

ภาคผนวก ต

เอกสารสอบเทียบ/ทวนสอบเครื่องมือ



ภาคผนวก ต-1

เอกสารสอบเทียบ/ทวนสอบ

เครื่องมือเก็บตัวอย่างและวิเคราะห์

คุณภาพอากาศ ระดับเสียง และความสั่นสะเทือน



## 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
<b>Ambient</b>									
1	Orifice Transfer Standard Calibrator	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Tisch Environmental,Inc.	TE-5025A 3541	Tisch Environmental,Inc.	11112022	11 Nov 21	10 Nov 23	-
2	Orifice Transfer Standard Calibrator	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Thermo Scientific	G25A 158M	Tisch Environmental,Inc.	05072022	5 Jul 22	4 Jul 24	-
3	U-Tube Manometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Dwyer	1221-36-W/M -	Technology Promotion Association (Thailand-Japan)	22P802	12 Mar 22	11 Mar 23	-
4	U-Tube Manometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Dwyer	1221-36-W/M -	Technology Promotion Association (Thailand-Japan)	22P803	12 Mar 22	11 Mar 23	-
5	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	22P2722	22 Jul 22	21 Jul 23	-
6	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	22P2728	22 Jul 22	21 Jul 23	-
7	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	22H1589	27 Jul 22	26 Jul 23	-
8	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM <sub>10</sub> )	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	22H1587	27 Jul 22	26 Jul 23	-
9	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1200636462	UAE Consultant Co.,Ltd.	10112021	10 Nov 21	9 Nov 22	-
10	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM19050151	UAE Consultant Co.,Ltd.	24062022	24 Jun 22	23 Jun 23	-
11	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
12	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-

## 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
<b>Ambient</b>									
13	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1201778119	UAE Consultant Co.,Ltd.	21122021	21 Dec 21	20 Dec 22	-
14	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1201778119	UAE Consultant Co.,Ltd.	15062022	15 Jun 22	14 Jun 23	-
15	Standard Gases (Mixture)	Carbon Monoxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
16	Standard Gases (Mixture)	Carbon Monoxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
17	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 19040405	Thai Meteorological Department	148/22	7 Apr 22	6 Apr 23	-
18	Wind Speed/Wind Direction	WS/WD	LSI LASTEM	E-LOG305 20040002	Thai Meteorological Department	275/22	2 Aug 22	1 Aug 23	-
19	Vibration Meter	Vibration Level Acceleration Level	Instantel Inc.	Micromate UM14547	Calibration Laboratory Co.Ltd	Q22012261	7 Feb 22	6 Feb 23	-
20	Vibration Meter	Vibration Level Acceleration Level	Instantel Inc.	Micromate UM12889	Calibration Laboratory Co.Ltd	Q22053609	31 May 22	30 May 23	-
21	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	Svantek	SV35A 73249	Innovative Instrument Co.,Ltd.	22-ACT-406	1 Jul 22	30 Jun 23	-
22	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	Svantek	SV35A 73246	Innovative Instrument Co.,Ltd.	22-ACT-405	1 Jul 22	30 Jun 23	-
23	Sound Level Meter	$L_{Aeq\ 24\ hrs}$ , $L_{Amax}$ , $L_{A90}$ , $L_{Adn}$	ACO	6236 182020	Sithiporn Associates Co., Ltd.	ACL22080	28 Jan 22	27 Jan 23	-
24	Sound Level Meter	$L_{Aeq\ 24\ hours}$ , $L_{Amax}$ , $L_{Adn}$ , $L_{A90}$	Larson Davis	LxT2 0005395	Innovative Instrument Co.,Ltd.	22-ACT-247	1 Apr 22	31 Mar 23	-



# Certificate of Calibration

Calibration Certification Information			
Cal. Date: November 11, 2021	Rootsmeter S/N: 438320	Ta: 295 °K	
Operator: Jim Tisch		Pa: 746.0 mm Hg	
Calibration Model #: TE-5025A	Calibrator S/N: 3541		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4110	3.2	2.00
2	3	4	1	0.9920	6.4	4.00
3	5	6	1	0.8890	7.9	5.00
4	7	8	1	0.8470	8.8	5.50
5	9	10	1	0.6980	12.7	8.00

Data Tabulation					
Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left( \frac{Ta}{Pa} \right)}$ (y-axis)
0.9873	0.6997	1.4082	0.9957	0.7057	0.8893
0.9831	0.9910	1.9915	0.9914	0.9994	1.2577
0.9811	1.1036	2.2266	0.9894	1.1129	1.4061
0.9799	1.1569	2.3353	0.9882	1.1667	1.4748
0.9747	1.3964	2.8165	0.9830	1.4083	1.7786
QSTD	m=	2.02432	QA	m=	1.26760
	b=	-0.00939		b=	-0.00593
	r=	0.99998		r=	0.99998

Calculations			
Vstd= ΔVol((Pa-ΔP)/Pstd)(Tstd/Ta)		Va= ΔVol((Pa-ΔP)/Pa)	
Qstd= Vstd/ΔTime		Qa= Va/ΔTime	
For subsequent flow rate calculations:			
Qstd= 1/m $\left( \sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)} - b \right)$		Qa= 1/m $\left( \sqrt{\Delta H \left( \frac{Ta}{Pa} \right)} - b \right)$	

Standard Conditions	
Tstd:	298.15 °K
Pstd:	760 mm Hg
Key	
ΔH:	calibrator manometer reading (in H2O)
ΔP:	rootsmeter manometer reading (mm Hg)
Ta:	actual absolute temperature (°K)
Pa:	actual barometric pressure (mm Hg)
b:	intercept
m:	slope

RECALIBRATION
US EPA recommends annual recalibration per 1998 40 Code of Federal Regulations Part 50 to 51, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere, 9.2.17, page 30

# Certificate of Calibration

Calibration Certification Information			
Cal. Date: July 5, 2022	Rootsmeter S/N: 438320	Ta: 297 °K	
Operator: Jim Tisch		Pa: 750.1 mm Hg	
Calibration Model #: G25A	Calibrator S/N: 158M		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3240	3.2	2.00
2	3	4	1	0.9480	6.4	4.00
3	5	6	1	0.8480	7.9	5.00
4	7	8	1	0.8060	8.7	5.50
5	9	10	1	0.6670	12.7	8.00

Data Tabulation					
Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left( \frac{Ta}{Pa} \right)}$ (y-axis)
0.9860	0.7447	1.4073	0.9957	0.7521	0.8899
0.9818	1.0357	1.9902	0.9915	1.0459	1.2585
0.9798	1.1554	2.2251	0.9895	1.1668	1.4071
0.9788	1.2143	2.3337	0.9884	1.2263	1.4757
0.9735	1.4595	2.8146	0.9831	1.4739	1.7798
QSTD	m=	1.96745	QA	m=	1.23199
	b=	-0.05315		b=	-0.03361
	r=	0.99995		r=	0.99995

Calculations			
Vstd= ΔVol((Pa-ΔP)/Pstd)(Tstd/Ta)		Va= ΔVol((Pa-ΔP)/Pa)	
Qstd= Vstd/ΔTime		Qa= Va/ΔTime	
For subsequent flow rate calculations:			
Qstd= 1/m $\left( \sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)} - b \right)$		Qa= 1/m $\left( \sqrt{\Delta H \left( \frac{Ta}{Pa} \right)} - b \right)$	

Standard Conditions	
Tstd:	298.15 °K
Pstd:	760 mm Hg
Key	
ΔH:	calibrator manometer reading (in H2O)
ΔP:	rootsmeter manometer reading (mm Hg)
Ta:	actual absolute temperature (°K)
Pa:	actual barometric pressure (mm Hg)
b:	intercept
m:	slope

RECALIBRATION
US EPA recommends annual recalibration per 1998 40 Code of Federal Regulations Part 50 to 51, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere, 9.2.17, page 30



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL. 0-2717-3000-24 FAX. 0-2719-9484

## Certificate of Calibration

Certificate No. : 22P802  
Page : 1 of 2

Equipment : U-Tube Manometer

Manufacturer: Dwyer

Model : 1221-36W/M

Serial No.: -

ID No.: UAE.EMA2.031/2554

Condition As-Received: Used Item

Received Date: 03 March 2022

Calibration Date: 12 March 2022

Reference: 2203-0131WSC

Submitted by: United Analyst and Engineering Consultant Co.,Ltd.

Ambient Temperature: ( 23 ± 2 ) °C

Relative Humidity: ( 50 ± 15 ) %

Atmospheric Pressure: 1010 mbar

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.

81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P04, using " DKD-R 6-1 ; Calibration of Pressure Gauges, Edition 03/2014 " as a guidelines.

### Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Pressure Calibrator	PC106P	1189	MP-0110-21	09 Aug 2022

2.This result of calibration was made on requested at the point specified by customer.

3.Scale and conversion factor is 1 kPa = 4.0146293 inH<sub>2</sub>O

4.This instrument was used clean air as pressure media.

5.This instrument was calibrated by applied pressure to high-port (+) side and low-port (-) side open to atmospheric pressure.

6.This instrument was installed in vertical orientation and top of the pressure port was used as the reference level.

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

8.This Certification is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suwit Aussarree  
Issue Date : 14 March 2022

Approved Signatory : Attapol P.  
[ ] Phalinee Prabpaipal  
[ ] Sura Suwannasri  
✓ Attapol Panurach

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Cert.No.: 22P802  
Page: 2 of 2

Result of calibration:- Without adjustment

Range : 0 inH<sub>2</sub>O to 36 inH<sub>2</sub>O

Function:- Pressure Measurement

Scale Interval : 0.1 inH<sub>2</sub>O ( The Fifth Estimate )

Increasing Pressure

Applied Pressure (inH <sub>2</sub> O)	UUC Indication		ΔP (inH <sub>2</sub> O)	Error (inH <sub>2</sub> O)
	High-port side (inH <sub>2</sub> O)	Low-port side (inH <sub>2</sub> O)		
0.00	0.00	0.00	0.00	0.00
2.00	1.00	-0.92	1.92	-0.08
4.00	2.00	-1.92	3.92	-0.08
6.00	3.00	-2.92	5.92	-0.08
8.00	4.02	-3.92	7.94	-0.06
10.00	5.02	-4.94	9.96	-0.04
12.00	6.04	-5.94	11.98	-0.02
14.00	7.04	-6.94	13.98	-0.02
16.00	8.06	-7.94	16.00	0.00
18.00	9.06	-8.94	18.00	0.00
20.00	10.08	-9.96	20.04	0.04
22.00	11.08	-10.96	22.04	0.04
24.00	12.10	-11.96	24.06	0.06
26.00	13.10	-12.96	26.06	0.06
28.00	14.10	-13.98	28.08	0.08
30.00	15.10	-14.98	30.08	0.08
32.00	16.12	-15.98	32.10	0.10
34.00	17.12	-16.98	34.10	0.10
35.50	17.98	-17.86	35.84	0.34

The uncertainty of measurement was ± 0.11 inH<sub>2</sub>O

\* UUC = Unit Under Calibration

\* ΔP = High-port side - Low-port side

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

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## Certificate of Calibration

Certificate No. : 22P803

Page : 1 of 2

Equipment : U Tube Manometer

Manufacturer: Dwyer

Model : 1221-36-W/M

Serial No.: -

ID No.: UAE.EFM.179/2561

Condition As-Received: Used Item

Received Date: 03 March 2022

Calibration Date: 12 March 2022

Reference: 2203-0131WSC

Submitted by: United Analyst and Engineering Consultant Co.,Ltd.

Ambient Temperature: ( 23 ± 2 ) °C

Relative Humidity: ( 50 ± 15 ) %

Atmospheric Pressure: 1010 mbar

81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260

**Procedure used:** The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P04, using " DKD-R 6-1 ; Calibration of Pressure Gauges, Edition 03/2014 " as a guidelines.

### Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Pressure Calibrator	PC106P	1189	MP-0110-21	09 Aug 2022

2.This result of calibration was made on requested at the point specified by customer.

3.Scale and conversion factor is 1 kPa = 4.0146293 inH<sub>2</sub>O

4.This instrument was used clean air as pressure media.

5.This instrument was calibrated by applied pressure to high-port (+) side and low-port (-) side open to atmospheric pressure.

6.This instrument was installed in vertical orientation and top of the pressure port was used as the reference level.

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

8.This Certification is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suwit Aussarree  
Issue Date : 14 March 2022

Approved Signatory : Attapol P.  
[ ] Phalinee Prabpaipal  
[ ] Sura Suwannasri  
[x] Attapol Panurach

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Cert.No.: 22P803

Page: 2 of 2

Result of calibration:- Without adjustment

Range : 0 inH<sub>2</sub>O to 36 inH<sub>2</sub>O

Function:- Pressure Measurement

Scale Interval : 0.1 inH<sub>2</sub>O ( The Fifth Estimate )

Increasing Pressure

Applied Pressure (inH <sub>2</sub> O)	UUC Indication		ΔP (inH <sub>2</sub> O)	Error (inH <sub>2</sub> O)
	High-port side (inH <sub>2</sub> O)	Low-port side (inH <sub>2</sub> O)		
0.00	0.00	0.00	0.00	0.00
2.00	1.00	-0.96	1.96	-0.04
4.00	2.00	-1.96	3.96	-0.04
6.00	3.00	-2.96	5.96	-0.04
8.00	4.00	-3.94	7.94	-0.06
10.00	5.00	-4.94	9.94	-0.06
12.00	6.00	-5.94	11.94	-0.06
14.00	7.02	-6.94	13.96	-0.04
16.00	8.02	-7.94	15.96	-0.04
18.00	9.04	-8.96	18.00	0.00
20.00	10.04	-9.96	20.00	0.00
22.00	11.06	-10.96	22.02	0.02
24.00	12.06	-11.96	24.02	0.02
26.00	13.08	-12.98	26.06	0.06
28.00	14.08	-13.98	28.06	0.06
30.00	15.10	-14.98	30.08	0.08
32.00	16.10	-15.98	32.08	0.08
34.00	17.08	-16.98	34.06	0.06
35.50	17.86	-18.00	35.86	0.36

The uncertainty of measurement was ± 0.11 inH<sub>2</sub>O

\* UUC = Unit Under Calibration

\* ΔP = High-port side - Low-port side

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

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## Certificate of Calibration

Certificate No. : 22P2722

Page : 1 of 2

Equipment : Aneroid Barometer  
Manufacturer: Barigo  
Model : -  
Serial No.: -  
ID No.: UAE.ANV.013/2547

Condition As-Received: Used Item

Received Date: 20 July 2022

Calibration Date: 22 July 2022

Reference: 2207-0584WSC

Submitted by: United Analyst and Engineering Consultant Co.,Ltd.

Ambient Temperature: ( 23 ± 2 ) °C

Relative Humidity: ( 50 ± 15 ) %

Atmospheric Pressure: 1010 mbar

81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P10, using " DKD-R 6-1 ; Calibration of Pressure Gauges, Edition 03/2014 " as a guidelines.

### Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Barometer	DPI142	1422505046	MP-0076-22	02 May 2023

2.This instrument was installed in vertical orientation and center of the dial was used as the reference level.

3.This result of calibration was made on requested at the point specified by customer.

4.Scale and conversion factor is 1 kPa = 7.50062 mmHg

5.This result of calibration instrument was in absolute pressure.

6.This instrument was used clean air as pressure media.

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

8.This Certification is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suwit Aussarree  
Issue Date : 25 July 2022

Approved Signatory : Attapol P.  
[ ] Phalinee Prabpaipal  
[ ] Sura Suwannasri  
[x] Attapol Panurach

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Cert.No.: 22P2722

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Result of calibration:- Without adjustment

Range : 720 mmHg to 780 mmHg

Function:- Absolute Pressure Measurement

Scale Interval : 1 mmHg ( The Fifth Estimate )

### Increasing Pressure

Applied Pressure (mmHg)	718.46	729.33	739.85	750.22	760.90	772.01	785.89
UUC* Indication (mmHg)	720.0	730.0	740.0	750.0	760.0	770.0	780.0
Error (mmHg)	1.54	0.67	0.15	-0.22	-0.90	-2.01	-5.89

### Decreasing Pressure

Applied Pressure (mmHg)	785.90	771.99	760.85	750.17	739.90	729.57	718.62
UUC* Indication (mmHg)	780.0	770.0	760.0	750.0	740.0	730.0	720.0
Error (mmHg)	-5.90	-1.99	-0.85	-0.17	0.10	0.43	1.38

The uncertainty of measurement was ± 0.24 mmHg

\* UUC = Unit Under Calibration

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

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## Certificate of Calibration

Certificate No. : 22P2728  
Page : 1 of 2

Equipment : Aneroid Barometer  
Manufacturer : Barigo  
Model : -  
Serial No. : -  
ID No. : UAE.ANV.152/2550

Condition As-Received: Used Item

Received Date: 20 July 2022

Calibration Date: 22 July 2022

Reference: 2207-0584WSC

Submitted by: United Analyst and Engineering Consultant Co.,Ltd.

Ambient Temperature: ( 23 ± 2 ) °C

Relative Humidity: ( 50 ± 15 ) %

Atmospheric Pressure: 1010 mbar

81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P10, using " DKD-R 6-1 ; Calibration of Pressure Gauges, Edition 03/2014 " as a guidelines.

### Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Barometer	DP1142	1422505046	MP-0076-22	02 May 2023

2.This instrument was installed in vertical orientation and center of the dial was used as the reference level.

3.This result of calibration was made on requested at the point specified by customer.

4.This result of calibration instrument was in absolute pressure.

5.This instrument was used clean air as pressure media.

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

7.This Certification is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suwit Aussarree  
Issue Date : 25 July 2022

Approved Signatory : Attapol P.  
[ ] Phalinee Prabpaipal  
[ ] Sura Suwannasri  
[x] Attapol Panurach

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B 0293209



Cert.No.: 22P2728  
Page: 2 of 2

Result of calibration:- Without adjustment

Range : 960 hPa to 1030 hPa

Function:- Absolute Pressure Measurement

Scale Interval : 1 hPa ( The Fifth Estimate )

### Increasing Pressure

Applied Pressure (hPa)	956.27	967.46	978.89	989.56	999.85	1009.89	1020.55	1031.06
UUC* Indication (hPa)	960.0	970.0	980.0	990.0	1000.0	1010.0	1020.0	1030.0
Error (hPa)	3.73	2.54	1.11	0.44	0.15	0.11	-0.55	-1.06

### Decreasing Pressure

Applied Pressure (hPa)	1031.19	1020.73	1009.91	999.92	989.72	979.13	967.71	956.64
UUC* Indication (hPa)	1030.0	1020.0	1010.0	1000.0	990.0	980.0	970.0	960.0
Error (hPa)	-1.19	-0.73	0.09	0.08	0.28	0.87	2.29	3.36

The uncertainty of measurement was ± 0.30 hPa

\* UUC = Unit Under Calibration

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

-oOo-

เอกสารไม่ควบคุม  
a 1118529



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL. 0-2717-3000-24 FAX. 0-2719-9484



## Certificate of Calibration

Certificate No. : 22H1589  
Page : 1 of 2

Equipment : Dial Thermo-Hygrometer  
Manufacturer: Barigo  
Model : -  
Serial No.: -  
ID No.: UAE.ANV.132/2550

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

Condition As-Received: Used Item

Received Date: 20 July 2022

Calibration Date: 22 July 2022  
to 27 July 2022

Reference: 2207-0586WSC

Submitted by: United Analyst and Engineering Consultant Co., Ltd.

Ambient Temperature: ( 25 ± 3 ) °C

81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260

Relative Humidity: ( 50 ± 20 ) %

Procedure used: Calibration were conducted using in-house calibration procedure CP-H02 according to comparison with standard chilled mirror sensor for humidity measurement function and comparison with standard temperature probe for temperature measurement function into humidity / temperature chamber.

### Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Chilled Mirror Hygrometer Sensor	Dew Prime II	31863	19714	17 Sep 2022
2) Standard Humidity/Temperature Meter	400	10240757	TH-0125-21	13 Dec 2022

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

3.This Certification is traceable to the International System of Unit maintained at:-

- National Institute of Standards and Technology (NIST) , The United States of America
- National Institute of Metrology Thailand (NIMT)

Calibrated by : Somchai Dumwor  
Issue Date : 03 August 2022

Approved Signatory :

- ☒ Chakrit Waewanjua  
☐ Pornthippa Tameyakul  
☐ Viporn Tantiyawutti

เอกสารไม่ควบคุม

B 0293725



Cert. No.: 22H1589  
Page.: 2 of 2

### Result of Calibration:-

Function:

Before Adjustment

Humidity measurement.

Reference Temperature	Standard Humidity	UUC* Reading	Error	Uncertainty of Measurement
(°C)	(%R.H.)	(%R.H.)	(%R.H.)	(±%R.H.)
25.0	40.1	40	-0.1	1.6
25.0	60.0	57	-3.0	1.8
25.0	80.0	72	-8.0	2.0

### Result of Calibration:-

Function:

After Adjustment

Humidity measurement.

Reference Temperature	Standard Humidity	UUC* Reading	Error	Uncertainty of Measurement
(°C)	(%R.H.)	(%R.H.)	(%R.H.)	(±%R.H.)
25.0	40.1	41	0.9	1.6
25.0	60.0	60	0.0	1.8
25.0	80.0	72	-8.0	2.0

### Result of Calibration:-

Function:

Without Adjustment

Temperature measurement.

Standard Temperature	UUC* Reading	Error	Uncertainty of Measurement
(°C)	(°C)	(°C)	(±°C)
20.00	20.0	0.00	0.72
25.04	25.0	-0.04	0.72
30.01	29.5	-0.51	0.72
35.04	34.0	-1.04	0.72
39.98	39.0	-0.98	0.72

UUC\* : Unit Under Calibration

The reported uncertainty of measurement was base on standard uncertainty multiplied by coverage factor k = 2.00, providing confidence level approximately 95%.

-o0o-

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

a 1119771





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL. 0-2717-3000-24 FAX. 0-2719-9484



## Certificate of Calibration

Certificate No. : 22H1587  
Page : 1 of 2

Equipment : Dial Thermo-Hygrometer  
Manufacturer: Barigo  
Model : -  
Serial No.: -  
ID No.: UAE.ANV.127/2550

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

Condition As-Received: Used Item

Received Date: 20 July 2022

Calibration Date: 22 July 2022  
to 27 July 2022

Reference: 2207-0586WSC

Submitted by: United Analyst and Engineering Consultant Co.,Ltd.

Ambient Temperature: ( 25 ± 3 ) °C

Relative Humidity: ( 50 ± 20 ) %

81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260

Procedure used: Calibration were conducted using in-house calibration procedure CP-H02 according to comparison with standard chilled mirror sensor for humidity measurement function and comparison with standard temperature probe for temperature measurement function into humidity / temperature chamber.

### Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Chilled Mirror Hygrometer Sensor	Dew Prime II	31863	19714	17 Sep 2022
2) Standard Humidity/Temperature Meter	400	10240757	TH-0125-21	13 Dec 2022

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

3.This Certification is traceable to the International System of Unit maintained at:-

- National Institute of Standards and Technology (NIST) , The United States of America
- National Institute of Metrology Thailand (NIMT)

Calibrated by : Somchai Dumwor  
Issue Date : 03 August 2022

Approved Signatory :

[✓] Chakrit Waewanjua  
[ ] Pornthippa Tameyakul  
[ ] Viporn Tantiyawutti

เอกสารไม่ควบคุม

B 0293723



Cert. No.: 22H1587  
Page.: 2 of 2

Result of Calibration:- Before Adjustment  
Function: Humidity measurement.

Reference Temperature	Standard Humidity	UUC* Reading	Error	Uncertainty of Measurement
(°C)	(%R.H.)	(%R.H.)	(%R.H.)	(±%R.H.)
25.0	40.1	38	-2.1	1.6
25.0	60.0	57	-3.0	1.8
25.0	80.0	74	-6.0	2.0

Result of Calibration:- After Adjustment  
Function: Humidity measurement.

Reference Temperature	Standard Humidity	UUC* Reading	Error	Uncertainty of Measurement
(°C)	(%R.H.)	(%R.H.)	(%R.H.)	(±%R.H.)
25.0	40.1	40	-0.1	1.6
25.0	60.0	60	0.0	1.8
25.0	80.0	77	-3.0	2.0

Result of Calibration:- Without Adjustment  
Function: Temperature measurement.

Standard Temperature	UUC* Reading	Error	Uncertainty of Measurement
(°C)	(°C)	(°C)	(±°C)
20.00	20.0	0.00	0.72
25.04	25.0	-0.04	0.72
30.01	30.0	-0.01	0.72
35.04	35.0	-0.04	0.72
39.98	40.0	0.02	0.72

UUC\* : Unit Under Calibration

The reported uncertainty of measurement was base on standard uncertainty multiplied by coverage factor k = 2.00, providing confidence level approximately 95%.

-o0o-

เอกสารไม่ควบคุม

a 1119773

### MULTI-POINT GAS TEST REPORT

Test Date : Nov 10, 2021

Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 42i  
Manufacturer : Thermo Scientific Serial Number : 1200636462

#### Standard Gas Concentration

Sulphur Dioxide (SO<sub>2</sub>) 44.75 PPM  
Nitric Oxide (NO) 45.35 PPM  
Methane (CH<sub>4</sub>) - PPM  
Carbon Monoxide (CO) 1007  
Cylinder No. : CC159599  
Expiration Date : Jul 30, 2022

#### Dilutor Detail

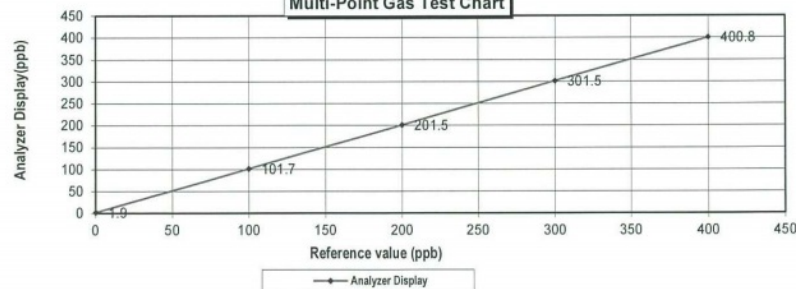
Manufacturer : Thermo Scientific  
Model : 146i  
Serial Number : 1180540071

#### Multi-point gas test data

	Reference Value (ppb)		Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	1.9	1.90	1.90	1.90
Level 2	20.00%	100.0	101.7	1.70	1.67	1.67
Level 3	40.00%	200.0	201.5	1.50	0.74	0.74
Level 4	60.00%	300.0	301.5	1.50	0.50	0.50
Level 5	80.00%	400.0	400.8	0.80	0.20	0.20
Remark : Measuring Range 500.0 ppb			Average Difference (%)		1.00	

:Acceptable Limit  $\pm 5\%$

Multi-Point Gas Test Chart



Calculate by

Sirichai y.  
10 / 11 / 64

Approve by

Binun u  
10 Nov 2021

### MULTI-POINT GAS TEST REPORT

Test Date : June 24, 2022

Equipment : Gas Analyzer (NO<sub>2</sub>) Model : 42i  
Manufacturer : Thermo Scientific Serial Number : CM19050151

#### Standard Gas Concentration

Sulphur Dioxide (SO<sub>2</sub>) 44.75 PPM  
Nitric Oxide (NO) 45.35 PPM  
Methane (CH<sub>4</sub>) - PPM  
Carbon Monoxide (CO) 1007  
Cylinder No. : CC159599  
Expiration Date : Jul 30, 2022

#### Dilutor Detail

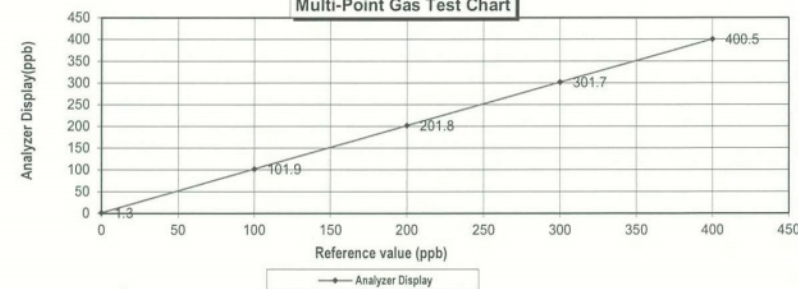
Manufacturer : Thermo Scientific  
Model : 146i  
Serial Number : 1180540071

#### Multi-point gas test data

	Reference Value (ppb)		Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	1.3	1.30	1.30	1.30
Level 2	20.00%	100.0	101.9	1.90	1.86	1.86
Level 3	40.00%	200.0	201.8	1.80	0.89	0.89
Level 4	60.00%	300.0	301.7	1.70	0.56	0.56
Level 5	80.00%	400.0	400.5	0.50	0.12	0.12
Remark : Measuring Range 500.0 ppb			Average Difference (%)		0.95	

:Acceptable Limit  $\pm 5\%$

Multi-Point Gas Test Chart



Calculate by

Sirichai y.  
24 / 06 / 65

Approve by

Binun u  
24 June 2022



## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E04NI99E15A01D3  
Cylinder Number: EB0143262  
Laboratory: 124 - Durham (SAP) - NC  
PGVP Number: B22021  
Gas Code: CO,NO,NOX,SO2,BALN

Reference Number: 122-402135167-1  
Cylinder Volume: 144.4 CF  
Cylinder Pressure: 2015 PSIG  
Valve Outlet: 660  
Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.96 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	45.00 PPM	45.94 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.00 PPM	44.68 PPM	G1	+/- 1.0% NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	1000 PPM	984.6 PPM	G1	+/- 0.7% NIST Traceable	06/14/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20061120	CC708068	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12386	D685025	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 20, 2020
GMIS	401423838102	CC505581	4.348 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 18, 2023
NTRM	16011043	CC473277	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14060119	CC434277	990.9 PPM CARBON MONOXIDE/NITROGEN	+/-0.6%	Nov 15, 2025

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AHR0801333 CO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO2	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 SO2	FTIR	Jun 03, 2021

Triad Data Available Upon Request

NOTES:PO #5221002807

GROSS WT: 28.40kg

NET WT: 4.73kg



The analytical test results reported on this certificate relate only to the cylinder number specified above. This concludes the test report.

*[Signature]*

Approved for Release



CERT 3082.01

เอกสารไม่ควบคุม

## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E04NI99E15A01D3  
Cylinder Number: EB0143262  
Laboratory: 124 - Durham (SAP) - NC  
PGVP Number: B22021  
Gas Code: CO,NO,NOX,SO2,BALN

Reference Number: 122-402135167-1  
Cylinder Volume: 144.4 CF  
Cylinder Pressure: 2015 PSIG  
Valve Outlet: 660  
Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.96 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	45.00 PPM	45.94 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.00 PPM	44.68 PPM	G1	+/- 1.0% NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	1000 PPM	984.6 PPM	G1	+/- 0.7% NIST Traceable	06/14/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20061120	CC708068	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12386	D685025	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 20, 2020
GMIS	401423838102	CC505581	4.348 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 18, 2023
NTRM	16011043	CC473277	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14060119	CC434277	990.9 PPM CARBON MONOXIDE/NITROGEN	+/-0.6%	Nov 15, 2025

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AHR0801333 CO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO2	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 SO2	FTIR	Jun 03, 2021

Triad Data Available Upon Request

NOTES:PO #5221002807

GROSS WT: 28.40kg

NET WT: 4.73kg



The analytical test results reported on this certificate relate only to the cylinder number specified above. This concludes the test report.

*[Signature]*

Approved for Release



CERT 3082.01

เอกสารไม่ควบคุม

**MULTI-POINT GAS TEST REPORT**

Test Date : Dec 21, 2021

Equipment : Gas Analyzer (CO) Model : 48i  
Manufacturer : Thermo Scientific Serial Number : 1201778119

**Standard Gas Concentration**

Sulphur Dioxide (SO<sub>2</sub>) 44.75 PPM  
Nitric Oxide (NO) 45.35 PPM  
Methane (CH<sub>4</sub>) - PPM  
Carbon Monoxide (CO) 1007 PPM  
Cylinder No. : CC159599  
Expiration Date : Jul 30, 2022

**Dilutor Detail**

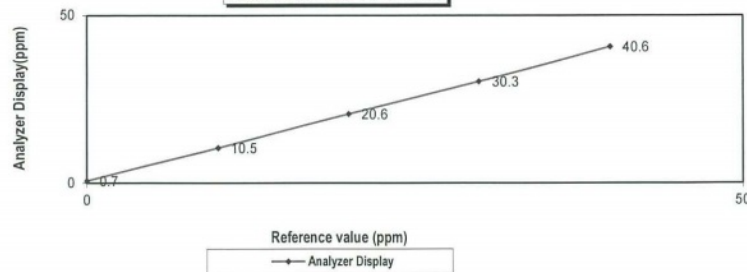
Manufacturer : Thermo Scientific  
Model : 146i  
Serial Number : 1180540071

**Multi-point gas test data**

Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1 Zero 0.0	0.7	0.7	0.7	0.7
Level 2 20.00% 10.0	10.5	0.5	4.8	4.8
Level 3 40.00% 20.0	20.6	0.6	2.9	2.9
Level 4 60.00% 30.0	30.3	0.3	1.0	1.0
Level 5 80.00% 40.0	40.6	0.6	1.5	1.5

Remark : Measuring Range 50.0 ppm  
Acceptable Limit  $\pm 5\%$

**Multi-Point Gas Test Chart**



Calculate by

*Snichas y.*  
21, Dec, 2021

Approve by

*Prakhan u.*  
21, Dec, 2021

**MULTI-POINT GAS TEST REPORT**

Test Date : June 15, 2022

Equipment : Gas Analyzer (CO) Model : 48i  
Manufacturer : Thermo Scientific Serial Number : 1201778119

**Standard Gas Concentration**

Sulphur Dioxide (SO<sub>2</sub>) 44.75 PPM  
Nitric Oxide (NO) 45.35 PPM  
Methane (CH<sub>4</sub>) - PPM  
Carbon Monoxide (CO) 1007 PPM  
Cylinder No. : CC159599  
Expiration Date : Jul 30, 2022

**Dilutor Detail**

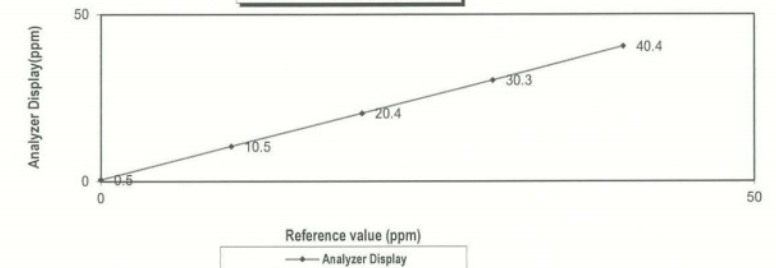
Manufacturer : Thermo Scientific  
Model : 146i  
Serial Number : 1180540071

**Multi-point gas test data**

Reference Value (ppm)	Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1 Zero 0.0	0.5	0.5	0.5	0.5
Level 2 20.00% 10.0	10.5	0.5	4.8	4.8
Level 3 40.00% 20.0	20.4	0.4	2.0	2.0
Level 4 60.00% 30.0	30.3	0.3	1.0	1.0
Level 5 80.00% 40.0	40.4	0.4	1.0	1.0

Remark : Measuring Range 50.0 ppm  
Acceptable Limit  $\pm 5\%$

**Multi-Point Gas Test Chart**



Calculate by

*Snichas y.*  
15, 06, 2022

Approve by

*Prakhan u.*  
16, June, 2022

## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E04NI99E15A01D3  
Cylinder Number: EB0143262  
Laboratory: 124 - Durham (SAP) - NC  
PGVP Number: B22021  
Gas Code: CO,NO,NOX,SO2,BALN

Reference Number: 122-402135167-1  
Cylinder Volume: 144.4 CF  
Cylinder Pressure: 2015 PSIG  
Valve Outlet: 660  
Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.96 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	45.00 PPM	45.94 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.00 PPM	44.68 PPM	G1	+/- 1.0% NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	1000 PPM	984.6 PPM	G1	+/- 0.7% NIST Traceable	06/14/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20061120	CC708068	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12386	D685025	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 20, 2020
GMIS	401423838102	CC505581	4.348 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 18, 2023
NTRM	16011043	CC473277	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14060119	CC434277	990.9 PPM CARBON MONOXIDE/NITROGEN	+/-0.6%	Nov 15, 2025

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AHR0801333 CO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO2	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 SO2	FTIR	Jun 03, 2021

Triad Data Available Upon Request

NOTES:PO #5221002807

GROSS WT: 28.40kg

NET WT: 4.73kg



The analytical test results reported on this certificate relate only to the cylinder number specified above. This concludes the test report.

*[Signature]*

Approved for Release



เอกสารไม่ควบคุม

## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E04NI99E15A01D3  
Cylinder Number: EB0143262  
Laboratory: 124 - Durham (SAP) - NC  
PGVP Number: B22021  
Gas Code: CO,NO,NOX,SO2,BALN

Reference Number: 122-402135167-1  
Cylinder Volume: 144.4 CF  
Cylinder Pressure: 2015 PSIG  
Valve Outlet: 660  
Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.96 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	45.00 PPM	45.94 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.00 PPM	44.68 PPM	G1	+/- 1.0% NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	1000 PPM	984.6 PPM	G1	+/- 0.7% NIST Traceable	06/14/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20061120	CC708068	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12386	D685025	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 20, 2020
GMIS	401423838102	CC505581	4.348 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 18, 2023
NTRM	16011043	CC473277	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14060119	CC434277	990.9 PPM CARBON MONOXIDE/NITROGEN	+/-0.6%	Nov 15, 2025

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AHR0801333 CO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO2	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 SO2	FTIR	Jun 03, 2021

Triad Data Available Upon Request

NOTES:PO #5221002807

GROSS WT: 28.40kg

NET WT: 4.73kg



The analytical test results reported on this certificate relate only to the cylinder number specified above. This concludes the test report.

*[Signature]*

Approved for Release



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# THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804,0-2399-0469

## Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 7 April, 2022

Certification No. 148/22

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : LSI

Type : Dato Logger E-LOG 305 wind speed and wind direction DNA 827  
Thermoigrometers DMA875 Barometer DQA 801

Mfg Code : Dato Logger 19040405 wind speed and wind direction 19050234  
Thermoigrometers 19050006 Barometer 19040218

Customer : United Analyst and Engineering Consultant Co.,Ltd.  
81 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Prakanong, Bangkok 10260.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1014.1 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

N.I.S.T. Test Reference Number 731/241460

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

STANDARD THERMOMETER : Theodor Friedrich : Dry No.8390/94 Wet No. 8389/94

: testo, testo 645 Serial No. 02848057 : Thermoschneider No.918802

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. V1220015

: Digital Barometer Vaisala Type PTB330 No. R4320001

(Authorised Signatory)

for the Chief  
Sub-Standard Instrument  
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Mechanical Engineer



# THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804,0-2399-0469

## The Result of Calibration

Certification No. 148/22

7 April, 2022

Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacumm	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	1.0	
3.02	-	-	-	2.9	0.12
5.00	-	-	-	4.7	0.30
7.04	-	-	-	6.9	0.14
9.02	-	-	-	8.7	0.32
11.02	-	-	-	10.8	0.22
13.01	-	-	-	12.7	0.31
15.01	-	-	-	14.8	0.21
17.02	-	-	-	16.7	0.32
20.02	-	-	-	19.8	0.22

Wind Aloft Plotting Board.	
U.S.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrate

Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

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# THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804,0-2399-0469

## Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 2 August, 2022

Certification No. 275/22

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : LSI

Type : Dato Logger E-LOG 305 wind speed and wind direction DNA 821

Serial No. : Dato Logger 20040002 wind speed and wind direction 20040162

ID No. : No.2/20

Customer : United Analyst and Engineering Consultant Co.,Ltd.  
81 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Prakanong, Bangkok 10260.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1007.7 hPa

### NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 Pitot Tube Theodor Friedrichs Type 0800.0000 serial 9023

N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec

Mechanical Engineer



# THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804,0-2399-0469

## The Result of Calibration

Certification No. 275/22

2 August, 2022

Page : 2 of 2

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure m/sec	Vacuum inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	3.0	0.02
5.00	-	-	-	4.9	0.10
7.04	-	-	-	6.8	0.24
9.02	-	-	-	8.8	0.22
11.01	-	-	-	10.7	0.31
13.01	-	-	-	12.7	0.31
15.01	-	-	-	14.6	0.41
17.02	-	-	-	16.6	0.42
20.02	-	-	-	19.5	0.52

Wind Aloft Plotting Board.	
US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated



Mechanical Engineer



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# CALIBRATION LABORATORY Co., LTD.

2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230  
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : VIBRATION METER  
MANUFACTURER : INSTANTEL  
MODEL / TYPE : 721A2601/721A3301  
SERIAL NO. : UM14547/UM14547  
CLID. NO. : 252000390  
JOB CONTROL NO. : 220207012261

CUSTOMER : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
81 SOI UDOMSUK 41, SUKHUMVIT ROAD,  
BANGCHAK, PHRAKHANONG, BANGKOK 10260

DATE OF RECEIVED : 07 February 2022

DATE OF ISSUED : 10 February 2022

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

Calibrated By : Suwit Phuanbusabong  
Calibration Engineer



Approved By : Mongkol Yotsoontorn  
Authorized Signatory  
10 February 2022

This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q22012261

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# CALIBRATION LABORATORY Co., LTD.

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Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : VIBRATION METER  
MANUFACTURER : INSTANTEL  
MODEL / TYPE : 721A2601/721A3301  
SERIAL NO. : UM14547/UM14547  
DATE OF CALIBRATION : 08 February 2022

#### ENVIRONMENT CONDITIONS :

Temperature :  $(23 \pm 2) ^\circ\text{C}$  Relative Humidity :  $(55 \pm 15) \% \text{RH}$

#### PROCEDURE USED :

This instrument was calibrated under procedure No. CLC-CPEE-08 based on ISO 16063-21 as calibration guideline.  
The calibration was performed by using Digital Multimeter, Universal Counter and Portable Vibration Calibrator which maintained by the Calibration Laboratory Co., Ltd.

#### REFERENCE STANDARD USED :

1. Digital Multimeter, Wavetek Model 1281 S/N. 29320.
2. Universal Counter, Hewlett Packard Model 5315A S/N. 2448A13042.
3. Portable Vibration Calibrator, The Modal Shop Model 9110D S/N. 11424.

#### TRACEABILITY :

1. The measurements are traceable to International System of Units (SI), through Aeronautical Radio of Thailand Ltd. Certificate No. 05-0207/21, Due Date 31 May 2023.
2. The measurements are traceable to International System of Units (SI), through Aeronautical Radio of Thailand Ltd. Certificate No. 07-0073/21, Due Date 14 May 2022.
3. The measurements are traceable to International System of Units (SI), through The Modal Shop, Inc. Certificate No. 2649.01, Due Date 10 November 2022.

#### UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k = 2,00$  which for a normal distribution corresponds to a coverage probability of approximately 95 %.  
It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2013)"

Certificate No. Q22012261

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**CONDITION OF CALIBRATION ITEM : GOOD**

**MEASUREMENT RESULTS : ( X ) without adjustment ( ) adjustment**

**CALIBRATION DATA**

**1. ACCELERATION RESULT**

Test point		Mode	STD Reading ( g )	DUC Reading ( g )	Correction ( g )	Uncertainty ± ( % of rdg. )
( g )	( frequency )					
0.3	50 Hz	peak	0.300	0.304	-0.004	1.9
0.4	50 Hz		0.400	0.407	-0.007	1.9
0.5	50 Hz		0.500	0.508	-0.008	1.3
0.6	50 Hz		0.600	0.611	-0.011	1.3
0.7	50 Hz		0.700	0.714	-0.014	1.3
0.3	100 Hz	peak	0.300	0.305	-0.005	1.9
0.4	100 Hz		0.400	0.407	-0.007	1.9
0.5	100 Hz		0.500	0.510	-0.010	1.3
0.6	100 Hz		0.600	0.613	-0.013	1.3
0.7	100 Hz		0.700	0.715	-0.015	1.3

**2. VELOCITY RESULT**

Test point		Mode	STD Reading ( mm/s )	DUC Reading ( mm/s )	Correction ( mm/s )	Uncertainty ± ( % of rdg. )
( mm/s )	( frequency )					
3	50 Hz	peak	3.000	3.035	-0.035	1.8
4	50 Hz		4.000	4.046	-0.046	1.8
5	50 Hz		5.000	5.063	-0.063	1.8
6	50 Hz		6.000	6.079	-0.079	1.8
7	50 Hz		7.000	7.088	-0.088	1.8
3	100 Hz	peak	3.000	3.036	-0.036	1.8
4	100 Hz		4.000	4.049	-0.049	1.8
5	100 Hz		5.000	5.066	-0.066	1.8
6	100 Hz		6.000	6.082	-0.082	1.8
7	100 Hz		7.000	7.093	-0.093	1.8

Certificate No. Q22012261

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**CALIBRATION DATA**

**\*3. DISPLACEMENT RESULT**

Test point		Mode	STD Reading ( mm )	DUC Reading ( mm )	Correction ( mm )	Uncertainty ± ( % of rdg. )
( mm )	( frequency )					
0.03	50 Hz	peak	0.030	0.030	0.000	2.1
0.04	50 Hz		0.040	0.040	0.000	1.7
0.05	50 Hz		0.050	0.051	-0.001	1.5
0.06	50 Hz		0.060	0.061	-0.001	1.3
0.07	50 Hz		0.070	0.072	-0.002	1.2
0.03	100 Hz	peak	0.030	0.030	0.000	2.1
0.04	100 Hz		0.040	0.040	0.000	1.7
0.05	100 Hz		0.050	0.050	0.000	1.5
0.06	100 Hz		0.060	0.061	-0.001	1.3
0.07	100 Hz		0.070	0.071	-0.001	1.2

Note. \* means Calibrations marked " Not ANAB Accredited " in this Certificate have been included for completeness.

The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 1 of 58

This report is valid for the above stated instrument/s only.

### End of Certificate ###

Certificate No. Q22012261

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# CALIBRATION LABORATORY Co., LTD.

2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230  
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



## CERTIFICATE OF CALIBRATION

### FOR

NOMENCLATURE : VIBRATION METER  
MANUFACTURER : INSTANTEL  
MODEL / TYPE : 721A2501/721A2901  
SERIAL NO. : UM12889/UM12889  
CLID. NO. : 251801805  
JOB CONTROL NO. : 220530053609

CUSTOMER : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
81 SOI UDOMSUK 41, SUKHUMVIT ROAD,  
BANGCHAK, PHRAKHANONG, BANGKOK 10260

DATE OF RECEIVED : 30 May 2022

DATE OF ISSUED : 02 June 2022

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

Calibrated By : Suwit Phuanbusabong  
Calibration Engineer

Approved By : Mongkol Yotsoontorn  
Authorized Signatory  
02 June 2022



This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q22053609

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# CALIBRATION LABORATORY Co., LTD.

2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230  
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## REPORT OF CALIBRATION

### FOR

NOMENCLATURE : VIBRATION METER  
MANUFACTURER : INSTANTEL  
MODEL / TYPE : 721A2501/721A2901  
SERIAL NO. : UM12889/UM12889  
DATE OF CALIBRATION : 31 May 2022

#### ENVIRONMENT CONDITIONS :

Temperature :  $(23 \pm 2) ^\circ\text{C}$

Relative Humidity :  $(55 \pm 15) \% \text{RH}$

#### PROCEDURE USED :

This instrument was calibrated under procedure No. CLC-CPEE-08 based on ISO 16063-21 as calibration guideline. The calibration was performed by using Digital Multimeter, High Resolution Programmable Timer/Counter and Portable Vibration Calibrator which maintained by the Calibration Laboratory Co., Ltd.

#### REFERENCE STANDARD USED :

- Digital Multimeter, Wavetek Model 1281 S/N. 29320.
- High Resolution Programmable Timer/Counter, Philips Model PM6680B S/N. SM607101.
- Portable Vibration Calibrator, The Modal Shop Model 9110D S/N. 11424.

#### TRACEABILITY :

- The measurements are traceable to International System of Units (SI), through Aeronautical Radio of Thailand Ltd. Certificate No. 05-0207/21, Due Date 31 May 2023.
- The measurements are traceable to International System of Units (SI), through Aeronautical Radio of Thailand Ltd. Certificate No. 07-0001/22, Due Date 22 February 2023.
- The measurements are traceable to International System of Units (SI), through The Modal Shop, Inc. Certificate No. 2649.01, Due Date 10 November 2022.

#### UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k = 2,00$  which for a normal distribution corresponds to a coverage probability of approximately 95 %. It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2021)"

Certificate No. Q22053609

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# CALIBRATION LABORATORY Co.,LTD.

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# CALIBRATION LABORATORY Co.,LTD.

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Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : ( X ) without adjustment ( ) adjustment

## CALIBRATION DATA

### 1. ACCELERATION RESULT

Test point		Mode	STD Reading ( g )	DUC Reading ( g )	Correction ( g )	Uncertainty ± ( % of rdg. )
( g )	( frequency )					
0.3	50 Hz	peak	0.300	0.308	-0.008	1.9
0.4	50 Hz		0.400	0.411	-0.011	1.9
0.5	50 Hz		0.500	0.517	-0.017	1.3
0.6	50 Hz		0.600	0.618	-0.018	1.3
0.7	50 Hz		0.700	0.719	-0.019	1.3
0.3	100 Hz	peak	0.300	0.308	-0.008	1.9
0.4	100 Hz		0.400	0.411	-0.011	1.9
0.5	100 Hz		0.500	0.515	-0.015	1.3
0.6	100 Hz		0.600	0.618	-0.018	1.3
0.7	100 Hz		0.700	0.720	-0.020	1.3

### 2. VELOCITY RESULT

Test point		Mode	STD Reading ( mm/s )	DUC Reading ( mm/s )	Correction ( mm/s )	Uncertainty ± ( % of rdg. )
( mm/s )	( frequency )					
3	50 Hz	peak	3.000	3.070	-0.070	1.8
4	50 Hz		4.000	4.079	-0.079	1.8
5	50 Hz		5.000	5.118	-0.118	1.8
6	50 Hz		6.000	6.133	-0.133	1.8
7	50 Hz		7.000	7.177	-0.177	1.8
3	100 Hz	peak	3.000	3.056	-0.056	1.8
4	100 Hz		4.000	4.063	-0.063	1.8
5	100 Hz		5.000	5.075	-0.075	1.8
6	100 Hz		6.000	6.103	-0.103	1.8
7	100 Hz		7.000	7.149	-0.149	1.8

Certificate No. Q22053609

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## CALIBRATION DATA

### 3. DISPLACEMENT RESULT

Test point		Mode	STD Reading ( mm )	DUC Reading ( mm )	Correction ( mm )	Uncertainty ± ( % of rdg. )
( mm )	( frequency )					
*0.03	50 Hz	peak	0.030	0.030	0.000	2.1
*0.04	50 Hz		0.040	0.040	0.000	1.7
*0.05	50 Hz		0.050	0.050	0.000	1.5
*0.06	50 Hz		0.060	0.061	-0.001	1.3
*0.07	50 Hz		0.070	0.071	-0.001	1.2
0.03	100 Hz	peak	0.030	0.030	0.000	2.1
0.04	100 Hz		0.040	0.040	0.000	1.7
0.05	100 Hz		0.050	0.050	0.000	1.5
0.06	100 Hz		0.060	0.061	-0.001	1.3
0.07	100 Hz		0.070	0.071	-0.001	1.2

Note. \* means Calibrations marked " Not ANAB Accredited " in this Certificate have been included for completeness.

The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 1 of 58

This report is valid for the above stated instrument/s only.

### End of Certificate ###

Certificate No. Q22053609

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### Certificate of Calibration

#### Customer

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

Certificate No : 22-ACT-406

Request No : Req-2022-1080

Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
 Prakanong, Bangkok 10260

#### Unit Under Calibration Details

Measurement item : Acoustic Calibrator

Class : 1

Manufacturer : SVANTEK

Range : 94 , 114 dB / 1000 Hz

Model : SV 35A

Instrumnt Status : Used

Serial Number : 73249

ID : UAE.EFM.105/2561

#### Calibration Environment and Details

Temperature : ( 23 ±2 °C )

Humidity : (50 ± 20 %RH )

Barometric Pressure : (1013 ±10.0 hPa )

Received Date : 15 June 2022

Calibration Date : 1 July 2022

Location of Calibration : LAB 1 Acoustic


Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators


Reference Standard	Model	Serial Number	Traceable	Due Calibration
Sound Calibrator	SV 35A	58079	EEI	31 May 2023
THD Multimeter	2015	1047765	NIMT	2 February 2023

**Traceability** : This certificate provides traceability of measurement to recognized national standard, and to the realization of the international System of Units (SI).

#### Note

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor k=2, providing a level of confidence approximately 95 %.

Calibrated By :   
 Mr. Noppadon Luangart  
 Service Calibration Engineer

Approved By :   
 Mr. Pacit Mathavorn  
 Calibration Engineer Supervisor

Issue Date : 1 July 2022

Certificate No : 22-ACT-406

Request No : Req-2022-1080

#### Sound pressure level

#### Calibration Results : Without Adjustment

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty ( ± dB)	Acceptance limit Class 1 ( ± dB)
	Measured	Error	Measured	Error		
94 dB / 1000 Hz	93.82	-0.18	-	-	0.11	0.25
114 dB / 1000 Hz	113.81	-0.19	-	-	0.11	0.25

#### Frequency of Sound pressure level

Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty ( ± %)	Acceptance limit Class 1 ( ± %)
	Measured (Hz)	Error (%)	Measured (Hz)	Error (%)		
94 dB / 1000 Hz	1000.00	0.00	-	-	0.10	0.70
114 dB / 1000 Hz	1000.00	0.00	-	-	0.10	0.70

#### Total Harmonic Distortion plus Noise of Sound pressure level (THD+N %)

Calibration Range (Hz)	Without Adjustment	Adjustment	Uncertainty ( ± %)	Acceptance limit Class 1 ( ± %)
	Measured (%)	Measured (%)		
94 dB / 1000 Hz	0.17	-	0.40	2.5
114 dB / 1000 Hz	0.04	-	0.40	2.5

#### Note :

- Acceptance limit was IEC60942:2017 Class 1

- The calibration results exclude the calibrator pressure correction

- The calibration results exclude the microphone volume correction

#### End of Calibration



## Certificate of Calibration

### Customer

Name : UNITED ANALYST AND ENGINEERING CONSULTANT  
 CO.,LTD.  
 Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak,  
 Prakanong, Bangkok 10260

Certificate No : 22-ACT-405  
 Request No : Req-2022-1080

### Unit Under Calibration Details

Measurement item : Acoustic Calibrator Class : 1  
 Manufacturer : SVANTEK Range : 94 , 114 dB / 1000 Hz  
 Model : SV 35A Intrument Status : Used  
 Serial Number : 73246  
 ID : UAE.EFM.104/2561

### Calibration Environment and Details

Temperature : ( 23 ±2 °C )  
 Humidity : ( 50 ± 20 %RH )  
 Barometric Pressure : ( 1013 ±10.0 hPa )  
 Received Date : 15 June 2022  
 Calibration Date : 1 July 2022  
 Location of Calibration : LAB 1 Acoustic  
 Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Sound Calibrator	SV 35A	58079	EEI	31 May 2023
THD Multimeter	2015	1047765	NIMT	2 February 2023

**Traceability** : This certificate provides traceability of measurement to recognized national standard, and to the realization of the international System of Units (SI).

### Note

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor k=2, providing a level of confidence approximately 95 %.

Calibrated By :                     me                      
 Mr. Noppadon Luangart  
 Service Calibration Engineer

Approved By :                     ชก                      
 Mr. Pacit Mathavorn  
 Calibration Engineer Supervisor

Issue Date : 1 July 2022

Certificate No : 22-ACT-405

Request No : Req-2022-1080

### Sound pressure level

### Calibration Results : Without Adjustment

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty ( ± dB)	Acceptance limit Class 1 ( ± dB)
	Measured	Error	Measured	Error		
94 dB / 1000 Hz	93.80	-0.20	-	-	0.12	0.25
114 dB / 1000 Hz	113.77	-0.23	-	-	0.11	0.25

### Frequency of Sound pressure level

Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty ( ± %)	Acceptance limit Class 1 ( ± %)
	Measured (Hz)	Error (%)	Measured (Hz)	Error (%)		
94 dB / 1000 Hz	1000.00	0.00	-	-	0.10	0.70
114 dB / 1000 Hz	1000.00	0.00	-	-	0.10	0.70

### Total Harmonic Distortion plus Noise of Sound pressure level (THD+N %)

Calibration Range (Hz)	Without Adjustment	Adjustment	Uncertainty ( ± %)	Acceptance limit Class 1 ( ± %)
	Measured (%)	Measured (%)		
94 dB / 1000 Hz	0.09	-	0.40	2.5
114 dB / 1000 Hz	0.31	-	0.40	2.5

### Note :

- Acceptance limit was IEC60942:2017 Class 1
- The calibration results exclude the calibrator pressure correction
- The calibration results exclude the microphone volume correction

End of Calibration

# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

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



Cert. No. : ACL22080  
Pages : 1 of 9

## Calibration Certificate

**Equipment :** SOUND LEVEL METER  
**Manufacturer :** ACO  
**Model :** TYPE 6236/ Microphone 7052NR / Preamplifier -  
**Serial No.:** 182020 / 69852 / -  
**ID No.:** -

**Condition As Found :** GOOD

**Customer :** UNITED ANALYST AND ENGINEERING CONSULTANT (UAE)  
81 SOI UDOMSUK 41, SUKHUMVIT ROAD,  
BANGCHAK SUB-DISTRICT,  
PHRAKHANONG DISTRICT, BANGKOK 10260  
THAILAND.

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

**Received Date :** 18 JANUARY 2022  
**Calibration Date :** 26 JANUARY 2022  
**Date of Issue :** 28 JANUARY 2022

**Calibrated by :** Nathakorn Pisutpaisan

**Approved by :**

*T. Petchur*  
( Thanakul Petchurai )

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

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# SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

## Continuation of Calibration Certificate

Cert. No. : ACL22080  
Job No. : VC65AC0044  
Pages : 2 of 9

**Calibration Procedure :** CP-AC-02

### Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).  
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.  
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

### Condition of this result of calibration :

#### 1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

- 3.1 National Institute of Metrology (Thailand).
- 3.2 Thailand Institute of Scientific and Technological Research (TISTR).

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*T. Petchur*



## Continuation of Calibration Certificate

Cert. No. : ACL22080  
Job No. : VC65AC0044  
Pages : 3 of 9

Summary of Measurement Result :

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

## Continuation of Calibration Certificate

Cert. No. : ACL22080  
Job No. : VC65AC0044  
Pages : 4 of 9

Result of calibration :

## 1. Absolute sensitivity

Reference Acoustic Signal ( dB )	Measured Value ( dB )	Deviation ( dB )	Acceptance Limit ( dB )
93.9 (93.96)	94.0	0.0	±0.3

## 2. Self-generated noise

## 2.1 Normal test

Measured Value ( dB )
28.6

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

Frequency Weighting	Measured value ( dB )
A - weight	28.2
C - weight	28.8
Flat	32.7

## 3. Acoustical signal tests of frequency weightings

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

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	-0.2	-0.2	-0.2	± 1.5
1000	-0.3	-0.3	-0.3	± 1.0
8000	0.5	0.3	0.3	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL22080  
Job No. : VC65AC0044  
Pages : 5 of 9

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency ( Hz )	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
63	-0.1	0.0	0.2	±2.0
125	-0.1	0.0	0.2	±1.5
250	0.0	0.0	0.1	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	-0.1	±2.0
4000	-0.1	-0.3	-0.4	±3.0
8000	-0.2	-0.4	-0.5	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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*G. Petch*

Continuation of Calibration Certificate

Cert. No. : ACL22080  
Job No. : VC65AC0044  
Pages : 6 of 9

7. Level linearity on the reference level range

Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.1	0.1	± 1.1
129.0	129.1	0.1	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.1	0.1	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.1	0.1	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.1	0.1	± 1.1
49.0	49.1	0.1	± 1.1
44.0	44.2	0.2	± 1.1
39.0	39.4	0.4	± 1.1

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*G. Petch*



Continuation of Calibration Certificate

Cert. No. : ACL22080  
Job No. : VC65AC0044  
Pages : 7 of 9

8. Level linearity including the level range control

Range	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
130	94.0	94.0	0.0	±0.5
120	94.0	94.0	0.0	±0.5
110	94.0	94.0	0.0	±0.5
100	94.0	93.9	-0.1	±0.5
90	94.0	94.0	0.0	±0.5

Level linearity on each level range

Range	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
130	43.0	43.1	0.1	±0.5
120	33.0	33.1	0.1	±0.5

9. Tone burst response

Time Weighting	Tone burst duration, Tb ( ms )	Cycle	Anticipated Value ( dB )	Measured Value ( dB )	Deviated Value ( dB )	Acceptance Limits ( dB )
Fast	0.25	1	108.0	107.7	-0.3	1.5 ; -5.0
	2	8	117.0	116.7	-0.3	1.0 ; -2.5
	200	800	134.0	133.6	-0.4	±1.0
Slow	2	8	108.0	107.9	-0.1	1.5 ; -5.0
	200	800	127.6	127.4	-0.2	±1.0
SEL	0.25	1	99.0	99.0	0.0	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

Continuation of Calibration Certificate

Cert. No. : ACL22080  
Job No. : VC65AC0044  
Pages : 8 of 9

10. Peak C sound level

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

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

11. Overload indication

Measured value ( dB )		Deviated Value ( dB )	Acceptance Limits ( dB )
Positive one-half cycle	Negative one-half cycle		
90.2	90.1	-0.1	±1.5

## Continuation of Calibration Certificate

Cert. No. : ACL22080  
Job No. : VC65AC0044  
Pages : 9 of 9

## 12. High level stability

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

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

End of Calibration Certificate

INNOVATIVE INSTRUMENT CALIBRATION LAB  
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE  
7/139 MOO 13, SOI SUNTINAKORN 11 TAMBON BANG KAE0,  
AMPHOE BANG PHU SAMUT PRAKAN PROVINCE 10540 THAILAND  
TEL: (6690)2116-5860-1 FAX: (6690)2116-7140



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## Certificate of Calibration

## Customer

Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok  
10260

Certificate No : 22-ACT-247

Request No : Req-2022-0627

## Unit Under Calibration Details

Measurement item : Sound Level Meter  
Manufacturer : LARSON DAVIS  
Model : LxT2  
Serial Number : 0005395  
ID : UAE.EFM.032/2564  
Resolution : 0.1 dB  
Microphone Class : 2  
Microphone Model : 375A04  
Microphone S/N : 329355  
Preamplifier Model : PRMLxT2C  
Preamplifier S/N : 073797  
Instrument Status : Used

## Calibration Environment and Details

Temperature : 23 °C ± 2 °C  
Humidity : 50 %RH ± 20 %RH  
Barometric Pressure : 1013 hPa ± 10 hPa  
Received Date : 23 March 2022  
Calibrated Date : 1 April 2022  
Calibration Procedure : In-house method CP-SLM-01 based on IEC 61672-3 : 2013 Electroacoustics - Sound level meters - Part 3: Periodic tests  
Location of Calibration : Lab Acoustic

## Reference Standard

Instrument	Brand	Model	SN.	Due calibration	Traceability
Standard Microphone	GRAS	40AN	188273	15 September 2022	GRAS
Multifrequency Calibrator	Quest	Quest-cal	EFA000234	14 June 2022	TSI
Audio Generator	Svantek	Svan401	131	18 October 2022	WK Electric

## Note

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor  $k = 2$ , providing a level of confidence approximately 95 %.

Calibrated By :   
Mr. Noppadon Luangart  
Calibration Officer

Approved By :   
Mr. Pacit Mathavorn  
Calibration Engineer Supervisor  
Issue Date : 1 April 2022



Certificate No : 22-ACT-247

Request No : Req-2022-0627

#### 1. Indication at the calibration check frequency

UUC Setting	Nominal	Before Adjust		Adjust		UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)
FAST / A / 37-139	Level	UUC	ERR	UUC	ERR		
Calibrator Setting	(dB)	(dB)	(dB)	(dB)	(dB)		
1000 Hz 114.00 dB	113.85	113.8	-0.05	113.9	0.05	0.20	0.3

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 35A, SN.58079

#### 2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139		
UUC Weighting	(dB)	( ± dB)
A	28.4	0.10

#### 3. Self-generated noise, Microphone replaced by the electrical input signal device

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139		
UUC Weighting	(dB)	( ± dB)
A	28.1	0.10
C	27.7	0.10
Z	32.0	0.10

#### 4. Acoustic signal test of frequency weightings (Without Windscreen)

UUC Setting	Deviation from various Frequency Weighting Response curve			UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)
	A	C	Z		
FAST / 37-139	(dB)	(dB)	(dB)		
STD Setting	(dB)	(dB)	(dB)		
125 Hz	0.0	0.1	0.1	0.50	2.0
1000 Hz	0.0	0.0	0.0	0.60	1.0
4000 Hz	0.4	0.5	0.5	0.60	3.0
8000 Hz	0.2	0.1	0.3	0.70	5.0

Certificate No : 22-ACT-247

Request No : Req-2022-0627

#### 5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz

UUC Setting	Deviation from various Frequency Weighting Response curve			UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)
FAST / 37-139	A (dB)	C (dB)	Z (dB)		
STD Setting	(dB)	(dB)	(dB)		
63 Hz	-0.2	-0.1	-0.1	0.2	2.0
125 Hz	-0.1	0.0	0.0		1.5
250 Hz	-0.1	0.0	0.0		1.5
500 Hz	-0.1	0.0	0.0		1.5
1000 Hz	0.0	0.0	0.0		1.0
2000 Hz	0.0	0.0	0.0		2.0
4000 Hz	0.0	0.0	0.0		3.0
8000 Hz	-0.1	-0.1	0.0		5.0
16000 Hz	-0.1	-0.1	-0.1		+5, -INF.

#### 6. Frequency and time weightings at 1kHz

UUC Setting	STD	Measured		UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)
FAST / 37-139	REF	UUC	ERR		
UUC Weighting	(dB)	(dB)	(dB)		
A	114.00	114.0	0.0	0.2	0.2
C	114.00	114.0	0.0		0.2
Z	114.00	114.0	0.0		0.2

UUC Setting	STD	Measured		UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)
37-139 / A	REF	UUC	ERR		
UUC Time Response	(dB)	(dB)	(dB)		
Fast	114.00	114.0	0.0	0.2	0.1
Slow	114.00	114.0	0.0		0.1
Leq	114.00	114.0	0.0		0.1

Certificate No : 22-ACT-247  
 Request No : Req-2022-0627

#### 7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)
FAST / A / 37-139	UUC		
STD Setting	(dB)		
Initial	114.0		
Final	114.0		
Deviated	0.0	0.1	0.3

#### 8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation		UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)
FAST / A / 37-139	REF	UUC	ERR		
STD dB	(dB)	(dB)	(dB)		
139.00	139	139.0	0.0	0.3	1.1
134.00	134	134.0	0.0		1.1
129.00	129	129.0	0.0		1.1
124.00	124	124.0	0.0		1.1
119.00	119	119.0	0.0		1.1
114.00	114	114.0	0.0		1.1
109.00	109	109.0	0.0		1.1
104.00	104	104.0	0.0		1.1
99.00	99	99.0	0.0		1.1
94.00	94	94.0	0.0		1.1
89.00	89	89.0	0.0		1.1
84.00	84	84.0	0.0		1.1
79.00	79	79.0	0.0		1.1
74.00	74	74.0	0.0		1.1
69.00	69	69.0	0.0		1.1
64.00	64	64.0	0.0		1.1
59.00	59	59.0	0.0		1.1
54.00	54	54.0	0.0		1.1
49.00	49	49.0	0.0		1.1
44.00	44	44.1	0.1		1.1
39.00	39	39.3	0.3		1.1
38.00	38	38.4	0.4		1.1

Certificate No : 22-ACT-247  
 Request No : Req-2022-0627

#### 9. Level linearity including the level range control

UUC Setting	STD	Measured		UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)
FAST / A	REF	UUC	ERR		
UUC Range	(dB)	(dB)	(dB)		
37-139	43.4	43.5	0.1	0.3	1.1
	114	114.0	0.0		1.1

#### 10. Tone burst response

UUC Setting	STD	Anticipated	Measured		UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)
A / 37-139	Toneburst	Ref	UUC	ERR		
UUC Time Respon	(ms)	(dB)	(dB)	(dB)		
Fast	200	135.0	134.9	-0.1	0.3	1.0
	2	118.0	117.8	-0.2		+1.0, -2.5
	0.25	109.0	108.7	-0.3		+1.5, -5.0
Slow	200	128.6	128.4	-0.2		1.0
	2	109.0	108.8	-0.2		+1.0, -5.0
SEL	200	129.0	129.0	0.0		1.0
	2	109.0	109.1	+0.1		+1.0, -2.5
	0.25	100.0	99.9	-0.1		+1.5, -5.0

#### 11. Peak C Sound level

UUC Setting	Anticipated	Measured		UNCERTAINTY ( ± dB)	Acceptance Limit ( ± dB)
FAST / C / 95-142	REF	UUC	ERR		
STD Setting	(dB)	(dB)	(dB)		
Complete cycle	137.4	136.8	-0.60	0.2	3.0
Positive half cycle	136.4	136.2	-0.20		2.0
Negative half cycle	136.4	136.2	-0.20		2.0



Certificate No : 22-ACT-247

Request No : Req-2022-0627

#### 12. Overload indication

UUC Setting	Measured	UNCERTAINTY ( ± dB)	Acceptance Limit
FAST / A / 37-139	UUC		( ± dB)
STD Setting	(dB)		
Positive one-half cycle	142.2		
Negative one-half cycle	142.2		
Deviated	0.0	0.2	1.5

#### 13. High Level Stability

UUC Setting	Measured	UNCERTAINTY ( ± dB)	Acceptance Limit
FAST / A / 37-139	UUC		( ± dB)
STD Setting	(dB)		
Initial	138.0		
Final	138.0		
Deviated	0.0	0.1	0.3

End of Certificate



**ภาคผนวก ต-2**  
**เอกสารสอบเทียบ/ทวนสอบ**  
**เครื่องมือเก็บตัวอย่างและวิเคราะห์คุณภาพน้ำผิวดิน**



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
Laboratory Equipment for Water Analysis									
1	pH Meter	ความเป็นกรด-ด่าง (pH) อุณหภูมิมีน้ำ (Temperature)	Mettler-Toledo	Seven Easy S20 / 1230525212	National Food Institute, Ministry of Industry, Thailand	2202093-001-01	16 Mar 22	15 Mar 23	-
2	Conductivity Meter	ความเค็ม (Salinity), ค่าความนำไฟฟ้า (Conductivity)	SI Analytics	Lab955 / 16300356	SPC Calibration Center Co.,Ltd.	C24220084	22 Mar 22	21 Mar 23	-
3	BOD Incubator	ความสกปรกในรูปความต้องการใช้ออกซิเจนสำหรับย่อยสลายอินทรีย์ (BOD <sub>5</sub> )	Arco	UC4-1320 / (UAE.WAO.015/2561)	Technology Promotion Association (Thailand-Japan)	22TM90	17 Feb 22	16 Feb 23	-
4	BOD Incubator		Arco	UR-1320 / (UAE.WAO.018/2551)	Technology Promotion Association (Thailand-Japan)	22TM305	7 Apr 22	6 Apr 23	-
5	Analytical Balance (Repeatability 0.01 mg)	ของแข็งแขวนลอย (Suspended Solids)	Mettler-Toledo	XSR205DU / C009071872	Technology Promotion Association (Thailand-Japan)	22MM210	26 Apr 22	25 Apr 23	-
6	Hot Air Oven		Memmert	UF55 / B216.1666	Technology Promotion Association (Thailand-Japan)	22TM1490	19 Oct 22	18 Oct 23	-
7	Analytical Balance (Repeatability 0.1 mg)	น้ำมันและไขมัน (Oil & Grease)	Mettler-Toledo	AB-204S/FACT / 1129361010	National Food Institute, Ministry of Industry, Thailand	2203120-001-01	1 Jun 22	31 May 23	-
8	Atomic Absorption Spectrometer (AAS)	ตะกั่ว (Pb) แคดเมียม (Cd) เหล็กทั้งหมด (Total Iron)	Agilent Technologies	System ID:G8432A AA240FS / MY13160001	Thailand Institute Of Science And Technological Research (TISTR)	MTC.ACL. No. 486/65	3 Feb 22	2 Feb 23	-
9	Inductively Coupled Plasma  (ICP)		Agilent Technologies	System ID:G8015A  G8015AA / MY18030001	Agilent Technologies (Thailand)  Co.,Ltd.	Preventive  Maintenance Checklist	30 Nov 22	29 Nov 23	-

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
Laboratory Equipment for Water Analysis									
10	Incubator	แบคทีเรียกลุ่มโคลิฟอร์มทั้งหมด (Total coliform bacteria)  แบคทีเรียกลุ่มฟีคอลโคลิฟอร์ม (Fecal coliform bacteria)	Memmert	IPP 260 / V616.0066	Technology Promotion Association (Thailand-Japan)	22TM672	5 May 22	4 May 23	-
11	Incubator		Memmert	IPP 260 / V618.0033	Technology Promotion Association (Thailand-Japan)	22TM503	3 May 22	2 May 23	-
12	Water Bath		Memmert	WNE 14 / L416.0606	Technology Promotion Association (Thailand-Japan)	22TM333	17 Feb 22	16 Feb 23	-
13	Water Bath		Memmert	WNE 14 / L416.0612	Technology Promotion Association (Thailand-Japan)	22TM334	17 Feb 22	16 Feb 23	-
14	Analytical Balance		Mettler-Toledo	MS603S / B007010311	Mettler-Toledo (Thailand) Ltd.	TH2058-096-040722-ACC-TH	7 Apr 22	6 Apr 23	-
15	Auto Clave		ALP	CL-40L / 802664	Technology Promotion Association (Thailand-Japan)	22TM89	17 Feb 22	16 Feb 23	-

Due Date of Calibration\* : กำหนดตามแผนการสอบเทียบประจำปี อย่างน้อยปีละ 1 ครั้ง

## Calibration Certificate

**Certificate No.:** 2202093-001-01  
**Client name:** UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.  
**Address:** 3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchack, Prakanong, Bangkok 10260

Page 1 of 5

**Equipment:** pH Meter  
**Manufacturer:** METTLER TOLEDO  
**Model:** SevenEasy pH  
**Serial No.:** 1230525212  
**ID No.:** UAE.WAS.003/2553  
**Order No.:** 2202093  
**Operation No.:** 2202093-001  
**Date of Receipt:** 11 March 2022  
**Date of Calibration:** 16 March 2022

**Calibrated by** Mr.Manas Somsak  
Specialist

**Approved by**   
( Mr.Pheraphat Tuanjit )

Manager, Division of Calibration Laboratory

**Date of Issue:** 21 March 2022

Responsible for the Technical Management Team

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.

## Calibration Report

**Certificate No.:** 2202093-001-01  
**Equipment:** pH Meter  
**Resolution:** 0.01 pH ; 1 mV  
**Manufacturer:** METTLER TOLEDO  
**Model:** SevenEasy pH  
**Serial No.:** 1230525212  
**Type:** Bench top  
**ID No.:** UAE.WAS.003/2553

**Date of Calibration:** 16 March 2022

Page 2 of 5

**Location:** Chemical Calibration Laboratory, National Food Institute.

**Environment Condition:** **Ambient Temperature:** ( 23.0 ± 1.5 ) °C **Relative Humidity:** ( 49.5 ± 5 ) %

**Condition of Equipment:** Good Condition

**Condition of this Results of Calibration**

1. Calibration Method In house method : W-CC-002 based on direct measurement by using standard voltage calibrator and certified reference material (CRM)

2. Reference Standards / Certified Reference Material

Instruments	Serial / ID No.	Manufacturer	Certificate No.	Due Date
2.1 DC Voltage Calibrator	2709007	Fluke	SCL-21F-0687	24 June 2022
2.2 Digital Thermometer	2709007	Fluke	CC-640599-01	30 October 2022
2.3 Thermo-Hygro Meter	๙๙๙.๙๙.๙๙.BTH 005/58	PONPE	QR21-2787	15 November 2022

Certified Reference Material	Lot No.	Manufacturer	Ref N	Expire Date
2.4 pH buffer 4.008 (Primary pH buffer Solution)	780012	CPAchem	PH216.L5	21 November 2023
2.5 pH buffer 6.865 (Primary pH buffer Solution)	780013	CPAchem	PH217.L5	21 November 2023
2.6 pH buffer 10.01 (Primary pH buffer Solution)	780015	CPAchem	PH220.L5	21 November 2022
2.7 pH buffer 7.00 (Standard pH buffer Solution)	776840	CPAchem	PH107.L5	8 November 2022

3. This certification is traceable to The International System of Unit (SI Unit)

3.1 Instruments No.2.1	through	NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0075
3.2 Instruments No.2.2	through	NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0061
3.3 Instruments No.2.3	through	NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0292
3.4 Certified Reference Material No. 2.4 to 2.6	traceable to	Primary measurement method- Harned cell using calibrated thermometer, barometer, and nanovoltmeter. The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025
3.5 Certified Reference Material No. 2.7	traceable to	BIM RefN HI-7 LotN 30.04.2020; BIM RefN HI-9 LotN 28.05.2020; BIM RefN HI-8 LotN 30.04.2020; BIM RefN HI-10 LotN 28.05.2020. The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025

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 Report

**Certificate No.:** 2202093-001-01  
**Equipment:** pH Meter  
**Resolution:** 0.01 pH ; 1 mV  
**Manufacturer:** METTLER TOLEDO  
**Model:** SevenEasy pH  
**Serial No.:** 1230525212  
**Type:** Bench top  
**ID No.:** UAE.WAS.003/2553

**Date of Calibration:** 16 March 2022 Page 3 of 5

### Calibration Results:

1. Calibration of pH Meter ( Manual Temperature Compensation at 25 °C )

Nominal pH	DC Voltage Standard ( mV )	Average Indicator Reading		Uncertainty ( ±mV )	Coverage Factor ( k )
		mV	pH		
0	414.117	414	0.00	0.58	2.00
2	295.811	296	2.00	0.58	2.00
4	177.462	178	4.00	0.58	2.00
6	59.159	59	6.00	0.58	2.00
7	-0.001	0	7.00	0.58	2.00
8	-59.159	-59	8.00	0.58	2.00
10	-177.463	-177	10.00	0.58	2.00
12	-295.812	-296	12.00	0.58	2.00
14	-414.119	-414	14.00	0.58	2.00

2. Calibration of pH Meter with Electrode ( Manual Temperature Compensation at 25 °C )

**Equipment:** pH Electrode  
**Manufacturer:** METTLER TOLEDO  
**Serial No.:** 9453943  
**Type:** Combined Electrode  
**Model:** InLab Solids  
**ID.No.:** N/A

**Performance of Electrode system** (Three-Point Calibration at pH4, pH7 and pH10)

Certified Value @25 °C (pH)	Average Indicator Reading		Relative Slope (%)	Uncertainty ( ± pH )	Coverage Factor ( k )
	pH	mV			
4.008	4.01	172	98.1	0.0071	2.00
6.866	6.87	6	-	0.0074	2.00
10.015	10.01	-175	97.4	0.0090	2.00
6.983	6.98	-3	-	0.0092	2.00

เอกสารไม่ควบคุม

## Calibration Report

**Certificate No.:** 2202093-001-01  
**Equipment:** Digital Thermometer with RTD (pH Meter)  
**Resolution:** 0.1 °C  
**Model:** SevenEasy pH  
**Serial No.:** 1230525212  
**ID No.:** UAE.WAS.003/2553  
**Manufacturer:** METTLER TOLEDO

**Date of Calibration:** 16 March 2022 Page 4 of 5

**Location:** Chemical Calibration Laboratory, National Food Institute.

**Environment Condition:** Ambient Temperature ( 23.0 ± 1.0 ) °C  
Relative Humidity ( 50 ± 4 ) %

### Condition of this results of Calibration:

- Calibration Method :
  - In house method: W-TE-025 by comparison with standard thermometer.
  - The Calibration is determined by comparing with a known temperature from a standard resistance thermometer.
  - The temperature scale in use at this laboratory is the International Temperature scale of 1990 ( ITS-90 ).

2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
HANDHELD THERMOMETER	1523	2118154	PSL-T 0851/64	24-Jun-22	TISTR
Platinum Resistance Thermometer (PRT)	5627A	877332			

Support Equipment : - Low Temperature Bath (ISOCAL-6), Model: Europa-6 Plus Basic, S/N: 341592/2

- This certificate is traceable to International System of Units (SI Units).
- This certificate was certified only for the instrument we calibrated.
- This result of calibration was found accurate as shown on date and place of calibration only.

6. Condition of Calibrated item : Good  
7. Result of Calibration : ☒ X Without adjustment ☐ After adjustment

เอกสารไม่ควบคุม



## Calibration Report

**Certificate No.:** 2202093-001-01  
**Equipment:** Digital Thermometer with RTD (pH Meter)  
**Resolution:** 0.1 °C **Model:** SevenEasy pH  
**Serial No.:** 1230525212 **ID No.:** UAE.WAS.003/2553  
**Manufacturer:** METTLER TOLEDO  
**Date of Calibration:** 16 March 2022

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**Calibration point:** 15.0, 25.0 and 35.0 °C

### Calibration result:

- The probe was immersed in liquid bath or dry bath to a minimum depth of 120 mm.
- Description of probe, model : N/A S/N : N/A
- Dimension of probe : Diameter 3.5 mm., Length 135 mm.,
- Sheath material : Stainless Steel

UUC* Reading (°C)	Standard Temperature (°C)	Correction Value (°C)	Uncertainty ± (°C)
15.2	15.001	-0.2	0.099
25.2	25.002	-0.2	0.099
35.2	35.002	-0.2	0.099

**Note** - UUC\* : Unit Under Calibration

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 -----

เอกสารไม่ควบคุม

## Certificate of Calibration

**Equipment:** CONDUCTIVITY METER  
**Model:** Lab955  
**Serial No. (or ID.):** 16300356  
**Manufacturer:** SI Analytics  
**Electrode Serial No.** 16070067  
**Condition:** In Condition  
**Certificate No.:** C24220084  
**Issued Date:** 22 March 2022  
**Job No.:** KSPR2203267  
**Page:** 1 of 2  
**Model :** LF413T **Brand :** SI Analytics


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

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

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

**Calibration By:** Mr. Wasan Nuchnabee  
**Calibration Date:** 22 March 2022  
**The Method used:** In house method, SPCC-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. 794135, 794136, 772624

  
(Mr. Wasan Nuchnabee)  
Person in charge

  
บริษัท เอสพีซี อาร์ที จำกัด  
SPC RT Co., Ltd.

  
(Mr. Dumrong Boonsopon)  
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 SPC RT Co., Ltd.

**Calibration Results:**

**Before Adjustment**

Standard Conductivity Solution	Unit Under Calibration Reading	Correction	Coverage Factor ( k )	Uncertainty ( ± )
25.000 μS/cm	25.9 μS/cm	-0.900 μS/cm	2.00	0.22 μS/cm
1413.0 μS/cm	1444 μS/cm	-31.0 μS/cm	2.00	8.9 μS/cm
111.3 mS/cm	107.9 mS/cm	3.40 mS/cm	2.00	0.66 mS/cm

**After Adjustment ; at 1413 μS/cm**

Standard Conductivity Solution	Unit Under Calibration Reading	Correction	Coverage Factor ( k )	Uncertainty ( ± )
25.000 μS/cm	25.0 μS/cm	0.000 μS/cm	2.00	0.22 μS/cm
1413.0 μS/cm	1413 μS/cm	0.0 μS/cm	2.00	8.9 μS/cm
111.3 mS/cm	107.2 mS/cm	4.10 mS/cm	2.00	0.66 mS/cm

The End of Certificate

**ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม**

เลขที่ใบงาน: KSPR2203267

ชนิดเครื่องมือ: CONDUCTIVITY METER

รุ่น: Lab955

หมายเลขเครื่อง: 16300356

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
22 Mar 2022			22 Mar 2022		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		<i>General</i>			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด ( ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิทช์ ปิด – เปิด เครื่อง (On-Off Swich)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		<i>Spectrophotometer</i>			
<input type="checkbox"/>	<input type="checkbox"/>	6. แบตเตอรี่ไฟฟ้า (Battery Backup) >= 2.5 VDC	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	7. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	11. ช่องวัดหลายตัวอย่าง (Carousel Module)	<input type="checkbox"/>	<input type="checkbox"/>	
		<i>pH Meter and Conductivity Meter</i>			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด ( Electrode and Connection Cable )	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	13. ระดับสารละลายใน Electrode (Level KCl )	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	14. ฝาปิดกันปลาย Electrode (Dust Protection Hood)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาจับอิเล็กโทรด (Stand)	<input type="checkbox"/>	<input type="checkbox"/>	
		<i>Turbidimeter</i>			
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่นเกิน 3.0)	<input type="checkbox"/>	<input type="checkbox"/>	
		<i>Automatic titrator</i>			
<input type="checkbox"/>	<input type="checkbox"/>	18. สภาพ Piston Burettes	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	19. Function Rinsing and Dosing	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	<input type="checkbox"/>	<input type="checkbox"/>	

ขอแนะนำ : Electrode วัดอุณหภูมิได้ 24.9 °C โดย Control Waterbath ที่ 25.0 ±0.1°C

Mr. Wasan Nuchnabee

Service Engineer





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



Cert. No.: 22TM90  
Page: 1 of 3

## Certificate of Calibration

**Equipment :** BOD Incubator  
**Manufacturer :** Arco  
**Model :** UC4-1320  
**Serial No. :** 13URC4S013201  
**ID No. :** UAE.WAO.015/2561  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
**Location :** Lab Floor 2  
**Received Order :** 17 February 2022  
**Calibration Date :** 17 February 2022  
**Ambient Temperature :** ( 26 ± 10 ) °C  
**Relative Humidity :** ( 50 ± 30 ) %  
**Calibrated by :** Kunchit Promprat

**Approved by :**

Malee Butkruea  
Approved Signatory

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

**Issue Date :** 22 February 2022

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม  
A 0038099



**Equipment :** BOD Incubator  
**Condition As-Received :** Used Item  
**Reference :** 2202-0446OC-1  
**Procedure Used :-**

**Cert. No.:** 22TM90  
**Page:** 2 of 3

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

The temperature scale used was based on ITS-90.

### Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34970A	MY44035217	21LM30	23 Dec 2022

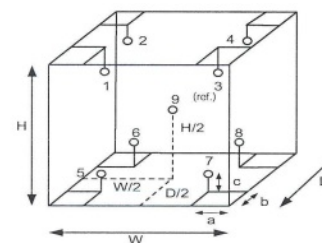
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Not Available



**Probe Installation Details :**

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

**Dimension of Chamber :**

D = 0.62 m  
W = 1.2 m  
H = 1.2 m  
Capacity = 0.89 m<sup>3</sup>

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	28	28
REL.Humid. ( % )	68	75
AC Supply ( Volt )	226	226

Position :	Ref. Std. ID No.:
1	18-10RTD-01
2	18-10RTD-02
3	18-10RTD-03
4	18-10RTD-04
5	18-10RTD-05
6	22-10RTD-10
7	18-10RTD-07
8	18-10RTD-08
9 (ref.)	18-10RTD-09

เอกสารไม่ควบคุม  
a 1096042





Equipment : BOD Incubator  
Condition As-Received : Used Item  
Reference : 2202-0446OC-1  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Not Available

Cert. No.: 22TM90  
Page.: 3 of 3

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor <i>k</i>
20.0	19.5	19.4	0.30	0.58	1.0	0.55	2

Calibration Point ( °C )	Measured Temperature ( °C )								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
20.0	20.154	20.013	20.356	19.939	19.834	19.761	19.817	19.824	19.922

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

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

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

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

UUC\* : Unit Under Calibration

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

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

-oOo-

Malee

เอกสารไม่ควบคุม  
a 1096041



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



Cert. No.: 22TM305  
Page.: 1 of 3

## Certificate of Calibration

Equipment : BOD Incubator  
Manufacturer : ARCO  
Model : UR-1320  
Serial No. : -  
ID No. : UAE.WAO.018/2551  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
Location : Lab Floor 2  
Received Order : 7 April 2022  
Calibration Date : 7 April 2022  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Man Pattanapongpaiboon

Approved by : Malee  
Approved Signatory

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

Issue Date : 18 April 2022

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

A 0040246



**Equipment :** BOD Incubator  
**Condition As-Received :** Used Item  
**Reference :** 2204-0015OC-2  
**Procedure Used :-**

**Cert. No.:** 22TM305  
**Page.:** 2 of 3

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

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34970A	MY41021843	22LM4	10 Jan 2023

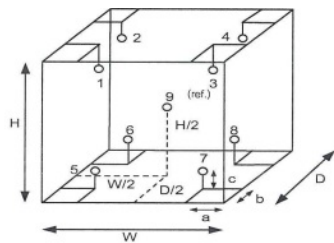
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Not Available



Probe Installation Details :			Dimension of Chamber :		
a =	10	cm	D =	0.62	m
b =	10	cm	W =	1.2	m
c =	10	cm	H =	1.2	m
			Capacity =	0.89	m <sup>3</sup>

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	27	27
REL.Humid. ( % )	56	59
AC Supply ( Volt )	222	221

Position :	Ref. Std. ID No.:
1	18-04RTD-01
2	18-04RTD-02
3	18-04RTD-03
4	18-04RTD-04
5	18-04RTD-05
6	18-04RTD-06
7	18-04RTD-07
8	18-04RTD-08
9 (ref.)	18-04RTD-09

*Malu*

เอกสารไม่ควบคุม

a 1104314



**Equipment :** BOD Incubator  
**Condition As-Received :** Used Item  
**Reference :** 2204-0015OC-2  
**Result of Calibration :-** ( \* ) Without Adjustment  
**Function of UUC\* :** Temperature Source  
**Fresh air setting :** Not Available

**Cert. No.:** 22TM305  
**Page.:** 3 of 3

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor k
20.0	20.0	20.0	0.50	0.44	1.1	0.64	2

Calibration Point ( °C )	Measured Temperature ( °C )								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
20.0	20.080	20.056	19.866	19.826	19.655	19.656	19.819	19.979	19.899

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

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

**Temperature uniformity :** The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

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

**UUC\* :** Unit Under Calibration

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

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

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*Malu*

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a 1104313






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



Cert.No.: 22MM210  
Page.: 1 of 3

## Certificate of Calibration

**Equipment :** Electronic Balance  
**Manufacturer :** Mettler Toledo  
**Model :** XSR205  
**Serial No. :** C009071872  
**ID No. :** UAE.WAO.012/2563  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phakhanong,  
Bangkok 10260  
**Location :** Balance Room  
**Received order :** 26 April 2022  
**Calibration Date :** 26 April 2022  
**Ambient Temperature :** 15 °C to 40 °C  
**Relative Humidity :** 30 % to 90 %  
**Calibrated by :** Kunchit Promprat  
**Approved by :**   
Approved Signatory  
( ) Pornthippa Tameyakul  
(✓) Malee Butkruea  
( ) Suwit Imjai  
**Issue Date :** 29 April 2022

The Uncertainties are for a confidence probability of approximately 95%

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



**Equipment :** Electronic Balance  
**Condition As-Received :** Used Item  
**Reference :** 2204-0542OC-1  
**Procedure used :-**

Cert.No.: 22MM210  
Page: 2 of 3

Calibration were conducted using in-house calibration procedure CP-OB01 according to direct measurement method against standard weight.

### Condition of this result of calibration

1. Reference standard instruments:-

Instruments	Model	Serial No.	ID No.	Test report No.	Due date
1) Standard Weight Set (E2)	15884	-	70RC138	MM-0009-21	3 Feb 2023

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

3. This result of calibration was made on requested at the point specified by customer.

4. This certificate is not certified for any commercial transaction.

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

**Result of calibration** ( ) Without Adjustment ( \* ) After Adjustment by Internal Calibration

Range capacity :	0 g to 81 g	Resolution	0.00001 g
	81 g to 220 g	Resolution	0.0001 g

**Before Adjustment :**

Applied Weight	Balance Reading	Correction	Measurement Uncertainty	Coverage Factor
( g )	( g )	( g )	( ± mg )	( k )
80	80.00004	-0.00004	0.15	2.00
200	199.9999	+0.0001	0.35	2.00

**After Adjustment :**

1. **Determination of the standard deviation of weighing machine** ( n = 10 )

Applied Weight	Standard Deviation
( g )	of Reading ( g )
80	0.000008
200	0.00005

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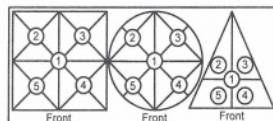
Equipment : Electronic Balance  
 Condition As-Received : Used Item  
 Reference : 2204-0542OC-1

#### Result of calibration

#### 2. Effect of off center loading

A mass of 100 g was placed to various position on the pan.  
 The weighing machine reading error obtained is given in the table

Cert.No.: 22MM210  
 Page: 3 of 3



Maximum difference between  
 off-center and central loading

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

0.0002

#### 3. Departure from nominal value

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
Unload	0.00000	0.00000	0.016	2.13
0.05	0.05001	-0.00001	0.016	2.13
0.1	0.10001	-0.00001	0.017	2.11
1	1.00002	-0.00002	0.019	2.05
5	5.00003	-0.00003	0.026	2.00
20	20.00008	-0.00008	0.049	2.00
50	50.00010	-0.00010	0.080	2.00
80	80.00014	-0.00014	0.15	2.00
100	100.0001	-0.0001	0.21	2.00
150	150.0001	-0.0001	0.29	2.00
200	200.0001	-0.0001	0.35	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 %.

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



Cert. No.: 22TM1490  
 Page : 1 of 3

## Certificate of Calibration

Equipment : Hot Air Oven  
 Manufacturer : Memmert  
 Model : UF 55  
 Serial No. : B216.1666  
 ID No. : UAE.WAO.027/2559  
 Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
 3 Soi Udumuk 41, Sukhumvit Road,  
 Bangchak, Phrakhanong,  
 Bangkok 10260  
 Location : Lab Floor 2  
 Received Order : 19 October 2022  
 Calibration Date : 19 October 2022  
 Ambient Temperature : ( 26 ± 10 ) °C  
 Relative Humidity : ( 50 ± 30 ) %

Calibrated by : Preecha Hlahib

Approved by :

*P. Yuen*

Approved Signatory

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

Issue Date : 31 October 2022

The Uncertainties are for a confidence probability of approximately 95%

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

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A 0046800



Equipment : Hot Air Oven  
 Condition As-Received : Used Item  
 Reference : 2210-0575OC-1

Cert. No.: 22TM1490  
 Page : 2 of 3

**Procedure Used :-**

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

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

**1. Reference standard instrument:-**

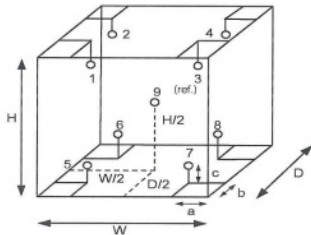
Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34970A	MY41021843	22LM4	10 Jan 2023

- This certificate is valid only to the item calibrated on date and place of calibration.
- This certification is traceable to the International System of Unit.

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Close



Probe Installation Details :		Dimension of Chamber :	
a =	5.0 cm	D =	0.33 m
b =	5.0 cm	W =	0.40 m
c =	5.0 cm	H =	0.40 m
		Capacity =	0.053 m <sup>3</sup>

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	29	30
REL.Humid. ( % )	47	40
AC Supply ( Volt )	221	220

Ref. Std. ID No.: @ Calibration Point		
Position :	( 104 ) °C	( 140,180 ) °C
1	18-04RTD-01	21-04TC-01
2	18-04RTD-02	21-04TC-02
3	18-04RTD-03	21-04TC-03
4	18-04RTD-04	21-04TC-04
5	18-04RTD-05	21-04TC-05
6	18-04RTD-06	21-04TC-06
7	18-04RTD-07	21-04TC-07
8	18-04RTD-08	21-04TC-08
9 (ref.)	18-04RTD-09	21-04TC-09

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a 1133252



Equipment : Hot Air Oven  
 Condition As-Received : Used Item  
 Reference : 2210-0575OC-1

Cert. No.: 22TM1490  
 Page : 3 of 3

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Close

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor k
104.0	104.0	104.0	0.061	1.3	1.7	0.42	2
140.0	140.0	140.0	0.14	2.3	2.4	1.1	2
180.0	180.0	180.0	0.21	3.5	3.6	1.3	2

Calibration Point ( °C )	Measured Temperature ( °C )								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.076	103.876	103.777	104.124	104.667	104.426	104.012	103.928	104.370
140.0	138.199	139.189	138.808	139.550	140.266	139.622	139.293	139.385	140.369
180.0	177.930	179.267	178.643	179.753	181.011	180.093	179.496	179.743	181.278

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

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

**Temperature uniformity :** The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

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

**UUC\* :** Unit Under Calibration

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

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

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เอกสารไม่ควบคุม

a 1133251




## Calibration Certificate

**Certificate No.:** 2203120-001-01  
**Client name:** UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.  
**Address:** 3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchack, Prakhong, Bangkok 10260

Page 1 of 3

**Equipment:** Electronic Balance  
**Manufacturer:** METTLER TOLEDO  
**Model:** AB204-S/FACT  
**Serial No.:** 1129361010  
**ID No.:** UAE.WAS.002/2552  
**Order No.:** 2203120  
**Operation No.:** 2203120-001  
**Date of Receipt:** 1 June 2022  
**Date of Calibration:** 1 June 2022

**Calibrated by** Mr.Taveesak Seilee  
Scientist

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

**Date of Issue:** 7 June 2022

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

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## Calibration Report

**Certificate No.:** 2203120-001-01  
**Equipment:** Electronic Balance  
**Model:** AB204-S/FACT  
**Serial No.:** 1129361010  
**Capacity:** 220 g  
**Manufacturer:** METTLER TOLEDO  
**Resolution:** 0.0001 g  
**ID No.:** UAE.WAS.002/2552

**Date of Calibration:** 1 June 2022

Page 2 of 3

**Environment Condition:** Ambient Temperature: 19.9 ± 0.3 °C Relative Humidity: 45 ± 1.5 %

**Place of Calibration:** 108, Balance Room, 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	B308068554	TCS	M2201020S	6 January 2023
Standard Weight Class E2	1-500g	B308068128	TCS	M2201021S	6 January 2023
Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	PONPE 490	NFI.BTH 010/18	Quality Reborn	QR22-0350	18 February 2023

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:**

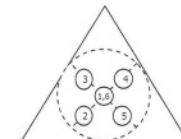
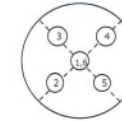
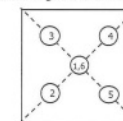
**1. Repeatability of Reading:**

Nominal Value ( g )	Standard Deviation of Reading ( g )
100	0.000048
200	0.000052

**2. Off-Center Error:**

A mass of 50 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 )
49.9999	49.9998	49.9998	49.9999	49.9998	49.9998	0.0001

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

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## Calibration Report

**Certificate No.:** 2203120-001-01  
**Equipment:** Electronic Balance  
**Model:** AB204-S/FACT  
**Serial No.:** 1129361010  
**Capacity:** 220 g  
**Manufacturer:** METTLER TOLEDO  
**Resolution:** 0.0001 g  
**ID No.:** UAE.WAS.002/2552

**Date of Calibration:** 1 June 2022 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
Unload	0.00000	0.0000	0.0000	0.000088	2.00
0.01	0.01000	0.0100	0.0000	0.000088	2.00
0.05	0.05000	0.0499	0.0001	0.000088	2.00
0.1	0.10000	0.1000	0.0000	0.000088	2.00
0.2	0.20000	0.2000	0.0000	0.000088	2.00
0.5	0.50000	0.5000	0.0000	0.000088	2.00
1	1.00000	0.9999	0.0001	0.000088	2.00
2	2.00000	1.9999	0.0001	0.000089	2.00
5	5.00000	5.0000	0.0000	0.000089	2.00
10	9.99998	9.9999	0.0001	0.000092	2.00
20	19.99999	19.9999	0.0001	0.000094	2.00
50	49.99990	49.9999	0.0000	0.00012	2.00
70	69.99989	69.9998	0.0001	0.00014	2.00
100	100.00001	99.9999	0.0001	0.00017	2.00
150	149.99991	149.9997	0.0002	0.00022	2.00
200	200.00007	199.9998	0.0003	0.00030	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

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2008 ซอย 36 ถนนพหลโยธิน แขวงบางพลัด กรุงเทพมหานคร 10700  
 2008 Soi 36, Arun Amarin Road, Bang Yi Khan Subdistrict, Bang Phlat District, Bangkok 10700, Thailand  
 Tel: +66(0) 2422 8688 Fax: +66(0) 2422 8545



nfi.or.th

Request No. 25-65 / 0398

MTC. ACL.No. 486 / 65

### 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. P2-MEB675610

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

3 Soi Udomsuk41, 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)

**REFERENCE MATERIAL :** Traceable to NIST "Agilent Technologies", "Carlo Erba"

Cadmium Lot No. 0108047046, Chromium Lot No. 0106315418, Copper Lot No. 0107480530, Iron Lot No. 0104697566, Lead Lot No. 0104659473, Manganese Lot No. T109228A, Nickel Lot No. 0104978044, Zinc Lot No. 0100792297

**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

**AMBIENT CONDITIONS :** Temperature 22 °C Relative humidity 60 %

The Atomic Absorption Spectrophotometer set 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

Approved by

Director of Analytical Chemistry Laboratory

Ref. 2025265020400522001

Calibration Date : 3 February 2022

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.

FM.BL.MTC.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 : mtc@tistr.or.th

**Office**

196 Phahonyothin Road, Chatuchak, Bangkok 10900, Thailand  
Tel. (66) 0 2557 8333  
Fax. (66) 0 2557 8392

E-mail : sumalee@tistr.or.th

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### CALIBRATION DATA

#### 1. Noise Level in term of standard deviation

Element	Cd	Cr	Cu	Fe	Pb	Mn	Ni	Zn
Absorbance	-0.0004	0.0002	0.0007	0.0002	-0.0016	-0.0001	-0.0004	-0.0001
	0.0002	-0.0005	0.0010	0.0007	0.0000	-0.0003	0.0007	-0.0014
	-0.0002	0.0001	0.0008	0.0000	-0.0001	-0.0003	-0.0012	-0.0006
	0.0000	-0.0007	0.0007	0.0000	-0.0005	-0.0004	-0.0004	-0.0012
	0.0001	0.0004	0.0013	0.0014	-0.0001	-0.0001	0.0003	-0.0008
	0.0000	-0.0004	0.0003	-0.0012	-0.0005	-0.0007	-0.0004	-0.0008
	0.0000	-0.0009	0.0009	-0.0002	-0.0010	-0.0008	0.0007	-0.0003
	-0.0004	-0.0003	0.0015	0.0010	-0.0005	-0.0003	-0.0002	-0.0004
	0.0004	0.0008	0.0014	-0.0004	-0.0014	-0.0005	-0.0006	-0.0003
	-0.0006	-0.0013	0.0012	-0.0006	-0.0006	-0.0006	-0.0007	-0.0007
	0.0005	-0.0003	0.0014	-0.0004	-0.0008	-0.0003	-0.0006	-0.0011
	-0.0007	-0.0014	0.0004	-0.0001	-0.0001	0.0000	0.0000	-0.0003
	0.0008	0.0004	0.0005	-0.0006	-0.0008	0.0000	-0.0005	-0.0009
	0.0011	0.0002	0.0005	0.0017	-0.0016	-0.0008	0.0004	-0.0005
	0.0002	0.0010	0.0014	-0.0002	-0.0010	-0.0010	0.0002	-0.0001
	0.0001	-0.0011	0.0011	-0.0003	-0.0011	-0.0003	-0.0008	-0.0012
	0.0000	-0.0015	0.0009	-0.0010	-0.0011	-0.0013	0.0000	-0.0004
	0.0015	-0.0012	0.0005	0.0002	-0.0017	-0.0001	0.0005	-0.0002
	0.0006	0.0014	0.0010	0.0002	-0.0003	0.0001	-0.0006	-0.0010
	0.0001	0.0003	0.0003	-0.0001	-0.0004	-0.0002	-0.0001	-0.0001
Average Absorbance	0.000	0.000	0.001	0.000	-0.001	0.000	0.000	-0.001
Standard Deviation	0.0005	0.0008	0.0004	0.0007	0.0005	0.0004	0.0005	0.0004

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#### 2. Precision

Element	Conc. (mg/l)	Absorbance										Ave. Abs.	SD	%RSD
Cd	0.02	0.0074	0.0062	0.0065	0.0062	0.0070	0.0068	0.0070	0.0065	0.0065	0.0069	0.007	0.0004	5.76
	0.30	0.0952	0.0959	0.0951	0.0957	0.0952	0.0950	0.0952	0.0948	0.0956	0.0943	0.095	0.0005	0.49
	0.70	0.2213	0.2180	0.2203	0.2208	0.2234	0.2211	0.2196	0.2219	0.2201	0.2194	0.221	0.0015	0.67
Cr	0.10	0.0096	0.0098	0.0097	0.0102	0.0106	0.0097	0.0098	0.0099	0.0103	0.0093	0.010	0.0004	3.83
	0.30	0.0309	0.0302	0.0300	0.0316	0.0306	0.0299	0.0309	0.0297	0.0311	0.0296	0.030	0.0007	2.20
	0.70	0.0659	0.0667	0.0664	0.0648	0.0656	0.0662	0.0658	0.0638	0.0638	0.0669	0.066	0.0011	1.70
Cu	0.05	0.0080	0.0075	0.0078	0.0075	0.0077	0.0081	0.0080	0.0075	0.0074	0.0076	0.008	0.0003	3.26
	0.30	0.0417	0.0419	0.0412	0.0421	0.0424	0.0420	0.0423	0.0403	0.0418	0.0415	0.042	0.0006	1.47
	0.70	0.0969	0.0965	0.0972	0.0957	0.0961	0.0958	0.0961	0.0963	0.0959	0.0972	0.096	0.0006	0.58
Fe	0.10	0.0090	0.0105	0.0078	0.0099	0.0091	0.0093	0.0096	0.0094	0.0093	0.0084	0.009	0.0007	8.11
	0.50	0.0462	0.0470	0.0464	0.0464	0.0467	0.0462	0.0467	0.0460	0.0468	0.0466	0.047	0.0003	0.67
	1.00	0.0867	0.0886	0.0910	0.0892	0.0897	0.0873	0.0892	0.0885	0.0888	0.0874	0.089	0.0013	1.43
Pb	0.20	0.0091	0.0095	0.0088	0.0087	0.0082	0.0094	0.0090	0.0087	0.0082	0.0090	0.009	0.0004	4.94
	0.70	0.0322	0.0321	0.0324	0.0318	0.0335	0.0326	0.0327	0.0315	0.0336	0.0321	0.032	0.0007	2.09
	1.50	0.0653	0.0645	0.0663	0.0664	0.0652	0.0671	0.0662	0.0666	0.0657	0.0648	0.066	0.0008	1.28
Mn	0.05	0.0092	0.0092	0.0097	0.0087	0.0085	0.0079	0.0096	0.0085	0.0084	0.0099	0.009	0.0007	7.33
	0.30	0.0616	0.0630	0.0632	0.0633	0.0634	0.0628	0.0640	0.0633	0.0640	0.0629	0.063	0.0007	1.08
	0.70	0.1396	0.1366	0.1386	0.1377	0.1386	0.1386	0.1396	0.1380	0.1374	0.1383	0.138	0.0009	0.67
Ni	0.10	0.0102	0.0092	0.0097	0.0104	0.0091	0.0105	0.0105	0.0096	0.0098	0.0102	0.010	0.0005	5.22
	0.50	0.0488	0.0489	0.0489	0.0495	0.0484	0.0490	0.0481	0.0492	0.0495	0.0492	0.049	0.0004	0.91
	1.00	0.0976	0.0979	0.0975	0.0992	0.0977	0.0973	0.0986	0.0962	0.0985	0.0982	0.098	0.0008	0.85
Zn	0.05	0.0340	0.0349	0.0340	0.0352	0.0337	0.0351	0.0344	0.0346	0.0349	0.0343	0.035	0.0005	1.49
	0.30	0.1669	0.1653	0.1628	0.1642	0.1657	0.1637	0.1659	0.1652	0.1654	0.1657	0.165	0.0012	0.72
	0.70	0.3456	0.3467	0.3445	0.3430	0.3422	0.3444	0.3437	0.3438	0.3435	0.3438	0.344	0.0013	0.37

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MTC. ACL. No. 486 / 65

### 3. Trueness

#### 3.1 Reading on wavelength- Cadmium(Cd) at 228.8 nm.

Element	Standard Value of RM (mg/l)	Reading (mg/l)	Error of Measurement (mg/l)	Error of Measurement (%)	Uncertainty (mg/l)
Cd	0.02004	0.019	-0.001	5.19	± 0.004
	0.30060	0.291	-0.010	3.19	± 0.006
	0.70140	0.678	-0.023	3.34	± 0.012

#### 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	0.1002	0.101	0.001	0.80	± 0.007
	0.3006	0.298	-0.003	0.86	± 0.012
	0.7014	0.635	-0.066	9.47	± 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	0.0502	0.046	-0.004	8.37	± 0.004
	0.3012	0.295	-0.006	2.06	± 0.010
	0.7028	0.694	-0.009	1.25	± 0.021

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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	0.1003	0.106	0.006	5.68	± 0.008
	0.5015	0.522	0.021	4.09	± 0.017
	1.0030	0.993	-0.010	1.00	± 0.032

### 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	0.1988	0.197	-0.002	0.91	± 0.014
	0.6958	0.722	0.026	3.77	± 0.022
	1.4910	1.463	-0.028	1.88	± 0.041

### 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	0.04955	0.054	0.004	8.98	± 0.004
	0.29730	0.317	0.0197	6.63	± 0.006
	0.69370	0.682	-0.0117	1.69	± 0.012

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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	0.099	0.102	0.003	3.03	± 0.007
	0.495	0.489	-0.006	1.21	± 0.010
	0.990	0.975	-0.015	1.52	± 0.020

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	0.050	0.000	0.00	± 0.012
	0.300	0.307	0.007	2.33	± 0.011
	0.700	0.660	-0.040	5.71	± 0.015

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



Appro



Director of Analytical Chemistry Laboratory

Calibration date : 3 February 2022

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## Agilent 5110 and 5100 ICP-OES Preventive Maintenance Checklist

Agilent Preventive Maintenance provides factory recommended service for your analytical systems 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 everything you need to reduce unplanned downtime and keep your systems operating at their peak.

For more information about Agilent Technologies services please visit our web site using the following URL <http://www.agilent.com/en-us/services/analytical-instrument-services>

## Customer Information

- Customers should provide all necessary operating supplies upon request of the engineer.
- For customers using HF applications, the instrument should be returned to its standard sample introduction system.
- A customer representative should be available to the engineer while performing the preventive maintenance procedures.
- 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 additional or special procedures and/or parts for the instrument service, then these must be ordered separately and charged as a repair, which may incur additional

## Service Engineer's Responsibilities

- Only complete/printout pages that relate to the system being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using a "X" or tick mark "✓" in the checkbox.
- Complete Not Applicable check boxes to indicate services not delivered, as needed.
- Complete the PM service in the order of the tasks listed.
- Complete the Service Review section together with the customer.

**Agilent 5110 and 5100 ICP-OES  
Preventive Maintenance Checklist**
**System Information**

<b>Instrument system name and ID</b>		ICP 5110 VDV	
<b>Instrument system site and location</b>		UAE / 3rd Floor Laboratory	
<b>List system component product numbers</b>		<b>List the serial numbers of each component</b>	
1.	G 8015A	1.	MY18030001
2.	G 8481A	2.	1801-01988
3.		3.	
4.		4.	
5.		5.	
6.		6.	
7.		7.	
8.		8.	
9.		9.	
10.		10.	

<b>ICP-OES Configuration table</b>	<b>Circle the type or write in the type if other</b>
Nebulizer Type	SeaSpray   OneNeb   other
Spray Chamber	Cyclonic Single Pass   Cyclonic Double Pass   other
Torch	Radial   Dual View   other
Injector Diameter	2.4mm   1.8mm   1.4mm   0.8mm   other
Injector Material	Quartz   Ceramic   other

**Agilent 5110 and 5100 ICP-OES  
Preventive Maintenance Checklist**
**General Preparation**

- ☒ Discuss any specific questions or issues with the customer prior to starting.
- ☒ Review the instrument logbook.
- ☒ Perform general external inspection of system for cleanliness.
- ☒ Check for proper installation of safety-related parts, assemblies, sensors etc.
- ☒ Check for required firmware/software updates and verify with customers if they would like it installed.
- ☒ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it. N/A
- ☒ Run Instrument Performance test and record results in Instrument Performance Test Results Table - Pre PM.

**Inspect and clean the 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. N/A
- ☒ Remove and clean instrument water inlet filter.

**G8481A Cooling water system**

- ☐ **Section NOT Applicable**
- ☒ Drain cooling fluid and remove any particles from the chiller reservoir
- ☒ Remove, clean and reinstall water inlet metal mesh filter.
- ☒ Re fill with Polyclear cooling fluid.
- ☒ Clean the cooling system Air filter and the condenser by compressed air or vacuum cleaner.

**Agilent 5110 and 5100 ICP-OES  
Preventive Maintenance Checklist**
**SPS 3 Auto Sampler**
☒ **Section 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**
☒ **Section 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

**AVS 4, 6, 7**
☒ **Section 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

**Instrument Adjustment**

- ☒ Check position of Zn peak, adjust if required.
- ☒ Check Argon Ratio, adjust to specified value if required.
- ☒ Perform Detector Calibration.
- ☒ Perform Instrument Calibration.
- ☒ Run Instrument Performance Test and 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 and record the result in the Instrument Test Results Table
  - ☒ Subsystem Communications Test
  - ☒ Air Flow

**Agilent 5110 and 5100 ICP-OES  
Preventive Maintenance Checklist**

- ☒ Water Flow
- ☒ Gas Flows
- ☒ RF Generator
- ☒ Camera Test
- ☒ Optics Test
- ☒ Nebulizer Test

**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	4106.6	8364.0	4375.0	8400.8
Mn 257.610 nm SRBR	11064.7	31842.1	12801.7	30846.2
Al 396.152 nm SBR	7.9	14.9	9.9	16.8
K 766.491 nm SBR	5.1	36.8	6.4	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



**Agilent 5110 and 5100 ICP-OES  
Preventive Maintenance Checklist**
**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	224.540 VAC	217.973 VAC
Mains Current	0.204 A	0.104 A
Instrument Temperature	22.8 °C	22.7 °C
RF Air Flow (sensor speed)	15.0 Hz	19.0 Hz
Plasma Exhaust Temperature	No measurement	26.7 °C
Water Flow Oscillator	No measurement	1.64 L/min
Water Flow Detector	1.06 L/min	1.06 L/min
Water Inlet Temperature	18.0 °C	18.0 °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	677.94 kPa	627.33 kPa
Purge Gas Supply Pressure*1	674.90 kPa	645.40 kPa
Option Gas Supply Pressure*1	N/A kPa	N/A kPa
Nebulizer Flow	No measurement	0.70 L/min
Nebulizer Back Pressure	No measurement	164.63 kPa
Plasma Gas Flow	No measurement	11.92 L/min
Auxiliary Gas Flow	No measurement	1.00 L/min
RF Power	No measurement	1200 W
RF Supply Current	No measurement	8.663 A
RF Supply Voltage	No measurement	184.66 V

\*1 If option installed

**Agilent 5110 and 5100 ICP-OES  
Preventive Maintenance Checklist**
**ICP-OES Parts List Table**

Part description	Part Number	Product / Model # where used	Quantity Consumed
Axial Pre-Optic Window	G8010-68014	G8010A, G8011A, G8014A/G8015A	1
Radial Pre-Optic Window	G8010-68015	All	1
Polyclear Cooling Fluid	G3292-80010	G8481A	
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	
<b>Additional Parts may be required from engineers stock:</b>			
X axis drive belt	5410047500	SPS 3	
Z axis drive belt	5410047400	SPS 3	
Peristaltic pump tubing, PVC SolvaFlex, 3 bridged,	3710049000	SPS 4	

**Restore system**

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**

- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☒ Complete the Service Engineer Comments section below if there are additional comments.

**Agilent 5110 and 5100 ICP-OES  
Preventive Maintenance Checklist**

- ☒ Review the service and any test results with the customer.
- ☒ If the Instrument firmware was updated, record the details of the change in the Service Engineer's Comments box below or if necessary, in the customer's IQ records.

**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.

**Other Important Customer Web Links**

How to get information on your product:

- ☐ Literature Library - <http://www.agilent.com/en-us/products/icp-oes/icp-oes-systems/5110-icp-oes#literature>
- ☒ Need to know more? - <http://www.agilent.com/crosslab/university/>
- ☒ Need technical support, FAQs? - <http://www.agilent.com/en-us/support/landing/icp-oes>
- ☒ Need supplies? - [www.agilent.com/chem/supplies](http://www.agilent.com/chem/supplies)

**Service Completion**

Service request number 6005625287 Date service completed 30 NOV 2022

Agilent signature Worawit T. Customer signature จกม

Document part number: G8014-90075

**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	Test Before PM
Test Completed On	11/30/2022 9:35:32 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	Pass
Precision Test	Pass

Resolution Test			Pass
Element Wavelength	Specification	Width	
N (174.213 nm)	≤ 9.40	6.62	
As (188.980 nm)	≤ 8.20	6.20	
C (193.027 nm)	≤ 11.50	8.35	
Mo (202.032 nm)	≤ 8.20	6.41	
Cr (206.158 nm)	≤ 13.40	9.04	
Zn (213.857 nm)	≤ 8.70	6.62	
Pb (220.353 nm)	≤ 9.50	7.13	
Co (228.615 nm)	≤ 17.20	11.71	
Ba (230.424 nm)	≤ 9.40	7.21	
Mn (257.610 nm)	≤ 13.30	9.50	
Mn (260.568 nm)	≤ 20.30	14.33	
Cr (267.716 nm)	≤ 11.00	8.14	
Cu (324.754 nm)	≤ 25.00	18.98	
Cu (327.395 nm)	≤ 14.20	11.24	
Sr (338.071 nm)	≤ 33.50	24.47	
Ba (455.403 nm)	≤ 44.00	33.88	
Sr (460.733 nm)	≤ 36.00	17.22	
Ba (493.408 nm)	≤ 36.00	25.48	
Ba (614.171 nm)	≤ 42.00	25.47	
Ar (675.283 nm)	≤ 74.00	59.82	
K (766.491 nm)	≤ 80.00	64.94	

เอกสารไม่ควบคุม

Sensitivity Test						Pass
Radial						
Element Wavelength	Specification	Method	Ratio	Standard	Blank	
As (188.980 nm)	≥ 46.0	SRBR	147.7	1156.5	55.5	
Se (196.026 nm)	≥ 41.0	SRBR	111.1	1195.3	97.7	
Zn (213.857 nm)	≥ 1421.0	SRBR	4100.6	51959.5	159.6	
Pb (220.353 nm)	≥ 46.0	SRBR	192.5	2808.6	185.7	
Mn (257.610 nm)	≥ 3518.0	SRBR	11064.7	264165.0	567.6	
Al (396.152 nm)	≥ 3.4	SBR	7.5	49047.9	5770.5	
Ba (493.408 nm)	≥ 34.0	SBR	107.4	1887710.3	17407.5	
K (766.491 nm)	≥ 1.8	SBR	5.1	100805.9	16626.4	
Axial						
Element Wavelength	Specification	Method	Ratio	Standard	Blank	
As (188.980 nm)	≥ 208.0	SRBR	234.9	3056.4	152.9	
Se (196.026 nm)	≥ 159.0	SRBR	218.1	3865.1	271.6	
Zn (206.200 nm)	≥ 234.0	SRBR	1306.5	15850.4	144.5	
Zn (213.857 nm)	≥ 1743.0	SRBR	8364.0	183037.8	476.4	
Cd (214.439 nm)	≥ 4227.0	SRBR	7718.5	143240.2	342.8	
Pb (220.353 nm)	≥ 320.0	SRBR	576.3	14465.2	580.4	
Mn (257.610 nm)	≥ 10625.0	SRBR	31842.1	1411257.3	1958.9	
Cr (267.716 nm)	≥ 1048.0	SRBR	4492.1	183110.6	1632.2	
Cu (324.754 nm)	≥ 19.0	SBR	46.2	371487.5	7862.9	
Al (396.152 nm)	≥ 6.0	SBR	14.9	278447.4	17552.6	
Ba (493.408 nm)	≥ 60.0	SBR	190.6	10061527.3	52519.8	
K (766.491 nm)	≥ 24.0	SBR	36.8	1922163.4	50858.1	

เอกสารไม่ควบคุม



Precision Test			Pass
Radial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 2.60	0.82	
Se (196.026 nm)	≤ 2.60	0.71	
Zn (213.857 nm)	≤ 1.50	0.43	
Pb (220.353 nm)	≤ 2.60	0.76	
Mn (257.610 nm)	≤ 1.50	0.60	
Al (396.152 nm)	≤ 1.50	0.48	
Ba (493.408 nm)	≤ 1.50	0.89	
K (766.491 nm)	≤ 1.50	0.42	
Axial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 1.50	0.57	
Se (196.026 nm)	≤ 1.50	0.76	
Zn (206.200 nm)	≤ 1.50	0.61	
Zn (213.857 nm)	≤ 1.50	0.51	
Cd (214.439 nm)	≤ 1.50	0.55	
Pb (220.353 nm)	≤ 1.50	0.52	
Mn (257.610 nm)	≤ 1.50	0.54	
Cr (267.716 nm)	≤ 1.50	0.54	
Cu (324.754 nm)	≤ 1.50	0.69	
Al (396.152 nm)	≤ 1.50	0.91	
Ba (493.408 nm)	≤ 1.50	0.85	
K (766.491 nm)	≤ 1.50	1.22	

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	PM Functional test	
Test Completed On	11/30/2022 11:43:36 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	19.00	
Water Flow Test	Pass	
RF Water Flow(L/min)	Camera Water Flow (L/min)	Water Inlet Temperature (°C)
1.44	1.05	18.51

เอกสารไม่ควบคุม

Gas Flows Test			Pass		
Nebulizer Target Flow	Actual Flow	Back Pressure	Auxiliary Target Flow	Actual Flow	Back Pressure
0.70	0.70	163.37	2.00	1.99	108.49
Makeup Target Flow	Actual Flow	Back Pressure	Plasma Target Flow	Actual Flow	Back Pressure
2.00	2.00	112.85	18.00	17.91	23.46
RF Generator Test			Pass		
RF Power Supply Test		Passed			
RF Power Supply (V)		147.437			
RF Oscillator Test		Passed			
RF Oscillator Frequency (MHz)		0.000			
Work Coil Current (A)		45.069			
RF Power Supply Current (A)		1.997			
Camera Test			Pass		
		Integration Time (ms)	Standard Deviation	Status	
Electronic Offset Test		1000	5.305	Passed	
Dark Current Test		6000	0.578	Passed	
Array Test		5	0.024	Passed	
Linearity Test			0.118	Passed	

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	PM Performance test	
Test Completed On	11/30/2022 12:10:42 PM	
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	Pass	
Advanced Valve System Test	Skipped	
Resolution Test	Pass	
Sensitivity Test	Pass	
Precision Test	Pass	
Optics Test		Pass
	Radial	Axial
Intensity	5674608	5823476
Wavelength	737.212	737.212

เอกสารไม่ควบคุม

Resolution Test			Pass
Element Wavelength	Specification	Width	
N (174.213 nm)	≤ 9.40	6.79	
As (188.980 nm)	≤ 8.20	6.09	
C (193.027 nm)	≤ 11.50	8.29	
Mo (202.032 nm)	≤ 8.20	6.30	
Cr (206.158 nm)	≤ 13.40	9.05	
Zn (213.857 nm)	≤ 8.70	6.77	
Pb (220.353 nm)	≤ 9.50	7.02	
Co (228.615 nm)	≤ 17.20	11.67	
Ba (230.424 nm)	≤ 9.40	7.39	
Mn (257.610 nm)	≤ 13.30	9.48	
Mn (260.568 nm)	≤ 20.30	14.25	
Cr (267.716 nm)	≤ 11.00	7.94	
Cu (324.754 nm)	≤ 25.00	18.99	
Cu (327.395 nm)	≤ 14.20	11.33	
Sr (338.071 nm)	≤ 33.50	24.44	
Ba (455.403 nm)	≤ 44.00	33.86	
Sr (460.733 nm)	≤ 36.00	17.51	
Ba (493.408 nm)	≤ 36.00	25.56	
Ba (614.171 nm)	≤ 42.00	24.96	
Ar (675.283 nm)	≤ 74.00	59.38	
K (766.491 nm)	≤ 80.00	65.63	

เอกสารไม่ควบคุม

Sensitivity Test						Pass
Radial						
Element Wavelength	Specification	Method	Ratio	Standard	Blank	
As (188.980 nm)	≥ 46.0	SRBR	147.8	1149.3	54.8	
Se (196.026 nm)	≥ 41.0	SRBR	111.6	1222.8	101.0	
Zn (213.857 nm)	≥ 1421.0	SRBR	4375.0	52592.3	143.7	
Pb (220.353 nm)	≥ 46.0	SRBR	199.8	2744.4	166.5	
Mn (257.610 nm)	≥ 3518.0	SRBR	12801.7	285591.3	496.0	
Al (396.152 nm)	≥ 3.4	SBR	9.9	52888.6	4873.6	
Ba (493.408 nm)	≥ 34.0	SBR	154.6	2287291.6	14698.1	
K (766.491 nm)	≥ 1.8	SBR	6.4	106701.6	14350.9	
Axial						
Element Wavelength	Specification	Method	Ratio	Standard	Blank	
As (188.980 nm)	≥ 208.0	SRBR	242.4	3170.1	154.8	
Se (196.026 nm)	≥ 159.0	SRBR	226.1	4134.5	289.3	
Zn (206.200 nm)	≥ 234.0	SRBR	1126.6	13782.0	146.5	
Zn (213.857 nm)	≥ 1743.0	SRBR	8400.8	177166.3	442.5	
Cd (214.439 nm)	≥ 4227.0	SRBR	7001.9	125884.2	321.6	
Pb (220.353 nm)	≥ 320.0	SRBR	536.3	12909.3	532.6	
Mn (257.610 nm)	≥ 10625.0	SRBR	30846.2	1287989.0	1738.8	
Cr (267.716 nm)	≥ 1048.0	SRBR	4396.0	167335.6	1424.4	
Cu (324.754 nm)	≥ 19.0	SBR	52.1	373690.7	7033.1	
Al (396.152 nm)	≥ 6.0	SBR	16.8	268357.7	15112.4	
Ba (493.408 nm)	≥ 60.0	SBR	225.2	10173441.5	44971.7	
K (766.491 nm)	≥ 24.0	SBR	39.7	1874136.2	46055.7	

เอกสารไม่ควบคุม



Precision Test			Pass
Radial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 2.60	0.60	
Se (196.026 nm)	≤ 2.60	0.84	
Zn (213.857 nm)	≤ 1.50	0.29	
Pb (220.353 nm)	≤ 2.60	0.59	
Mn (257.610 nm)	≤ 1.50	0.28	
Al (396.152 nm)	≤ 1.50	0.28	
Ba (493.408 nm)	≤ 1.50	0.59	
K (766.491 nm)	≤ 1.50	0.23	
Axial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 1.50	0.71	
Se (196.026 nm)	≤ 1.50	0.43	
Zn (206.200 nm)	≤ 1.50	0.46	
Zn (213.857 nm)	≤ 1.50	0.37	
Cd (214.439 nm)	≤ 1.50	0.48	
Pb (220.353 nm)	≤ 1.50	0.48	
Mn (257.610 nm)	≤ 1.50	0.74	
Cr (267.716 nm)	≤ 1.50	0.26	
Cu (324.754 nm)	≤ 1.50	0.51	
Al (396.152 nm)	≤ 1.50	0.45	
Ba (493.408 nm)	≤ 1.50	0.81	
K (766.491 nm)	≤ 1.50	0.84	

เอกสารไม่ควบคุม

	<p><b>TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)</b>  CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  TEL. 0-2717-3000-27 FAX. 0-2719-9484</p>	 
<p><b>Cert. No.:</b> 22TM672  <b>Page.:</b> 1 of 3</p>		
<h2>Certificate of Calibration</h2>		
<b>Equipment :</b>	Incubator	
<b>Manufacturer :</b>	Memmert	
<b>Model :</b>	IPP 260	
<b>Serial No. :</b>	V616.0066	
<b>ID No. :</b>	UAE.MIC.032/2559	
<b>Submitted by :</b>	United Analyst and Engineering Consultant Co.,Ltd. 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260	
<b>Location :</b>	Microbiology Laboratory (302)	
<b>Received Order :</b>	3 May 2022	
<b>Calibration Date :</b>	5 May 2022	
<b>Ambient Temperature :</b>	( 26 ± 10 ) °C	
<b>Relative Humidity :</b>	( 50 ± 30 ) %	
<b>Calibrated by :</b>	Preecha Hlahib	
<b>Approved by :</b>	 Approved Signatory	
<input type="checkbox"/> Pornthippa Tameyakul <input checked="" type="checkbox"/> Malee Butkruea <input type="checkbox"/> Suwit Imjai		
<b>Issue Date :</b>	11 May 2022	
<p>The Uncertainties are for a confidence probability of approximately 95 %</p> <p><small>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</small></p>		

เอกสารไม่ควบคุม



Equipment : Incubator  
 Condition As-Received : Used Item  
 Reference : 2205-0003OC-3

Cert. No.: 22TM672  
 Page.: 2 of 3

#### Procedure Used :-

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

The temperature scale used was based on ITS-90.

#### Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34970A	MY44067817	21LM10	20 Jul 2022

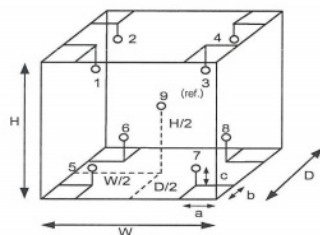
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Not Available



#### Probe Installation Details :

a = 5.0 cm	D = 0.50 m
b = 5.0 cm	W = 0.60 m
c = 5.0 cm	H = 0.80 m
	Capacity = 0.24 m <sup>3</sup>

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	25	23
REL.Humid. ( % )	62	57
AC Supply ( Volt )	221	221

Position :	Ref. Std. ID No.:
1	19-15RTD-01
2	19-15RTD-02
3	19-15RTD-03
4	19-15RTD-04
5	19-15RTD-05
6	21-15RTD-06
7	19-15RTD-07
8	19-15RTD-08
9 (ref.)	19-15RTD-09

เอกสารไม่ควบคุม



Equipment : Incubator  
 Condition As-Received : Used Item  
 Reference : 2205-0003OC-3  
**Result of Calibration :-** ( \* ) Without Adjustment

Cert. No.: 22TM672  
 Page.: 3 of 3

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Not Available

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor k
25.0	25.0	25.0	0.021	0.18	0.33	0.30	2
36.0	36.0	36.0	0.077	0.96	1.8	0.33	2

Calibration Point ( °C )	Measured Temperature ( °C )								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
25.0	25.221	25.146	25.127	25.113	24.968	24.986	24.933	25.017	25.047
36.0	35.637	35.238	36.130	36.515	36.928	36.845	36.630	36.761	36.113

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

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

**Temperature uniformity :** The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

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

**UUC\* :** Unit Under Calibration

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

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

-o0o-

เอกสารไม่ควบคุม



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



Cert. No.: 22TM503  
Page.: 1 of 3

## Certificate of Calibration

**Equipment :** Incubator  
**Manufacturer :** Memmert  
**Model :** IPP 260  
**Serial No. :** V618.0033  
**ID No. :** UAE.MIC.021/2561  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
**Location :** Microbiology Laboratory (302)  
**Received Order :** 3 May 2022  
**Calibration Date :** 3 May 2022  
**Ambient Temperature :**  $(26 \pm 10) ^\circ\text{C}$   
**Relative Humidity :**  $(50 \pm 30) \%$   
**Calibrated by :** Krisda Malee

**Approved by :**

*Malee*  
Approved Signatory

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

**Issue Date :** 10 May 2022

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม



**Equipment :** Incubator  
**Condition As-Received :** Used Item  
**Reference :** 2205-0003OC-4  
**Procedure Used :-**

Cert. No.: 22TM503  
Page.: 2 of 3

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

The temperature scale used was based on ITS-90.

### Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34970A	MY49023932	21LM8	06 Jul 2022

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

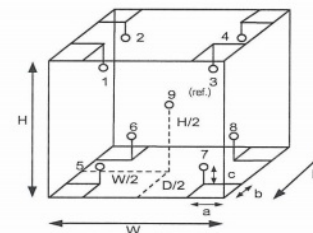
3. This certification is traceable to the International System of Unit.

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

**Fresh air setting :** Not Available

Environment during calibration		
	Beginning	Finished
Temp. ( °C )	23	22
REL.Humid. ( % )	53	54
AC Supply ( Volt )	221	220



**Probe Installation Details :**

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

**Dimension of Chamber :**

D = 0.50 m  
W = 0.64 m  
H = 0.80 m  
Capacity = 0.26 m<sup>3</sup>

Position :	Ref. Std. ID No.:
1	20-16RTD-01
2	20-16RTD-02
3	20-16RTD-03
4	20-16RTD-04
5	20-16RTD-05
6	20-16RTD-06
7	20-16RTD-07
8	20-16RTD-08
9 (ref.)	20-16RTD-09

เอกสารไม่ควบคุม





Equipment : Incubator  
Condition As-Received : Used Item  
Reference : 2205-0003OC-4  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source  
Fresh air setting : Not Available

Cert. No.: 22TM503  
Page.: 3 of 3

Calibration Point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Temperature stability ( ± °C )	Temperature uniformity ( °C )	Overall Variation ( °C )	Uncertainty ( ± °C )	Coverage Factor <i>k</i>
22.0	22.0	22.0	0.051	0.095	0.19	0.30	2
44.0	44.0	44.0	0.10	0.83	1.2	0.32	2

Calibration Point ( °C )	Measured Temperature ( °C )								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
22.0	22.238	22.200	22.139	22.207	22.184	22.178	22.136	22.169	22.161
44.0	44.604	44.670	44.240	44.315	43.974	44.446	43.584	44.209	44.306

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

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

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

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

UUC\* : Unit Under Calibration

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

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

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



Cert. No.: 22TM333  
Page.: 1 of 3

## Certificate of Calibration

Equipment : Water Bath  
Manufacturer : Memmert  
Model : WNE 14  
Serial No. : L416.0606  
ID No. : UAE.MIC.002/2560  
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
Location : Microbiology Laboratory  
Received Order : 17 February 2022  
Calibration Date : 17 February 2022  
Ambient Temperature : ( 26 ± 10 ) °C  
Relative Humidity : ( 50 ± 30 ) %  
Calibrated by : Suwit Imjai

Approved by :   
Approved Signatory

( ) Pornthippa Tameyakul  
( ) Malee Butkruea

Issue Date : 22 February 2022

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Water Bath  
 Condition As-Received : Used Item  
 Reference : 2202-0444OC-3

Cert. No.: 22TM333  
 Page.: 2 of 3

**Procedure Used :-**

Calibration were conducted using in-house calibration procedure CP-OT04 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer ( IPRT ).

The temperature scale used was based on ITS-90.

**Condition of this result of calibration**

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34970A	MY44067817	21LM10	20 Jul 2022

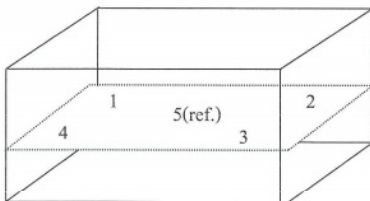
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

	Environmental		AC Voltage Supply
	( °C )	( %R.H. )	( Volt )
Beginning of Calibration	21	65	229
Finished of Calibration	22	58	230



Front

Position :	Ref. Std. ID No.:
1	70RC143
2	70RC144
3	70RC145
4	70RC146
5(ref.)	70RC147

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Equipment : Water Bath  
 Condition As-Received : Used Item  
 Reference : 2202-0444OC-3

Cert. No.: 22TM333  
 Page.: 3 of 3

**Result of Calibration :-** ( \* ) Without Adjustment  
**Function of UUC\* :** Temperature Source

Calibration point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Average* Standard Reading ( °C )				
			Position				
			1	2	3	4	5 (ref.)
44.5	44.5	44.5	44.498	44.481	44.482	44.518	44.534

Calibration point ( °C )	Uniformity ( °C )	Stability ( ± °C )	Uncertainty ( ± °C )	Coverage Factor k
44.5	0.13	0.057	0.15	2

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

**Uniformity :** The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

**Stability :** One-half of the greatest maximum difference of measured temperature at any one probe.

**UUC\* :** Unit Under Calibration

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

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

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TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22TM334  
Page.: 1 of 3

## Certificate of Calibration

**Equipment :** Water Bath  
**Manufacturer :** Memmert  
**Model :** WNE 14  
**Serial No. :** L416.0612  
**ID No. :** UAE.MIC.003/2560  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
**Location :** Microbiology Laboratory  
**Received Order :** 17 February 2022  
**Calibration Date :** 17 February 2022  
**Ambient Temperature :** ( 26 ± 10 ) °C  
**Relative Humidity :** ( 50 ± 30 ) %  
**Calibrated by :** Suwit Imjai  
**Approved by :**   
( / ) Pornthippa Tameyakul  
( / ) Malee Butkruea  
**Issue Date :** 22 February 2022

The Uncertainties are for a confidence probability of approximately 95%

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A 0038095



**Equipment :** Water Bath  
**Condition As-Received :** Used Item  
**Reference :** 2202-0444OC-4  
**Procedure Used :-**

Cert. No.: 22TM334  
Page.: 2 of 3

Calibration were conducted using in-house calibration procedure CP-OT04 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer ( IPRT ).

The temperature scale used was based on ITS-90.

### Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34970A	MY44067817	21LM10	20 Jul 2022

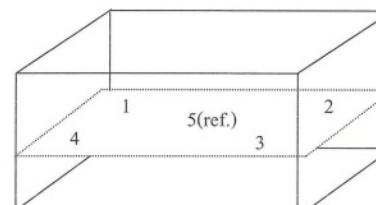
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source

	Environmental		AC Voltage Supply
	( °C )	( %R.H. )	( Volt )
Beginning of Calibration	21	65	229
Finished of Calibration	22	57	230



Front

Position :	Ref. Std. ID No.:
1	70RC143
2	70RC144
3	70RC145
4	70RC146
5(ref.)	70RC147

เอกสารไม่ควบคุม

a 1096055





Equipment : Water Bath  
Condition As-Received : Used Item  
Reference : 2202-0444OC-4  
Result of Calibration :- ( \* ) Without Adjustment  
Function of UUC\* : Temperature Source

Cert. No.: 22TM334  
Page.: 3 of 3

Calibration point ( °C )	UUC* Setting ( °C )	UUC* Reading ( °C )	Average* Standard Reading ( °C )				
			Position				
			1	2	3	4	5 (ref.)
44.5	44.5	44.5	44.572	44.514	44.507	44.530	44.565

Calibration point ( °C )	Uniformity ( °C )	Stability ( ± °C )	Uncertainty ( ± °C )	Coverage Factor k
44.5	0.10	0.042	0.15	2

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

**Uniformity** : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

**Stability** : One-half of the greatest maximum difference of measured temperature at any one probe.

**UUC\*** : Unit Under Calibration

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

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

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a 1096054

Calibration Certificate ID  
TH2058-096-040722-ACC-TH

METTLER TOLEDO

Mettler-Toledo (Thailand) Ltd.  
846/4 - 846/5 Lasalle Rd., Bangna Tai Sub-District  
Bangna District, Bangkok 10260  
+66 2723 0382  
MT-TH.ServiceSupport@mt.com



## Accuracy Calibration Certificate

### Customer

Company: United Analyst and Engineering Consultant Co., Ltd.  
Address: 3 Soi Udom Suk 41, Sukhumvit Rd., Bang Chak  
City: Phra Khanong Contact: Suwit Chotnok  
Zip / Postal: 10260  
State / Province: Bangkok  
Order Number:



### Weighing Device

Manufacturer: Mettler Toledo Instrument Type: Weighing Instrument  
Model: MS603S/01 Asset Number: UAE.MIC.008/2553  
Serial No.: B007010311 Terminal Model: N/A  
Building: N/A Terminal Serial No.: N/A  
Floor: 2 Terminal Asset No.: N/A  
Room: Balance Room (206)

Range	Max. Capacity	Readability (d)
1	620 g	0.001 g

### Procedure

Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)  
METTLER TOLEDO Work Instruction: CPW002/20

This calibration certificate contains measurements for As Found calibration. No As Left calibration was performed because the device was not modified after As Found calibration. Therefore, results for As Left correspond to As Found.

The sensitivity/span of the weighing instrument was adjusted before calibration with a built-in weight.

In accordance with EURAMET cg-18 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific calibration conditions.

	Temperature		Humidity	
As Found	Start: 22.8 °C	End: 23.0 °C	Start: 49.9 %	End: 58.3 %

As Found Calibration Date: 07-Apr-2022  
As Left Calibration Date: N/A  
Issue Date: 08-Apr-2022

Calibrator: Sirawit Chamchan  
Approved Signatory: Kassakorn Tassanachaisakul  
☒ Kassakorn Tassanachaisakul  
☐ Santi Jitniyom  
☐ Surachet Sukkate

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## Measurement Results

### Repeatability

Test Load: 200 g

	As Found	As Left
1	200.001 g	N/A
2	200.001 g	N/A
3	200.001 g	N/A
4	200.001 g	N/A
5	200.001 g	N/A
6	200.000 g	N/A
7	200.001 g	N/A
8	200.001 g	N/A
9	200.000 g	N/A
10	200.001 g	N/A
Standard Deviation		
	0.0004 g	N/A

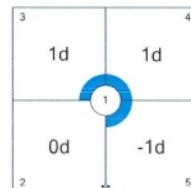


The "d" in the graph represents the readability of the range/interval in which the test was performed.  
The results of this graph are based upon the absolute values of the differences from the mean value.

### Eccentricity

Test Load: 200 g

Position	As Found	As Left
1	200.001 g	N/A
2	200.001 g	N/A
3	200.002 g	N/A
4	200.002 g	N/A
5	200.000 g	N/A
Maximum Deviation		
	0.001 g	N/A



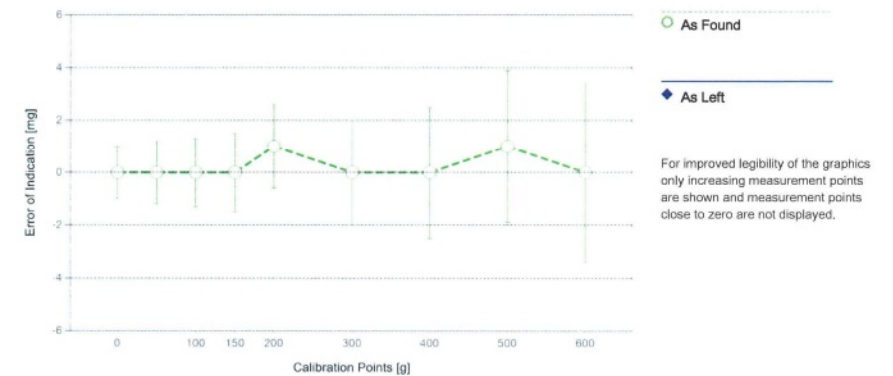
As Found

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

### Error of Indication

As Found

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.000 g	0.000 g	0.000 g	1.0 mg	2
2	0.500 g	0.500 g	0.000 g	1.2 mg	2
3	1.000 g	1.000 g	0.000 g	1.2 mg	2
4	50.000 g	50.000 g	0.000 g	1.2 mg	2
5	100.000 g	100.000 g	0.000 g	1.3 mg	2
6	150.000 g	150.000 g	0.000 g	1.5 mg	2
7	200.000 g	200.001 g	0.001 g	1.6 mg	2
8	300.001 g	300.001 g	0.000 g	2.0 mg	2
9	400.001 g	400.001 g	0.000 g	2.5 mg	2
10	500.001 g	500.002 g	0.001 g	2.9 mg	2
11	600.001 g	600.001 g	0.000 g	3.4 mg	2



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

The user is responsible for maintaining environmental conditions and the settings of the weighing instrument when it was calibrated.

## Test Equipment

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

### Weight Set 1: OIML F1

Weight Set No.: WS55 Date of Issue: 09-Jul-2021  
Certificate Number: CCM-0137-21-C Calibration Due Date: 07-Jul-2022

### Weight Set 2: OIML E2

Weight Set No.: WS80 Date of Issue: 23-Feb-2022  
Certificate Number: C208581631 Calibration Due Date: 14-Aug-2023

### Thermo Hygrometer

Equipment No.: IN161 Date of Issue: 14-Jun-2021  
Certificate Number: 21H1220 Calibration Due Date: 01-Jun-2022

## Remarks

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

### End of Accredited Section

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

## Measurement Uncertainty of the Weighing Instrument in Use

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

Temperature coefficient for the evaluation of the measurement uncertainty in use:  $3.0 \cdot 10^{-6} / K$

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

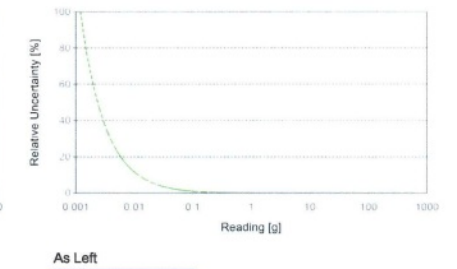
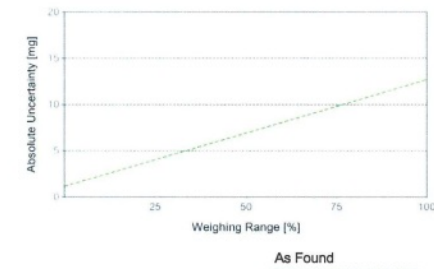
### Linearization of Uncertainty Equation

1	Range		As Found	As Left
	d	Max		
1	0.001 g	620 g	$U_1 = 1.2 \text{ mg} + 0.0186 \text{ mg/g} \cdot R$	N/A

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

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

Net Indication	As Found		As Left	
0.062 g	1.2 mg	1.9%	N/A	N/A
0.620 g	1.2 mg	0.20%	N/A	N/A
6.200 g	1.3 mg	0.021%	N/A	N/A
62.000 g	2.4 mg	0.0038%	N/A	N/A
620.000 g	13 mg	0.0021%	N/A	N/A







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## Certificate of Calibration

Cert. No.: 22TM89  
Page.: 1 of 3

**Equipment :** Autoclave  
**Manufacturer :** ALP  
**Model :** CL-40L  
**Serial No. :** 802664  
**ID No. :** UAE.MIC.014/2550  
**Submitted by :** United Analyst and Engineering Consultant Co.,Ltd.  
3 Soi Udomsuk 41, Sukhumvit Road,  
Bangchak, Phrakhanong,  
Bangkok 10260  
**Location :** Air Analysis Unit  
**Received Order :** 17 February 2022  
**Calibration Date :** 17 February 2022  
**Ambient Temperature :** ( 26 ± 10 ) °C  
**Relative Humidity :** ( 50 ± 30 ) %  
**Calibrated by :** Kunchit Promprat  
**Approved by :**   
( ) Pornthippa Tameyakul  
( ✓ ) Malee Butkruea  
( ) Suwit Imjai  
**Issue Date :** 22 February 2022

The Uncertainties are for a confidence probability of approximately 95%

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**Equipment :** Autoclave  
**Condition As-Received :** Used Item  
**Reference :** 2202-0444OC-1  
**Procedure Used :-**

Cert. No.: 22TM89  
Page.: 2 of 3

Calibration were conducted using in-house calibration procedure CP-OT03 according to direct measurement method with Data Acquisition which connected with Thermocouple Type T  
The temperature scale used was based on ITS-90.

### Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1 ) Data Acquisition	34970A	MY44035217	21LM30	23 Dec 2022

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

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

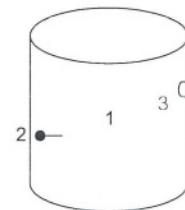
4. This result of calibration covers laboratory autoclaves for the sterilization of goods and material which could be infected with organisms categorized as Hazard Group 1, 2 and 3\*\*

(\*\* = Categorization of pathogens according to hazard and categories of containment, second edition, 1990 )  
It does not cover autoclaves for use with material infect with organisms in Hazard Group 4, for which complete containment and sterilization of infected condensate is considered to be essential.

This result of calibration does not apply to sterilizers or disinfectors used for medical, dental, pharmaceutical or veterinary purposes which are directly concerned with patient care, or those used for fabrics subjected to sterilization which are required to be dry at the end of cycle.

**Result of Calibration :-** ( \* ) Without Adjustment

**Function of UUC\* :** Temperature Source



	Environmental		
	( °C )	( %R.H. )	( Volt )
Beginning of Calibration	27	68	226
Finished of Calibration	27	65	226

Position	Description	Ref. Std. ID No.:
1 =	Center of chamber	22-10TC-01
2 =	Temperature sensor	22-10TC-02
3 =	Exhaust port	22-10TC-03

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Equipment : Autoclave  
Condition As-Received : Used Item  
Reference : 2202-0444OC-1

Cert. No.: 22TM89

Page.: 3 of 3

Result of Calibration :- ( \* ) Without Adjustment

Operating parameter Set : Temperature = 122 °C

Sterilization period = 30 minute

UUC* Setting ( °C )	UUC* Reading ( °C )	Position	Average* Standard Reading ( °C )	Stability ( ± °C )	Pressure Reading ( MPa )	Uncertainty ( ± °C )	Coverage Factor <i>k</i>
122	122	1	122.373	0.32	0.12	1.2	2
		2	122.421				
		3	122.292				

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

Stability : One-half of the greatest maximum difference of measured temperature at any one probe.

UUC\* : Unit Under Calibration

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

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

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