisut Suebchantha
Calibration Date: 11 March 2024
The Method used: In house method, CAL-WI-49, base on ASTM D 1125-14 and D 5391-14
Traceability: This certificate is traceable to the SI Units maintained by CRM of NIST(SRM) through CPA chem Co., Ltd. (ISO/IEC 17034) Certificate No. 960753, 890591, 890593

Calibration Results:

Before Adjustment

Standard	Unit Under Calibration	Correction	Coverage Factor	Uncertainty (±)
Conductivity Solution	Reading		(k)	
25.000 μS/cm	26.7 μS/cm	-1.700 μS/cm	2.00	0.21 μS/cm
1413.0 μS/cm	1428 μS/cm	-15.0 μS/cm	2.00	9.0 μS/cm
111.3 mS/cm	108.4 mS/cm	2.9 mS/cm	2.00	0.67 mS/cm

After Adjustment ; at 1413 $\mu\text{S}/\text{cm}$

Standard	Unit Under Calibration	Coverage Factor	Uncertainty (±)
Conductivity Solution	Reading	Correction (k)	
25.000 μS/cm	25.9 μS/cm	-0.900 μS/cm	2.00
1413.0 μS/cm	1413 μS/cm	0.0 μS/cm	2.00
111.3 mS/cm	107.5 mS/cm	3.8 mS/cm	2.00
			0.67 mS/cm

The End of Certificate

(Mr Pongpisut Suehchantha)

Person in charge

(Mr Nitinun Srihawan)

Authorized signatory

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

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k) 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 DKSH Technology Limited.

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บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangnaek, Phraekhanong, Bangkok 10260
โทร: 02-262 3300 โทรสาร: 02-262 3301 อีเมล: info@dksh.com เว็บไซต์: www.dksh.com/thailand

Delivering Growth – In Asia and Beyond.

เอกสารไม่ควบคุม

CAL-FM-C24-09: 12 Sep 2022

บริษัท ดีเคเอส อีซี จำกัด
DKSH Technology Limited
2533 หมู่ 9 ตำบล บางพลีใหญ่ (บางพลีใหญ่ กรุงเทพมหานคร 10260)
2533 Sukhumvit Road, Bangphli, Prachinburi, Bangkok 10260
Phone: +66 2639 7000 E-mail: info@calibrating@dksh.co Website: www.dksh.com/en/thailand

Delivering Growth – in Asia and Beyond

เอกสารไม่ควบคุม

CAL-FM-C24-09: 12 Sep 2022

DQE Services		DQE Services Co.,Ltd. 32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230 Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com		 ISO 9001:2015 CALIBRATION DATA	
CERTIFICATE OF CALIBRATION					
Certificate No. :		SP24-018		Page 1 of 5	
Customer :		United Analyst and Engineering Consultant Co.,Ltd. (Head Office)			
Address :		3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260			
Location of calibration :		Laboratory 315			
Equipment :		UV-Vis Spectrophotometer			
Manufacturer :		Agilent Technologies			
Model :		Cary 60			
Serial No. :		MY15410009			
ID No. :		UAE.WAT.020/2558			
Received Date :		7 May 2024			
Calibration Date :		7 May 2024			
Issue Date :		9 May 2024			
Condition Instrument :		Good			
Calibrated by :		 (Mr. Tanawat Rittidach) Technical Manager		Approved by :  (Ms. Chonthicha Sangngem) Quality Manager	
The calibration result is applied only to the above calibrated item and was found accurate as shown on date and place of calibration only.					
The measurement capability of the laboratory and its traceability to recognized national standards and to the unit of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the DQE Services Co., Ltd.					



DQE Services

32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230

Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com



ISO 17025:2017
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP24-018

Environment Condition : Ambient Temperature 25 ± 5 °C

Relative humidity 55 ± 20 %RH

Calibration method : In-house method CP-01 Based on ASTM E275-08

Certified Reference Materials :

Material	Serial No.	Certificate No.	Due date
Absorbance Standard set	25760	115663	25 October 2025
Absorbance Standard set	25757	115638	25 October 2025
Wavelength Standard set	25806	115657	25 October 2025
Wavelength Standard set	25758	115665	25 October 2025

Page 2 of 5

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

Institute of Standards and Technology (NIST) through Starna Scientific Limited

Spectral Band Width of UUC : 1.5 nm.

Scan Speed of UUC : 60 nm/min

Scan Interval of UUC : 0.15 nm.

Resolution of UUC : Photometric 0.0001 Abs.

Wavelength 0.1 nm.

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

DQE Services Co.,Ltd.

DQE Services

32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230

Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com



ISO 17025:2017
CALIBRATION MARK

REPORT OF CALIBRATION

Certificate No. : SP24-018

Page 3 of 5

Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.0000	0.0000	0.0028	2.00
	0.5780	0.5747	0.0033	0.0031	2.00
	1.0484	1.0438	0.0046	0.0029	2.00
	2.1876	2.1832	0.0044	0.0080	2.00
440	0.0000	0.0000	0.0000	0.0028	2.00
	0.5595	0.5581	0.0014	0.0034	2.00
	1.0239	1.0231	0.0008	0.0035	2.00
	2.1230	2.1219	0.0011	0.0080	2.00
465	0.0000	0.0000	0.0000	0.0028	2.00
	0.5230	0.5184	0.0046	0.0030	2.00
	0.9633	0.9614	0.0019	0.0029	2.00
	1.9753	1.9731	0.0022	0.0070	2.00
546.1	0.0000	0.0000	0.0000	0.0028	2.00
	0.5181	0.5150	0.0031	0.0031	2.00
	1.0002	0.9964	0.0038	0.0033	2.00
	1.9973	1.9914	0.0059	0.0088	2.00
590	0.0000	0.0000	0.0000	0.0028	2.00
	0.5517	0.5485	0.0032	0.0030	2.00
	1.0803	1.0772	0.0031	0.0030	2.00
	2.0373	2.0293	0.0080	0.0080	2.00
635	0.0000	0.0000	0.0000	0.0028	2.00
	0.5591	0.5565	0.0026	0.0031	2.00
	1.0518	1.0482	0.0036	0.0030	2.00
	1.9274	1.9202	0.0072	0.0079	2.00

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DQE Services

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Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com



ISO 17025:2017
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP24-018

Page 4 of 5

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
235	0.0000	0.0000	0.0000	0.0050	2.00
	0.7469	0.7435	0.0034	0.0057	2.00
257	0.0000	0.0000	0.0000	0.0050	2.00
	0.8674	0.8639	0.0035	0.0060	2.00
313	0.0000	0.0000	0.0000	0.0050	2.00
	0.2919	0.2907	0.0012	0.0051	2.00
350	0.0000	0.0000	0.0000	0.0050	2.00
	0.6430	0.6402	0.0028	0.0055	2.00

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DQE Services Co.,Ltd.

DQE Services

32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230

Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com



ISO 17025:2017
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP24-018

Page 5 of 5

Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.72	242.0	-0.28	0.18	2.00
279.45	279.5	-0.05	0.18	2.00
287.81	287.9	-0.09	0.18	2.00
334.06	333.9	0.16	0.18	2.00
360.93	360.5	0.43	0.18	2.00
418.59	418.1	0.49	0.18	2.00
445.94	445.6	0.34	0.18	2.00
453.66	453.3	0.36	0.18	2.00
460.02	459.8	0.22	0.18	2.00
536.59	536.0	0.59	0.18	2.00
637.98	638.7	-0.72	0.18	2.00
431.38	430.8	0.58	0.18	2.00
472.50	472.4	0.10	0.18	2.00
513.47	513.7	-0.23	0.18	2.00
528.88	529.1	-0.22	0.18	2.00
573.17	573.5	-0.33	0.18	2.00
585.35	585.2	0.15	0.20	2.00
684.40	685.1	-0.70	0.18	2.00
740.72	741.4	-0.68	0.20	2.00
748.55	749.1	-0.55	0.18	2.00
807.03	807.3	-0.27	0.18	2.00
879.28	879.3	-0.02	0.18	2.00

Remark : - UUC = Unit Under Calibration

- N/A = Not Available

- The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor k,

which for a normal distribution corresponds to a coverage probability of approximately 95%

- * Indicates non TISI accredited

- End of Certificate -

เอกสารไม่ควบคุม

SCIENCE TECH CO., LTD. Head Office : 321/43 Nanglinchee Rd. Chongnondsee Yannawa Bangkok 10120 Thailand Tel. 0-2285-4101 Fax. 0-2285-4856 www.scientech.th.com Science Tech Laboratory : 279/27-29 Soi Watpoman Sathupradit 19 Rd. Chongnondsee Yannawa Bangkok 10120 Tel. 0-2285-4101 Fax. 0-2285-4856	
Job No. : JF004/24	Certificate No. : FT004/24
Page : 1 of 2	
Certificate of Calibration	
Equipment :	pH/ISE Meter
Manufacturer :	Orion
Made in :	USA.
Model :	STAR A214
Serial No. :	X36836
ID No. :	UAE.WAT.025/2560
Ion Selective Model :	9409BN
Serial No. :	ZW1-18420
Reference Electrode Model :	900100
Serial No. :	ZW1-16834
Range :	0 to 14 pH
Resolution :	0.001 pH 0.1 mV
Submitted by :	บริษัท ฟูโนด เทคโนโลยี แอนด์ เซอร์วิส จำกัด 3 ซอยอุดมสุข 41 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพฯ 10260
Ambient Temperature :	(25 ± 3) °C
Relative Humidity :	(50 ± 15)%
Issue date :	Monday, May 27, 2024
Calibrated by :	Khannika Sangkham
Approved by :	 (Khannika Sangkham) Laboratory manager

เอกสารไม่ควบคุม



Certificate of Calibration

Job No. : JF004/24

Certificate No. : FT004/24

Received date : Thursday, May 23, 2024

Page : 2 of 2

Calibration date : Thursday, May 23, 2024

Condition of this calibration result

- 1 Reference standard materials : Certified Fluoride standard reference solution (Directly measured by differential potentiometry with the aid of potassium fluoride "quasi without transference" against solutions prepared from primary reference materials from NIST)
- 2 This certificate was certified only for the instrument we calibrated
- 3 This result of calibration was found accurate as shown on date and place of calibration only

Result of Calibration

Function : pH/ISE Meter with Probe

Direct Measurement

First Standard concentrated	=	0.1	ppm
Secondary Standard concentrated	=	1	ppm
Tertiary Standard concentrated	=	10	ppm
Fourthly Standard concentrated	=	100	ppm
Slope	=	-55.1	mV/Dec.

Channel : 1

Unit Under Calibration	Standard Concentrated (ppm)	UUC Reading (ppm)	Correction (ppm)	Stdev (ppm)
Model :	0.1	0.104	-0.004	0.00
9409BN S/N. ZW1-18420	1	1.03	-0.03	0.01
900100 S/N. ZW1-16834	10	10.2	-0.2	-0.16
	100	100	0	0.48

-00000-

Handwritten signature

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มูลนิธิพัฒนาอุตสาหกรรมอาหาร
ศูนย์บริการทดสอบปฏิบัติการอุตสาหกรรมอาหาร
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center

Verification Certificate

Substitute for Certificate No.: 2402957-001-01

Certificate No.: 2402957-001-02

Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhonong, Bangkok 10260

Page 1 of 4

Equipment: HEATING BLOCK DIGESTION

Manufacturer: FOSS

Model: 2520

Serial No.: 91794469

ID No.: UAE.WAS.011/2560

Order No.: 2402957

Operation No.: 2402957-001

Date of Receipt: 23 May 2024

Date of Calibration: 23-24 May 2024

Calibrated by Mr.Jerawut Prapawuttipong
Scientist

Approved by (Mr.Pheraphat Tuanjit)
Manager, Division of Calibration Laboratory
Responsible for the Technical Management Team

Date of Issue: 18 June 2024

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 standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.

F-CS-011 Revision: 01 Date: 20-04-65

2008 3503 ถนนสุขุมวิท 35 แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10700
2008 Soi 35, Asoi Asoin Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand
Tel : +66(0) 2423 8668 - Fax : +66(0) 2423 8545

เอกสารไม่ควบคุม



มูลนิธิพัฒนาอุตสาหกรรมอาหาร
ศูนย์บริการทดสอบปฏิบัติการอุตสาหกรรมอาหาร
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center

Verification Report

Certificate No.: 2402957-001-02

Equipment: HEATING BLOCK DIGESTION

Model: 2520 Serial No.: 91794469

Resolution: 1 °C ID No.: UAE.WAS.011/2560

Manufacturer: FOSS

Date of Calibration: 23-24 May 2024

Page 2 of 4

Location: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

Environment Condition: Ambient Temperature (25 ± 3) °C

Relative Humidity (55 ± 15) %

Line Voltage (220 ± 10) Volt

Condition of this results of Calibration:

1. This instrument was calibrated by insert standard thermocouples type R into its heating block digestion and compared to temperature obtained from reference standards thermometer at calibrated point.
 - The temperature scale used was based on ITS - 90 .
 - All data show below were final values and the initial data may be obtained upon request.
2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
Digital Thermometer with Thermocouple	34570A	HY458157/ANALYST/0403	TC23/0048	2-Jun-2024	N.M. Technical Center Laboratory
	Type R	TC180-103 / CH180-103			

3. This certificate is traceable to international system of units (SI Units).

4. This certificate was certified only for the instrument we calibrated.

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

6. Condition of Calibrated item : Good

UUC* Description

Time of Record : Hour 30 Minute At 380 °C

7. Result of Calibration : ☒ Without adjustment ☐ After adjustment

F-CS-012 Revision: 01 Date: 20-04-65

2008 3503 ถนนสุขุมวิท 35 แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10700
2008 Soi 35, Asoi Asoin Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand
Tel : +66(0) 2423 8668 - Fax : +66(0) 2423 8545

เอกสารไม่ควบคุม



มูลนิธิพัฒนาอุตสาหกรรมอาหาร
ศูนย์บริการทดสอบปฏิบัติการอุตสาหกรรมอาหาร
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center

Verification Report

Certificate No.: 2402957-001-02

Equipment: HEATING BLOCK DIGESTION

Model: 2520 Serial No.: 91794469

Resolution: 1 °C ID No.: UAE.WAS.011/2560

Manufacturer: FOSS

Date of Calibration: 23-24 May 2024

Page 3 of 4

Calibration point: 380 °C

Calibration result:

Reporting of Temperature

Block No.	UUC* Setting (°C)	UUC* Reading (°C)	Stability (±°C)	Standard Thermometer (°C)	Uncertainty (±°C)
1	380	380	0.96	378.86	2.1
2	380	380	0.40	378.41	2.1
3	380	380	1.18	378.94	2.1
4	380	380	0.44	377.64	1.6
5	380	380	0.11	377.75	1.6
6	380	380	0.14	378.35	1.6
7	380	380	1.17	377.09	2.1
8	380	380	0.33	377.08	2.1
9	380	380	0.14	376.61	2.1
10	380	380	0.96	377.74	2.1
11	380	380	0.40	377.17	2.1
12	380	380	1.18	377.71	2.1
13	380	380	0.44	379.07	1.6
14	380	380	0.11	379.19	1.6
15	380	380	0.14	379.78	1.6
16	380	380	1.17	378.74	2.1
17	380	380	0.33	378.74	2.1
18	380	380	0.14	378.27	2.1
19	380	380	0.96	379.53	2.1
20	380	380	0.40	378.96	2.1

Note:

- UUC* = Unit Under Calibration

- Immersion depth of standard thermometer in tube level high of sand is equal heater plate of UUC.

- Stability = One-half of the greatest maximum difference of measured temperatures at one sensors, for at least half an hour after reaching steady state.

F-CS-012 Revision: 01 Date: 20-04-65

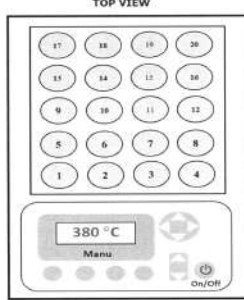
2008 3503 ถนนสุขุมวิท 35 แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10700
2008 Soi 35, Asoi Asoin Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10700, Thailand
Tel : +66(0) 2423 8668 - Fax : +66(0) 2423 8545

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Verification Report

Certificate No.: 2402957-001-02
Equipment: HEATING BLOCK DIGESTION
Model: 2520 Serial No.: 91794469
Resolution: 1 °C ID No.: UAE.WAS.011/2560
Manufacturer: FOSS
Date of Calibration: 23-24 May 2024
Calibration point: 380 °C
Calibration result: Continued

Figure 1. Location of Reference Standard and Block Diagram of Digestion Unit



Sensor Installation Location

Remark: Edited Date of Calibration from 23-24 May 2024 to 23-24 May 2024.

Note:

- UUC* = Unit Under Calibration
- Immersion depth of standard thermometer in tube level high of sand is equal heater plate of UUC.
- Stability = One-half of the greatest maximum difference of measured temperatures at one sensors, for at least half an hour after reaching steady state.

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

----- End -----

F-CS-012 Revision: 01 Date: 20-04-65

FOSS

Customer Service Report

FOSS South East Asia
3388 Srinrat Building, 25th - 26th Floor, Unit No. 3388/90,
Rama IV Road, Klongtoey, Klongtoey, Bangkok, Thailand 10110

Report No: 9810

Date: 9 Feb 2024

Customer: UAE

Address: BANGKOK

Instrument: KJ200

Serial: 91790524

Hours Start: 08:00
Finish: 09:30

Labour: 2 persons

Travel From Customer: 1 person, 16:50

Application	Special	Standard
Normal	Courtesy Visit	Installation
Distributor	PMA Onboarding	Quote
Internal	Warranty	Repair
Digital Service	Sales Support	Remote
		PM
		Other

PO/Quote Number: - If applicable

PMA Type: FOSScare If applicable Contract No. - If applicable

Details of Work / Test	Condition / Status
# PM KIT00	
- ตรวจสอบและปรับเทียบ PM	
- ตรวจสอบและปรับเทียบ 3 บิน 100 mL	
- Adjust 50 mL - 80 mL	
- ตรวจสอบ PM kit	
- ตรวจสอบ PM kit	
# ตรวจสอบ SOPH Model ตรวจสอบและปรับเทียบ 10000725 SOPH Model Complete 1 PC	
Instrument Ready for Use	OK Not OK

Part No.	Batch	Description	Qty
10009965	14.12.2020	Foss PM kit KJ200 be101 of Analyser 6100	1

I confirm this report is accurate and complete

Signed FOSS: [Signature] Signed Customer: [Signature]
Name: [Name] Name: [Name]

Would you be willing to participate in a brief survey in order to tell us how we performed? Email: [Email]

FOSS

Customer Service Report

FOSS South East Asia
3388 Srinrat Building, 25th - 26th Floor, Unit No. 3388/90,
Rama IV Road, Klongtoey, Klongtoey, Bangkok, Thailand 10110

Report No: 9810

Date: 9 Feb 2024

Customer: UAE

Address: BANGKOK

Instrument: KJ200

Serial: 91790524

Hours Start: 08:00
Finish: 09:30

Labour: 2 persons

Travel From Customer: 1 person, 16:50

Application	Special	Standard
Normal	Courtesy Visit	Installation
Distributor	PMA Onboarding	Quote
Internal	Warranty	Repair
Digital Service	Sales Support	Remote
		PM
		Other

PO/Quote Number: - If applicable

PMA Type: FOSScare If applicable Contract No. - If applicable

Details of Work / Test	Condition / Status
# PM KIT00	
- ตรวจสอบและปรับเทียบ PM	
- ตรวจสอบและปรับเทียบ 3 บิน 100 mL	
- Adjust 50 mL - 80 mL	
- ตรวจสอบ PM kit	
- ตรวจสอบ PM kit	
# ตรวจสอบ SOPH Model ตรวจสอบและปรับเทียบ 10000725 SOPH Model Complete 1 PC	
Instrument Ready for Use	OK Not OK

Part No.	Batch	Description	Qty
10009965	14.12.2020	Foss PM kit KJ200 be101 of Analyser 6100	1

I confirm this report is accurate and complete

Signed FOSS: [Signature] Signed Customer: [Signature]
Name: [Name] Name: [Name]

Would you be willing to participate in a brief survey in order to tell us how we performed? Email: [Email]



Request No. 25-67 / 0275

MTC. ACL.No. 358 / 67

CALIBRATION CERTIFICATE

NOMENCLATURE : 1. Atomic Absorption Spectrophotometer "Agilent Technologies"

Model AA240FS, Serial No. MY13160001

2. Working standard solution "Inorganic Ventures"

Multi Analyte Custom Grade Solution, Lot No. S2-MEB675610

SUBMITTED BY : United Analyst and Engineering Consultant Co., Ltd.

3 Sol Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260

CALIBRATION PROCEDURE : 1. Performance Verification of Atomic Absorption Spectrophotometer (WI-500-02-30)

2. Estimation Uncertainty of Measurement in Analytical Chemistry (QP-513)

CALIBRATION RANGE: 0.02, 0.10, 0.30, 0.50, 0.70 mg/l at 228.8 nm.Cd, 0.10, 0.20, 0.30, 0.50, 0.70 mg/l at 357.9 nm.Cr, 0.05, 0.10, 0.30, 0.50, 0.70 mg/l at 324.7 nm.Cu, 0.10, 0.30, 0.50, 0.70, 1.00 mg/l at 248.3 nm.Fe, 0.20, 0.50, 0.70, 1.00, 1.50 mg/l at 217.0 nm.Pb, 0.05, 0.10, 0.30, 0.50, 0.70 mg/l at 279.5 nm.Mn, 0.10, 0.30, 0.50, 0.70, 1.00 mg/l at 232.0 nm.Ni, 0.05, 0.10, 0.30, 0.50, 0.70 mg/l at 213.9 nm.Zn

CALIBRATION DATE : 2 February 2024

REFERENCE MATERIAL : Traceable to NIST "Agilent Technologies", "CARLO ERBA"

Cadmium Lot No. 0006589926, Chromium Lot No. 0112384886, Copper Batch No. T117098A, Iron Batch No. T126087A, Lead Lot No. 1227873, Manganese Batch No. T109228A, Nickel Batch No. T270178A, Zinc Batch No. T820140A

AMBIENT CONDITIONS : Temperature 25 ± 5 °C Relative humidity 50 ± 20 %

The Atomic Absorption Spectrophotometer has been calibrated against Reference Material traceable to National Institute of Standards and Technology (NIST) by The Analytical Chemistry Laboratory. The results are attached herewith.

Calibrated by: Atipat
(Mr. Atipat Ratana)

Approved by: [Signature]
(Miss Suladda Deawtong)
Director of Analytical Chemistry Laboratory
Ref. 2015267020100454001
Issued Date : 11 March 2024

The results relate only to the items tested/calibrated or value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

Head Office: 35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang, Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9009
Fax. (66) 0 2577 9009
E-mail: rumpa@tistr.or.th Website: www.tistr.or.th

Office/Laboratory: Sol 1C, Bangso Industrial Estate, Sukhumvit Road, Amphoe Muang Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2523 1672-80 ext. 115, 116
Fax. (66) 0 2523 9165
E-mail: mtc@tistr.or.th

Office: 196 Phahonyothin Road, Chatuchak, Bangkok 10900, Thailand
Tel. (66) 0 2578 8592
Fax. (66) 0 2578 8592
E-mail: sumaloo@tistr.or.th

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Request No. 25-67 / 0275

1 / 5

MTC. ACL. No. 358 / 67

CALIBRATION DATA

1. Noise Level

Element	Cd	Cr	Cu	Fe	Pb	Mn	Ni	Zn
Absorbance	0.0006	0.0004	-0.0003	0.0001	-0.0011	-0.0005	0.0008	0.0004
	0.001	0.0017	-0.0009	0.0008	0.0001	0.0002	-0.0003	0.0007
	0.0006	0.0017	-0.0020	0.0005	0.0005	0.0004	0.0013	0.0014
	0.0001	0.0018	-0.0007	0.0005	0.0004	-0.0003	-0.0001	0.0010
	-0.0001	0.0019	-0.0014	0.0003	0.0010	0.0000	0.0002	-0.0001
	0.0011	0.0014	-0.0017	0.0009	-0.0008	0.0004	0.0006	0.0010
	-0.0002	0.0015	-0.0015	0.0003	0.0002	-0.0008	0.0009	0.0013
	0.0006	0.0012	-0.0001	-0.0006	0.0008	0.0001	-0.0002	0.0013
	0.0008	0.0009	-0.0003	0.0003	0.0005	0.0002	0.0001	0.0007
	0.0012	0.0011	-0.0012	0.0008	0.0003	0.0004	-0.0004	0.0013
Average Absorbance	0.0003	0.0015	-0.0019	0.0001	-0.0002	0.0000	-0.0003	0.0003
	0.0005	0.0017	-0.0019	-0.0007	0.0000	-0.0007	0.0005	0.0005
	-0.0006	0.0016	0.0000	0.0006	-0.0001	0.0013	0.0006	0.0010
	0.0003	0.0011	-0.0002	0.0001	-0.0007	0.0009	0.0009	0.0002
	0.0003	0.0012	-0.0011	0.0007	-0.0003	-0.0003	0.0010	0.0009
	0.0004	0.0018	-0.0016	-0.0004	-0.0006	0.0008	0.0007	0.0007
	-0.0001	0.0018	-0.0018	0.0013	-0.0006	-0.0001	0.0014	0.0006
	0.0003	0.0017	-0.0001	0.0001	-0.0012	-0.0004	0.0001	0.0002
	0.0010	0.0018	-0.0007	0.0003	-0.0005	-0.0002	0.001	0.0003
	0.0004	0.0019	-0.0006	-0.0001	-0.0004	0.0003	0.0002	0.0008

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Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Sri 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtctr@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2323 1672-80 ext. 5225, 5217
Fax. (66) 0 2323 9165
E-mail : sumalee@tistr.or.th

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Request No. 25-67 / 0275

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MTC. ACL. No. 358 / 67

3. Trueness

3.1 Reading on wavelength- Cadmium(Cd) at 228.3 nm.

Element	Standard Value of RM (mg/L)	Reading (mg/L)	Error of Measurement (mg/L)	Error of Measurement (%)	Uncertainty (mg/L)
Cd	0.020	0.020	0.000	1.10	± 0.005
	0.301	0.301	0.000	0.11	± 0.005
	0.707	0.693	-0.013	1.85	± 0.008

3.2 Reading on wavelength- Chromium (Cr) at 357.9 nm.

Element	Standard Value of RM (mg/L)	Reading (mg/L)	Error of Measurement (mg/L)	Error of Measurement (%)	Uncertainty (mg/L)
Cr	0.1007	0.104	0.004	3.49	± 0.009
	0.3035	0.297	-0.006	2.11	± 0.012
	0.7071	0.685	-0.023	3.19	± 0.023

3.3 Reading on wavelength- Copper (Cu) at 324.7 nm.

Element	Standard Value of RM (mg/L)	Reading (mg/L)	Error of Measurement (mg/L)	Error of Measurement (%)	Uncertainty (mg/L)
Cu	0.051	0.047	-0.004	7.58	± 0.003
	0.303	0.296	-0.007	2.19	± 0.009
	0.704	0.698	-0.006	0.74	± 0.020

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35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Sri 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
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E-mail : mtctr@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2323 1672-80 ext. 5225, 5217
Fax. (66) 0 2323 9165
E-mail : sumalee@tistr.or.th

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MTC. ACL. No. 358 / 67

2. Precision

Element	Conc. (mg/L)	Absorbance										Ave. Abs.	SD	%RSD
Cd	0.02	0.0078	0.0076	0.0069	0.0075	0.0071	0.0070	0.0076	0.0074	0.0067	0.0067	0.0007	0.0004	5.15
	0.30	0.1008	0.1007	0.0999	0.0997	0.1000	0.0996	0.1008	0.1002	0.1005	0.0999	0.100	0.0005	0.46
	0.70	0.2301	0.2306	0.2277	0.2305	0.2310	0.2295	0.2290	0.2293	0.2305	0.2296	0.230	0.0010	0.42
	0.10	0.0094	0.0093	0.0093	0.0098	0.0094	0.0095	0.0090	0.0090	0.0094	0.0090	0.009	0.0003	2.75
Cr	0.30	0.0241	0.0236	0.0221	0.0238	0.0231	0.0226	0.0231	0.0223	0.0230	0.0231	0.023	0.0006	2.75
	0.70	0.0500	0.0500	0.0500	0.0524	0.0499	0.0511	0.0509	0.0512	0.0515	0.0504	0.051	0.0008	1.63
	0.05	0.0061	0.0062	0.0064	0.0061	0.0069	0.0069	0.0061	0.0062	0.0064	0.0061	0.006	0.0003	5.00
	0.30	0.0419	0.0411	0.0402	0.0407	0.0405	0.0404	0.0399	0.0400	0.0399	0.0400	0.040	0.0006	1.58
Cu	0.70	0.0960	0.0960	0.0960	0.0959	0.0947	0.0955	0.0952	0.0952	0.0951	0.0955	0.096	0.0005	0.48
	0.10	0.0096	0.0101	0.0103	0.0100	0.0099	0.0096	0.0106	0.0099	0.0105	0.0102	0.010	0.0003	3.38
	0.50	0.0424	0.0415	0.0428	0.0427	0.0421	0.0426	0.0413	0.0430	0.0421	0.0419	0.042	0.0006	1.33
	1.00	0.0830	0.0839	0.0847	0.0834	0.0832	0.0820	0.0839	0.0838	0.0837	0.0845	0.084	0.0008	0.92
Pb	0.20	0.0078	0.0074	0.0078	0.0076	0.0078	0.0077	0.0078	0.0078	0.0077	0.0078	0.008	0.0001	1.71
	0.70	0.0278	0.0273	0.0271	0.0267	0.0270	0.0264	0.0274	0.0273	0.0269	0.0269	0.027	0.0004	1.45
	1.50	0.0551	0.0548	0.0552	0.0555	0.0547	0.0546	0.0548	0.0544	0.0549	0.0547	0.055	0.0004	0.64
	0.05	0.0116	0.0107	0.0110	0.0103	0.0108	0.0108	0.0112	0.0107	0.0109	0.0108	0.011	0.0003	3.15
Mn	0.30	0.0650	0.0649	0.0649	0.0651	0.0646	0.0646	0.0649	0.0646	0.0640	0.0648	0.065	0.0003	0.48
	0.70	0.1463	0.1465	0.1459	0.1471	0.1475	0.1474	0.1487	0.1473	0.1462	0.1468	0.147	0.0008	0.56
	0.10	0.0095	0.0100	0.0096	0.0103	0.0102	0.0096	0.0100	0.0095	0.0097	0.0096	0.010	0.0003	3.04
	0.50	0.0443	0.0433	0.0438	0.0444	0.0430	0.0437	0.0444	0.0437	0.0438	0.0434	0.044	0.0005	1.09
Ni	1.00	0.0812	0.0820	0.0834	0.0829	0.0818	0.0829	0.0831	0.0835	0.0816	0.0819	0.082	0.0008	0.99
	0.05	0.0374	0.0377	0.0373	0.0377	0.0374	0.0377	0.0373	0.0371	0.0371	0.0374	0.037	0.0002	0.61
	0.30	0.1985	0.1993	0.1975	0.1992	0.1979	0.1988	0.1995	0.1985	0.1974	0.2004	0.199	0.0009	0.47
	0.70	0.4027	0.4031	0.4019	0.4021	0.4023	0.3981	0.4042	0.4025	0.3993	0.3997	0.402	0.0019	0.48

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Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Sri 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtctr@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2323 1672-80 ext. 5225, 5217
Fax. (66) 0 2323 9165
E-mail : sumalee@tistr.or.th

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3.4 Reading on wavelength- Iron (Fe) at 248.3 nm.

Element	Standard Value of RM (mg/L)	Reading (mg/L)	Error of Measurement (mg/L)	Error of Measurement (%)	Uncertainty (mg/L)
Fe	0.100	0.104	0.005	4.60	± 0.014
	0.500	0.482	-0.018	3.55	± 0.016
	1.006	0.968	-0.038	3.75	± 0.029

3.5 Reading on wavelength- Lead (Pb) at 217.0 nm.

Element	Standard Value of RM (mg/L)	Reading (mg/L)	Error of Measurement (mg/L)	Error of Measurement (%)	Uncertainty (mg/L)
Pb	0.201	0.202	0.001	0.34	± 0.014
	0.706	0.719	0.012	1.73	± 0.030
	1.513	1.459	-0.054	3.57	± 0.061

3.6 Reading on wavelength- Manganese (Mn) at 279.5 nm.

Element	Standard Value of RM (mg/L)	Reading (mg/L)	Error of Measurement (mg/L)	Error of Measurement (%)	Uncertainty (mg/L)
Mn	0.0505	0.050	0.000	0.83	± 0.005
	0.3031	0.306	0.003	1.12	± 0.007
	0.7023	0.698	-0.004	0.62	± 0.014

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Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Sri 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtctr@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2323 1672-80 ext. 5225, 5217
Fax. (66) 0 2323 9165
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3.7 Reading on wavelength- Nickel (Ni) at 232.0 nm.

Element	Standard Value of RM (mg/L)	Reading (mg/L)	Error of Measurement (mg/L)	Error of Measurement (%)	Uncertainty (mg/L)
Ni	0.101	0.098	-0.003	2.90	± 0.013
	0.508	0.502	-0.006	1.16	± 0.018
	1.012	0.962	-0.051	5.02	± 0.032

3.8 Reading on wavelength- Zinc (Zn) at 213.9 nm.

Element	Standard Value of RM (mg/L)	Reading (mg/L)	Error of Measurement (mg/L)	Error of Measurement (%)	Uncertainty (mg/L)
Zn	0.050	0.045	-0.005	9.39	± 0.013
	0.303	0.324	0.021	7.04	± 0.013
	0.707	0.675	-0.032	4.52	± 0.019

Remark : The reported uncertainty is an expanded uncertainty calculated using a coverage factor of 2 (k = 2) which gives a level of confidence of approximately 95%

Calibrated by Atipat
(Mr. Atipat Ratana)

Approved by Suladda
(Miss Suladda Deawtong)
Director of Analytical Chemistry Laboratory
Issued Date : 11 March 2024

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Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12125, Thailand
Tel. (66) 0 2377 9000
Fax. (66) 0 2377 9009
E-mail : rump@tistr.or.th Website: www.tistr.or.th

Office/Laboratory
Sol 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mt@tistr.or.th

Office
196 Phahonyothin Road, Chatchak, Bangkok 10900,
Thailand
Tel. (66) 0 2225 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

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Agilent 5100, 5110 Preventive Maintenance Checklist



From Insight to Outcome

Introduction

Customer Information

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

Agilent 5100, 5110 Preventive Maintenance Checklist



From Insight to Outcome

Important Customer Web Links

- To access **Agilent University**, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- To access the **Agilent Resource Center** web page, visit <https://www.agilent.com/en-us/agilentresources>. The following information topics are available:
 - Sample Prep and Containment
 - Chemical Standards
 - Analysis
 - Service and Support
 - Application Workflows
- The **Agilent Community** is an excellent place to get answers, collaborate with others about applications and Agilent products, and find in-depth documents and videos relevant to Agilent technologies. Visit <https://community.agilent.com/welcome>
- Videos about specific preparation requirements for your instrument can be found by searching the **Agilent YouTube** channel at <https://www.youtube.com/user/agilent>
- Need to place a service call?** Flexible Repair Options | Agilent

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Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Only select those pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
- Check "Service not applicable" check boxes to indicate services/tasks not delivered, as appropriate.
- Complete the Preventive Maintenance services in the most logical order relevant to the individual system service in the order of the tasks listed.
- Complete the **Service Review** section together with the customer.
- Complete the fields for page numbers at the foot of each selected page
- Add relevant page numbers to selected pages and complete the total number of pages field in the Service Completion section
- Ask the customer to sign the Service Verification section including the customer's and your signature.

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Instrument Maintenance

System Information

- ☐ Check this box if an instrument configuration report is attached instead of completing the table.

Instrument System Name and ID	5110 VDV ICP-OES
Instrument System Site and Location	UAE

List System Component Product Numbers	List the Serial Numbers of each Component
1. G 8013 A	171 16030001
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	

ICP-OES Configuration Table	Circle the type or write in the type if other
Nebulizer Type	SeaSpray (OneNeb) Conical Other
Spray Chamber	Cyclonic Single Pass Cyclonic Double Pass Other
Torch	Radial (Dual View) Other
Torch Type	One Piece (Semi Demountable) Fully Demountable Other
Injector Diameter	2.4mm 1.8mm 1.4mm 0.8mm Other
Injector Material	Quartz Ceramic Other

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Preparation

- Discuss any specific issues with the customer before starting.
- Review the instrument logbook for recorded problems and comments.
- Save instrument control settings before starting the procedure.
- Perform a general inspection of the system for cleanliness.
- Check for proper installation of parts, assemblies, sensors etc.
- Check system for required installation of components and implementation of Service Notes.
- Check for required firmware/software updates and verify with customers if they would like them installed.
- ☐ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it. **with**
- Ask the customer to remove any samples from the ICP-OES sample introduction area, auto sampler or around the ICP-OES.

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Preventive Maintenance Procedures

Record Pre-PM instrument performance

- Run Instrument Performance test.
- Record results in Instrument Performance Test Results Table – Pre-PM.

Clean and inspect ICP-OES system

- Look for any obvious external damage or problems.
- Inspect water cooling hoses, gas lines and power cord for excessive wear or damage.
- Perform a general internal inspection of the system for excessive dust accumulation, clean if necessary.
- Inspect sample introduction components and record any required maintenance in the Service Engineer Comments and notify the customer as the required actions required.
- Record the instrument operating conditions in the ICP-OES Status Results Table.
- Replace the polychromator purge filter.
- Replace the radial pre-optics window.
- Replace the axial pre-optics window for SVDV and VDV instruments.
- Check exhaust flow for the correct positive extraction at the exhaust duct to insure they meet minimum specifications.
- Replace air inlet dust filter.
- ☐ Replace high capacity air inlet dust filter element if installed. **with**
- Remove and clean instrument water inlet filter.

Agilent Water Recirculator

- ☐ Service not applicable
- Drain cooling fluid and remove any particles from the chiller reservoir.
- Remove, clean and reinstall water inlet metal mesh filter if present.
- Re fill with Agilent Cool Clear cooling fluid.
- Clean the cooling system Air filter and the condenser.

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SPS 3 Auto Sampler

- ☒ **Service not applicable**
- ☐ Power cycle the autosampler and verify successful initialization.
 - ☐ Inspect X and Z axis belts for wear. Replace is necessary.
 - ☐ Clean X and Z axis slide shafts.
 - ☐ Using customer's racks and the Agilent software move the sample probe to the 4 outermost corners and rinse port, ensure that the probe is approximately centered in the vial.

SPS 4 Auto sampler

- ☒ **Service not applicable**
- ☐ Clean the spill tray, rack location mat, end frames and chassis with a damp soft cloth and diluted mild detergent.
 - ☐ Clean the auto sampler cover panels, if cover kit is installed, with domestic window cleaner.
 - ☐ Check the X-axis and Z-axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
 - ☐ Check the X-axis, Theta-axis and Z-axis FFC cables for cracks, incorrect positioning, damaged edges or damaged connectors.
 - ☐ Pump Tubing Replacement. Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles
 - ☐ Test using customer's tray and move the sample probe to the sample vial 1, wash vial and rinse port and ensure that the probe is centered in the vial. If not use calibration wizard and calibrate the position.

AVS 4, 6, 7 Advanced Valve System

- ☒ **Service not applicable**
- ☐ Replace valve rotor seal
 - ☐ Check fittings for signs of leaks
 - ☐ Check tubing including autosampler tubing for kinks or excessive wear
 - ☐ Check high flow pump for signs of leaks

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ICP-OES adjustment

- ☒ Check position of Zn peak, adjust if required.
- ☒ Check Argon Ratio, adjust to specified value if required.
- ☒ Perform Detector Calibration.
- ☒ Perform Instrument Calibration.

Record Post-PM instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table - Post PM.
- ☒ For systems using ICP Expert version 7.3 and above, run the following instrument tests
 - ☒ Subsystem Communications Test
 - ☒ Air Flow
 - ☒ Water Flow
 - ☒ Gas Flows
 - ☒ RF Generator
 - ☒ Camera Test
 - ☒ Optics Test
 - ☒ Nebulizer Test
- ☒ Record the result in the Instrument Test Results Table

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Restore Instrument

- ☐ For HF applications, ask the customer to reinstall their sample introduction system.
- ☒ Leave system in an idle state: on and purging.
- ☒ Guidance: If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

Service Review

- ☒ Attach available reports/printouts of all tests to this documentation.
- ☒ Record the Preventive Maintenance service activity in the customer's records/logbook.
- ☒ Record the PM event in the Smart Alerts logbook, if applicable.
- ☒ Update/reset instrument maintenance counters as appropriate.
- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☒ Complete the Service Engineer Comments section if there are additional comments.
- ☒ Review this service, parts replaced, and test results obtained with the customer.
- ☒ If the instrument firmware was updated, record the details of the change in the Service Engineer's Comments box. Systems in a compliant environment may need additional documentation.
- ☒ Complete the Signature Page with both Service Engineer and Customer signatures.

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Test Results

Instrument Performance Test Results Table

Note: These measurements do not form part of any specification and are for reference only.

	Pre PM Sensitivity Check		Post PM Sensitivity Check	
	Radial	Axial *	Radial	Axial*
Zn 213.857 nm SRBR	4190.5	6849.9	4700.8	7564.2
Mn 257.610 nm SRBR	13691.0	27295.3	14569.1	29992.5
Al 396.152 nm SBR	12.1	14.6	11.9	15.6
K 766.491 nm SBR	6.0	31.2	7.4	39.7

* Axial result is not applicable for G8016AA, G8012AA Radial View instruments.

Instrument Test Results Table

Note: The Instrument Test results are for systems using ICP Expert version 7.3 and above only.

Instrument Test	Result
Subsystem Communications Test	Pass
Air Flow	Pass
Water Flow	Pass
Gas Flows	Pass
RF Generator	Pass
Camera Test	Pass
Optics Test	Pass
Nebulizer test	Pass

เอกสารไม่ควบคุม

ICP-OES Status Results Table

Note: These measurements do not form part of any specification and are for reference only.

Measurement	Standby Mode	Plasma On
Mains Voltage	225.153 VAC	220.613 VAC
Mains Current	0.090 A	0.219 A
Instrument Temperature	24.0 °C	25.1 °C
RF Air Flow (sensor speed)	15.0 Hz	19.0 Hz
Plasma Exhaust Temperature	No measurement	39.2 °C
Water Flow Oscillator	No measurement	1.37 L/min
Water Flow Detector	0.64 L/min	0.81 L/min
Water Inlet Temperature	17.3 °C	19.8 °C
Polychromator Temperature	35.0 °C	35.0 °C
CCD Temperature	-39.8 °C	-39.8 °C
Thermal Stabilizer	35.0 °C	35.0 °C
Argon Supply Pressure	659.52 kPa	608.63 kPa
Purge Gas Supply Pressure*1	656.41 kPa	627.71 kPa
Option Gas Supply Pressure*1	- kPa	- kPa
Nebulizer Flow	No measurement	0.70 L/min
Nebulizer Back Pressure	No measurement	166.30 kPa
Plasma Gas Flow	No measurement	11.98 L/min
Auxiliary Gas Flow	No measurement	1.00 L/min
RF Power	No measurement	1199.5 W
RF Supply Current	No measurement	5.223 A
RF Supply Voltage	No measurement	194.481 V

*1 If option installed

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Consumed PM Parts

Part Description	Part Number	Product or Model# where used	Quantity consumed
Axial Pre-Optic Window	G8010-68014	G8010A, G8011A, G8014A/G8015A	1
Radial Pre-Optic Window	G8010-68015	All	1
Agilent Cool Clear Coolant Fluid	5799-0037	Agilent Water Recirculator	-
Purge Gas Filter	G8010-60136	All	1
Air inlet filter	G8000-68002	All	1
High Capacity Air Filter	G8010-60189	Optional	-
Rotor seal for 6-7 port valve for AVS6/7	G8494-60002	G8494A/G8495	-
Rotor seal for 4 port valve for AVS4	G8493-60002	G8493A	-
Rinse solution to rinse station 2.5mm id x 1m	G8410-80123	SPS 4	-
Barb connector 2.5mm-1.5mm ID	G8410-80124	SPS 4	-
PVC waste tubing 8mm od x 5mm id, 2m	G8410-80122	SPS 4	-
Additional Parts may be required from engineer's stock:			
X axis drive belt	5410047500	SPS 3	-
Z axis drive belt	5410047400	SPS 3	-
Peristaltic pump tubing, PVC SolvaFlex, 3 bridged,	3710049000	SPS 4	-

Consumed Parts Reference
(Purchased by customer, not included as part of PM)☐ Section Not Applicable.

Part Description	Part Number	Product or Model# where used	Quantity consumed

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Signature Page

Service Engineer Comments (optional)

If there are any specific points you wish to note as part of performing the installation or other items of interest for the customer, please write in this box.

Service Verification

Service Request Number:
6006371120Service Engineer Name:
Kanyakorn S.Service Engineer Signature:
Kanyakorn S.Total number of pages in this document:
14Date Service Completed:
15 Nov 2023Customer Name:
Aphorn OnkongCustomer Signature:
Aphorn Onkong

เอกสารไม่ควบคุม

Report Summary	
Instrument Model	Agilent 5100/5110 VDV ICP-OES
Instrument ID	G8011A/G8015A
Instrument Serial Number	MY18030001
Software Version	7.3.1.9507
Firmware Version	3442
Tested By	Kanyakorn S.
Test Completed On	11/13/2023 9:18:24 AM
Result Summary	
Subsystem Communications Test	Skipped
Air Flow Test	Skipped
Water Flow Test	Skipped
Gas Flows Test	Skipped
RF Generator Test	Skipped
Camera Test	Skipped
Optics Test	Skipped
Advanced Valve System Test	Skipped
Resolution Test	Pass
Sensitivity Test	Fail
Precision Test	Pass

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Resolution Test			Pass
Element Wavelength	Specification	Width	
N (174.213 nm)	≤ 9.40	6.92	
As (188.980 nm)	≤ 8.20	6.12	
C (193.027 nm)	≤ 11.50	8.31	
Mo (202.032 nm)	≤ 8.20	6.35	
Cr (206.158 nm)	≤ 13.40	8.99	
Zn (213.857 nm)	≤ 8.70	6.64	
Pb (220.353 nm)	≤ 9.50	7.06	
Co (228.615 nm)	≤ 17.20	11.68	
Ba (230.424 nm)	≤ 9.40	7.27	
Mn (257.610 nm)	≤ 13.30	9.46	
Mn (260.568 nm)	≤ 20.30	14.18	
Cr (267.716 nm)	≤ 11.00	8.01	
Cu (324.754 nm)	≤ 25.00	18.89	
Cu (327.395 nm)	≤ 14.20	11.29	
Sr (338.071 nm)	≤ 33.50	24.46	
Ba (455.403 nm)	≤ 44.00	33.62	
Sr (460.733 nm)	≤ 36.00	17.37	
Ba (493.408 nm)	≤ 36.00	25.47	
Ba (514.171 nm)	≤ 42.00	25.43	
Ar (675.283 nm)	≤ 74.00	60.50	
K (766.491 nm)	≤ 80.00	65.33	

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เอกสารไม่ควบคุม

Sensitivity Test			Fail		
Radial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	142.0	958.5	41.7
Se (196.026 nm)	≥ 41.0	SRBR	105.9	937.4	67.5
Zn (213.857 nm)	≥ 1421.0	SRBR	4190.3	44372.5	111.6
Pb (220.353 nm)	≥ 46.0	SRBR	213.9	2521.3	125.4
Mn (257.610 nm)	≥ 3518.0	SRBR	13681.0	279651.7	416.6
Al (396.152 nm)	≥ 3.4	SBR	12.1	52269.7	3994.3
Ba (493.408 nm)	≥ 34.0	SBR	185.8	2294372.8	12280.0
K (766.491 nm)	≥ 1.8	SBR	8.0	107401.4	11876.7
Axial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	189.4	2285.0	129.5
Se (196.026 nm)	≥ 159.0	SRBR	168.7	2813.7	233.8
Zn (206.200 nm)	≥ 234.0	SRBR	905.0	10158.4	123.0
Zn (213.857 nm)	≥ 1743.0	SRBR	6849.9	135760.6	390.5
Cd (214.439 nm)	≥ 4227.0	SRBR	5597.6	92921.3	273.9
Pb (220.353 nm)	≥ 320.0	SRBR	454.8	10111.2	451.1
Mn (257.610 nm)	≥ 10625.0	SRBR	27295.3	1126118.1	1697.0
Cr (267.716 nm)	≥ 1048.0	SRBR	3948.2	144875.3	1322.0
Cu (324.754 nm)	≥ 19.0	SBR	49.2	341489.7	6798.2
Al (396.152 nm)	≥ 6.0	SBR	14.6	235321.6	15043.9
Ba (493.408 nm)	≥ 60.0	SBR	183.3	8393101.3	45538.3
K (766.491 nm)	≥ 24.0	SBR	31.2	1447045.2	44917.1

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เอกสารไม่ควบคุม

Precision Test			Pass
Radial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 2.60	1.22	
Se (196.026 nm)	≤ 2.60	0.76	
Zn (213.857 nm)	≤ 1.50	0.33	
Pb (220.353 nm)	≤ 2.60	0.86	
Mn (257.610 nm)	≤ 1.50	0.45	
Al (396.152 nm)	≤ 1.50	0.37	
Ba (493.408 nm)	≤ 1.50	0.68	
K (766.491 nm)	≤ 1.50	0.33	
Axial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 1.50	0.63	
Se (196.026 nm)	≤ 1.50	0.87	
Zn (206.200 nm)	≤ 1.50	0.59	
Zn (213.857 nm)	≤ 1.50	0.46	
Cd (214.439 nm)	≤ 1.50	0.70	
Pb (220.353 nm)	≤ 1.50	0.36	
Mn (257.610 nm)	≤ 1.50	0.95	
Cr (267.716 nm)	≤ 1.50	0.56	
Cu (324.754 nm)	≤ 1.50	0.69	
Al (396.152 nm)	≤ 1.50	0.63	
Ba (493.408 nm)	≤ 1.50	0.86	
K (766.491 nm)	≤ 1.50	1.13	

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เอกสารไม่ควบคุม

Report Summary	
Instrument Model	Agilent 5100/5110 VDV ICP-OES
Instrument ID	G8011A/G8015A
Instrument Serial Number	MY18030001
Software Version	7.3.1.9507
Firmware Version	3442
Tested By	Kanyakorn S.
Test Completed On	11/13/2023 11:10:02 AM
Result Summary	
Subsystem Communications Test	Pass
Air Flow Test	Skipped
Water Flow Test	Skipped
Gas Flows Test	Skipped
RF Generator Test	Skipped
Camera Test	Skipped
Optics Test	Pass
Advanced Valve System Test	Skipped
Resolution Test	Pass
Sensitivity Test	Pass
Precision Test	Pass
Subsystem Communications Test	Pass
Optics Test	
Intensity	Radial 3522064 Axial 4003312
Wavelength	Radial 737.212 Axial 737.212

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เอกสารไม่ควบคุม

Resolution Test			Pass
Element Wavelength	Specification	Width	
N (174.213 nm)	≤ 9.40	6.92	
As (188.980 nm)	≤ 8.20	6.08	
C (193.027 nm)	≤ 11.50	8.33	
Mo (202.032 nm)	≤ 8.20	6.31	
Cr (208.158 nm)	≤ 13.40	8.98	
Zn (213.857 nm)	≤ 8.70	6.73	
Pb (220.353 nm)	≤ 9.50	7.02	
Co (228.615 nm)	≤ 17.20	11.65	
Ba (230.424 nm)	≤ 9.40	7.38	
Mn (257.610 nm)	≤ 13.30	9.46	
Mn (260.568 nm)	≤ 20.30	14.05	
Cr (267.716 nm)	≤ 11.00	7.92	
Cu (324.754 nm)	≤ 25.00	18.84	
Cu (327.395 nm)	≤ 14.20	11.31	
Sr (338.071 nm)	≤ 33.50	24.18	
Ba (455.403 nm)	≤ 44.00	33.28	
Sr (460.733 nm)	≤ 36.00	17.41	
Ba (493.408 nm)	≤ 36.00	25.43	
Ba (614.171 nm)	≤ 42.00	25.27	
Ar (675.283 nm)	≤ 74.00	56.87	
K (766.491 nm)	≤ 80.00	65.88	

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Sensitivity Test						Pass
Radial						
Element Wavelength	Specification	Method	Ratio	Standard	Blank	
As (188.980 nm)	≥ 46.0	SRBR	168.6	1284.6	53.3	
Se (196.026 nm)	≥ 41.0	SRBR	122.4	1256.0	90.7	
Zn (213.857 nm)	≥ 1421.0	SRBR	4700.8	53870.1	130.7	
Pb (220.353 nm)	≥ 46.0	SRBR	236.0	3100.6	155.7	
Mn (257.610 nm)	≥ 3518.0	SRBR	14569.1	318398.1	476.2	
Al (396.152 nm)	≥ 3.4	SBR	11.5	59510.5	4761.6	
Ba (493.408 nm)	≥ 34.0	SBR	170.6	2490835.6	14514.2	
K (766.491 nm)	≥ 1.8	SBR	7.4	117698.7	14024.1	
Axial						
Element Wavelength	Specification	Method	Ratio	Standard	Blank	
As (188.980 nm)	≥ 208.0	SRBR	214.5	2706.2	142.8	
Se (196.026 nm)	≥ 159.0	SRBR	188.0	3262.8	255.9	
Zn (206.200 nm)	≥ 234.0	SRBR	1088.2	12794.8	135.3	
Zn (213.857 nm)	≥ 1743.0	SRBR	7564.2	156883.9	427.8	
Cd (214.439 nm)	≥ 4227.0	SRBR	6647.3	116281.7	304.4	
Pb (220.353 nm)	≥ 320.0	SRBR	519.3	12490.2	530.3	
Mn (257.610 nm)	≥ 10625.0	SRBR	29992.5	1305852.5	1890.2	
Cr (267.716 nm)	≥ 1048.0	SRBR	4366.6	173343.4	1547.9	
Cu (324.754 nm)	≥ 19.0	SBR	46.8	361093.0	7560.5	
Al (396.152 nm)	≥ 6.0	SBR	15.6	274029.5	16498.6	
Ba (493.408 nm)	≥ 60.0	SBR	203.6	9028914.5	44122.1	
K (766.491 nm)	≥ 24.0	SBR	38.7	1701521.4	41771.8	

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Precision Test			Pass
Radial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 2.60	0.85	
Se (196.026 nm)	≤ 2.60	1.26	
Zn (213.857 nm)	≤ 1.50	0.42	
Pb (220.353 nm)	≤ 2.60	0.54	
Mn (257.610 nm)	≤ 1.50	0.60	
Al (396.152 nm)	≤ 1.50	0.47	
Ba (493.408 nm)	≤ 1.50	0.68	
K (766.491 nm)	≤ 1.50	0.50	
Axial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 1.50	0.42	
Se (196.026 nm)	≤ 1.50	0.66	
Zn (206.200 nm)	≤ 1.50	0.42	
Zn (213.857 nm)	≤ 1.50	0.54	
Cd (214.439 nm)	≤ 1.50	0.42	
Pb (220.353 nm)	≤ 1.50	0.22	
Mn (257.610 nm)	≤ 1.50	0.54	
Cr (267.716 nm)	≤ 1.50	0.49	
Cu (324.754 nm)	≤ 1.50	0.85	
Al (396.152 nm)	≤ 1.50	0.81	
Ba (493.408 nm)	≤ 1.50	0.78	
K (766.491 nm)	≤ 1.50	1.00	

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Report Summary		
Instrument Model	Agilent 5100/5110 VDV ICP-OES	
Instrument ID	G8011A/G8015A	
Instrument Serial Number	MY18030001	
Software Version	7.3.1.9507	
Firmware Version	3442	
Tested By	Kanyakorn S.	
Test Completed On	11/13/2023 11:15:43 AM	
Result Summary		
Subsystem Communications Test		Pass
Air Flow Test		Pass
Water Flow Test		Pass
Gas Flows Test		Pass
RF Generator Test		Pass
Camera Test		Pass
Optics Test		Skipped
Advanced Valve System Test		Skipped
Resolution Test		Skipped
Sensitivity Test		Skipped
Precision Test		Skipped
Subsystem Communications Test		Pass
Air Flow Test		Pass
30% Air Flow (relative speed)	75% Air Flow (relative speed)	
14.00	20.00	
Water Flow Test		Pass
RF Water Flow(L/min)	Camera Water Flow (L/min)	Water Inlet Temperature (°C)
1.27	0.61	20.37

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Gas Flows Test			Pass		
Nebulizer Target Flow	Actual Flow	Back Pressure	Auxiliary Target Flow	Actual Flow	Back Pressure
0.70	0.70	271.62	2.00	2.00	111.13
Makeup Target Flow	Actual Flow	Back Pressure	Plasma Target Flow	Actual Flow	Back Pressure
2.00	2.00	116.00	18.00	17.94	23.11
RF Generator Test			Pass		
RF Power Supply Test		Passed			
RF Power Supply (V)		147.380			
RF Oscillator Test		Passed			
RF Oscillator Frequency (MHz)		25.843			
Work Coil Current (A)		44.410			
RF Power Supply Current (A)		1.999			
Camera Test			Pass		
	Integration Time (ms)	Standard Deviation	Status		
Electronic Offset Test	1000	5.361	Passed		
Dark Current Test	6000	0.779	Passed		
Array Test	5	0.025	Passed		
Linearity Test		0.118	Passed		

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