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## เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์

เอกสารสอบเทียบเครื่องมือ ตรวจวัดคุณภาพอากาศ  
ในบรรยากาศ และ คุณภาพ เสียง

รายการเครื่องมือที่ใช้ในการตรวจวัด/วิเคราะห์

No	Model	Serial Number	Part	Remark
1	TE-5170 (TSP)	2727	1	TSP/บ้านคลองบางหงส์ (A1)
2	TE-5170 (TSP)	2730	2	TSP/วัดบ้านพาสน์ (A2)
3	APNA-370	9BRKGTUK	3	NO <sub>2</sub> /บ้านคลองบางหงส์ (A1)
4	APNA-370	705KA9JJ	4	NO <sub>2</sub> /วัดบ้านพาสน์ (A2)
5	APSA-370	PGRKTBDX	5	SO <sub>2</sub> /บ้านคลองบางหงส์ (A1)
6	APSA-370	Y8SW7T00	6	SO <sub>2</sub> /วัดบ้านพาสน์ (A2)
7	Test WS/WD Report	A5040	7-10	WindSpeed/บ้านคลองบางหงส์ (A1)
8	Test WS/WD Report	A5041	11-14	WindSpeed/วัดบ้านพาสน์ (A2)
9	แบบบันทึกการสอบเทียบเครื่อง Sound Level Meter	00396801	15	Noise/บ้านคลองบางหงส์ (N1)
10	แบบบันทึกการสอบเทียบเครื่อง Sound Level Meter	00396923	16	Noise/วัดบ้านพาสน์ (N2)

High Volume Air Sampler Calibration Worksheet

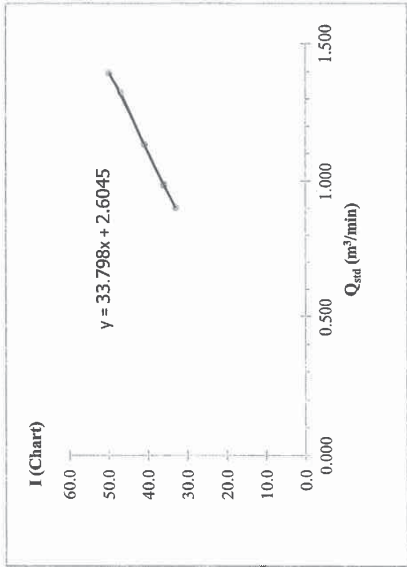
Project Site :  
Location :  
Date of measurement :  
Worksheet No. :  
High Volume ID :  
High Volume Model :  
High Volume S/N :  
Ambient Condition  
Temperature (°C) :  
Barometric Pressure (mmHg) :

ณ จุดสถานีกรมบ้านหัว  
(ไผ่เตด)  
บ้านคลองบางหงส์  
18/3/2024  
C-180324-WWL0095  
WWL0095  
TE-5170 (TSP)  
2727  
13/03/2023  
26  
756

Calibration Office  
Calibrator ID :  
Calibrator Model :  
Calibrator S/N :  
Calibrate Date :  
Quality Standard Slop  
Quality Standard Inte

WWL0103  
TE-5028A  
3271  
13/03/2023  
1.61297  
-0.04609

Test No.	delta H <sub>2</sub> O (inch)	Q <sub>ad</sub> (m <sup>3</sup> /min)	I (Chart)	IC (Corrected)	Linear Regression
1	4.90	1.395	50.0	49.80	Slope : 33.66 Intercept : 2.594 Correlation Coefficient : 0.9995
2	4.40	1.324	47.0	46.81	
3	3.20	1.133	41.0	40.83	
4	2.40	0.985	36.0	35.85	
5	2.00	0.902	33.0	32.87	



Calibrated by :



Sulfur Dioxide Analyzer Calibration Worksheet

Project Site :

Location :

Date of measurement :

Worksheet No. :

Ambient SO<sub>2</sub> Analyzer ID :

Manufacturer :

Ambient SO<sub>2</sub> Analyzer Model :

Ambient SO<sub>2</sub> Analyzer S/N :

นิคมอุตสาหกรรมบ้านหว้า (โศภค)

บ้านค้อจันทน์หงส์

18 March 2024

C-180324WWL 0111

WWL 0111

HORIBA

AFSA-370

PGKKTBDX

Multi Gas Calibrator

Calibrator ID :

Calibrator Model :

Calibrator S/N :

Calibrate Date :

Cylinder Std. Gas

Std. Gas Concentration (PPM) :

Cylinder Pressure (psi)

Certified Date :

Expired Date :

Serial No. :

WWL0128

Series 6100

S/N 7462

10 January 2023

50.90

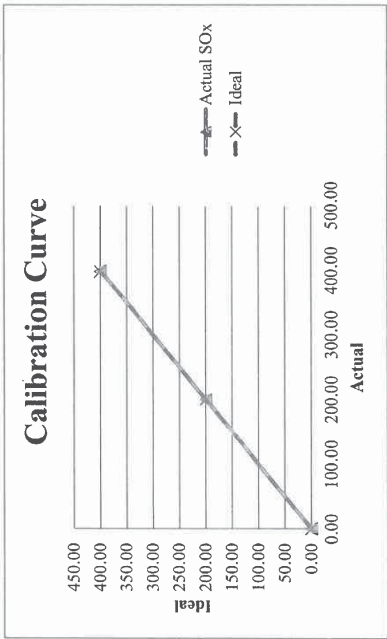
2000

07 December 2021

07 December 2025

CC241587

CALIBRATION RESULTS					
Point	Ideal	Actual SO <sub>2</sub>	Error Sox	%Error Sox	
ZERO	0.00	0.10	0.10	-	
SPAN 200 ppb	200.00	200.10	0.10	0.05	
SPAN 400 ppb	400.00	400.10	0.10	0.03	
AVERAGE (%)					0.04



Calibrated by

Nitrogen Dioxide Analyzer Calibration Worksheet

Project Site :

Location :

Date of measurement :

Worksheet No. :

Ambient NO<sub>x</sub> Analyzer ID :

Manufacturer :

Ambient NO<sub>x</sub> Analyzer Model :

Ambient NO<sub>x</sub> Analyzer S/N :

นิคมอุตสาหกรรมบ้านหว้า (โศภค)

วัดบ้านเพน

18 March 2024

C-0180324-WWL-0115

WWL 0115

HORIBA

APNA-370

705KA9JJ

Multi Gas Calibrator

Calibrator ID :

Calibrator Model :

Calibrator S/N :

Calibrate Date :

Cylinder Std. Gas

Std. Gas Concentration (PPM) :

Cylinder Pressure (psi)

Certified Date :

Expired Date :

Serial No. :

WWL0128

Series 6100

S/N 7462

10 January 2023

50.90

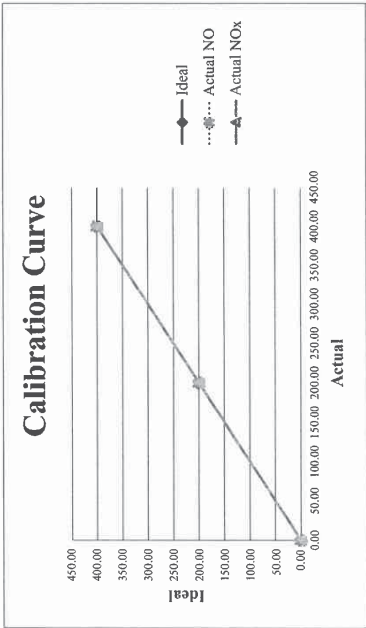
2000

07 December 2021

07 December 2025

CC241587

CALIBRATION RESULTS						
Point	Ideal	Actual NO	Error NO	%Error NO	Error NO <sub>x</sub>	%Error NO <sub>x</sub>
ZERO	0.00	0.10	0.10	0.10	0.10	-
SPAN 200 ppb	200.00	200.10	0.10	0.05	0.20	0.10
SPAN 400 ppb	400.00	400.20	0.20	0.05	0.10	0.03
AVERAGE (%)					0.05	0.06



Calibrated by

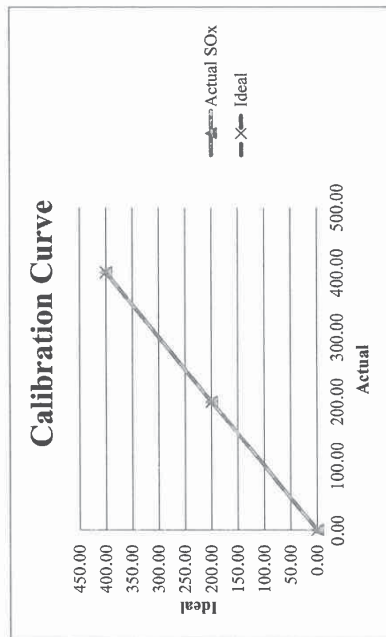


บริษัท ศูนย์วิเคราะห์น้ำ จำกัด  
WATER ANALYSIS CENTER COMPANY LIMITED  
194 หมู่ 5 ต.คันham อ.อุทัย จ.พระนครศรีอยุธยา 13210  
194 Moo 5, T.Kanhm, A.U-Thai, Ayutthaya 13210, Thailand  
Tel: 0-35226-383, 0-35800-593 Fax: 0-35800-594

## Sulfur Dioxide Analyzer Calibration Worksheet

Project Site :	นิคมอุตสาหกรรมบ้านหว้า (ไทยท)		
Location :	วัดบ้านพลาญ	Calibrator ID :	WWL0128
Date of measurement :	18 March 2024	Calibrator Model :	Series 6100
Worksheet No. :	C-180324WWL 0110	Calibrator SN :	S/N 7462
Ambient SOx Analyzer ID :	WWL 0110	Calibrate Date :	10 January 2023
Manufacturer :	HORIBA	Cylinder Std. Gas :	
Ambient SOx Analyzer Model :	APSA-370	Std. Gas Concentration (PPM) :	50.90
Ambient SOx Analyzer S/N :	Y8SW7T00	Cylinder Pressure (psi)	2000
		Certified Date :	07 December 2021
		Expired Date :	07 December 2025
		Serial No. :	CC241587

CALIBRATION RESULTS				
Point	Ideal	Actual SOx	Error Sox	% Error Sox
ZERO	0.00	0.10	0.10	-
SPAN 200 ppb	200.00	200.10	0.10	0.05
SPAN 400 ppb	400.00	400.20	0.20	0.05
AVERAGE (%)				
				0.05



Calibrated



JIRANAN ASSOCIATES CO., LTD.

Accredited calibration laboratory  
ISO/IEC 17025:2017  
NAC-TISI-TS 17025  
CALIBRATION 0567

Jiranan Associates Co., Ltd.  
63/14-15, 67/35-36  
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Bangkok 10600 (Thailand)  
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Mobile: +6688399453  
E-mail: jnac-calibration@jiranana.com  
Web site: www.jiranana.com

Air speed measurement laboratory  
Calibration services department

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM	: Wind Direction Sensor
MANUFACTURER	: Novolynx
MODEL/TYPE	: Sensor: WS-02F Data logger: 200-WS-25LB
SERIAL NUMBER	: Sensor: K6-040 Data logger: AS040
ID NUMBER	: -
CONDITION AS-RECEIVED	: Used item
CUSTOMER	: Water Analysis Center Co., Ltd. 94/1 Moo 5, T.Kanhm, A.U-thai, Ayutthaya 13210
RECEIVED DATE	: 10 Mar 2023
MEASUREMENT DATE	: 13 Mar 2023
ISSUE DATE	: 13 Mar 2023

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:  
Temperature : 23.0 ± 3.0 °C  
Relative Humidity : 55.0 ± 15.0 %RH  
Atmospheric Pressure : 1010 ± 10 hPa

### PLACE OF CALIBRATION

: Effect-type wind tunnel of Jiranan Associates Co., Ltd.

### CALIBRATION CONDITION

: Wind tunnel cross-section area<sup>1</sup> 900 cm<sup>2</sup>  
Win direction frontal area<sup>2</sup> 129 cm<sup>2</sup>  
Diameter of mounting pipe<sup>3</sup> - mm  
Blockage ratio of test object<sup>4</sup> 0.143 [-]

### Preconditioning Measurement Condition

: 24 hours at ambient conditions.  
: The average values during measurement are (23.8)°C, (41.2) %RH and (1012.3) hPa.

### TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:  
☒ Mr. Soravit Thichaiad  
☐ Miss Jitraporn Jertsatthaphol

Approved signatory: .....



Remarks:  
1. Nozzle cross-section area of the wind tunnel  
2. Projected cross-section area of the tested object include mounting pipe  
3. Diameter of mounting pipe  
4. Ratio <sup>2</sup> to <sup>1</sup>

Calibration procedure:  
The wind direction sensor was calibrated against Standard Rotary Encoder model: AK4991S-DIM04-P3-S-U0 in an close test-section of Effect-type wind tunnel with 900 cm<sup>2</sup> cross test section area. The WI-CL-008 based on IEC 61400-12-1, Wind energy generation systems - Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:  
This certificate provides a traceability of The measurement to recognition the national standards, did to realization of the international system of units (SI) through the NMVT (National Metrology Institute of Thailand) via Certificate number: BA-0043-22

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

Certificate Number

CL-026-66

Page 2 of 2 Pages

MEASUREMENT RESULTS<sup>5</sup>

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed m/s	D <sub>1</sub> <sup>1st</sup> Degree (°)	D <sub>2</sub> <sup>2nd</sup> Degree (°)	Error Degree (°)	U (k=2) Degree (°)
	45.000	41	-4	1.0
	90.000	87	-3	1.0
	135.000	133	-2	1.0
	180.000	180	0	1.0
5.05	225.001	227	2	1.0
	270.001	273	3	1.0
	315.000	319	4	1.0
	360.000	359	-1	1.0

Remark:

<sup>1</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration was made<sup>2</sup> Direction of standard<sup>3</sup> Direction of Unit Under Calibration

ภาคผนวก ข - 6



\*\*\*End of Certificate of Calibration\*\*\*



Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC-TIS-TIS 17025  
CALIBRATION 0367

Jiranatee Associates Co., Ltd.  
63/14-15, 67/35-36  
Petchkasem 7/71, Rd. Watthapra, Bangkokkya,  
Bangkok 10600 (Thailand)  
Tel: +6688680812  
Mobile: +66863995453  
E-mail: jnac-calibration@jiranatee.com  
Web site: www.jiranatee.com

Air speed measurement laboratory  
Calibration services department.

Certificate Number

CL-026-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM

MANUFACTURER

MODEL/TYPE

SERIAL NUMBER

ID NUMBER

CONDITION AS-RECEIVED

CUSTOMER

Cup anemometer

: Novallink

Sensor: WS-02F

Data logger: 200-WS-25LB

: Sensor: KG-040

Data logger: ASD-40

:-

: Used item

: Water Analysis Center Co., Ltd.

94/1 Moo 5, T. Kaniham, A.U. Hai, Ayutthaya 13210

RECEIVED DATE

MEASUREMENT DATE

ISSUE DATE

: 10 Mar 2023

: 13 Mar 2023

: 13 Mar 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature

: 23.0 ± 3.0 °C

Relative Humidity

: 55.0 ± 15.0 %RH

Atmospheric Pressure

: 1010 ± 10 hPa

PLACE OF CALIBRATION

: Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS

Wind tunnel cross-section: area<sup>1</sup>Win direction frontal area<sup>2</sup>Diameter of mounting pipe<sup>3</sup>Blockage ratio of test object<sup>4</sup>900 cm<sup>2</sup>100 cm<sup>2</sup>

mm

0.111 [-]

Preconditioning

Measurement Condition

: 24 hours at ambient conditions.

: The average values during measurement are (24.5) °C, (42.9) %RH and (1008.6) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☒ Mr. Soravit Thichchallad☐ Miss Jittaporn Jansomphol

Remark:

<sup>1</sup> Nozzle cross-section area of the wind tunnel<sup>2</sup> Projected cross-section area of the tested object include mounting pipe<sup>3</sup> Diameter of mounting pipe<sup>4</sup> Ratio <sup>2</sup> to <sup>1</sup>

Approved signature

**Calibration procedure:**  
The cup anemometer was calibrated against Standard air velocity transducer model: 8455-32 and pitot tube with precision differential pressure meter model: DPM2500 in an edge test section of Eiffel-type wind tunnel with 900 cm<sup>2</sup> cross test section area. The WH-CL-002 based on IEC 61400-12-1, Wind energy generation systems - Part 12-1, Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

**Traceability:**

This certificate provides a traceability of the measurement to recognized the national standards and to calibration of the international system of units (SI) through the NMRT (National Metrology Institute of Thailand) via Certificate number: MN-0052-21 and MN-0065-22

**Uncertainty of Measurement:**

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

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



MEASUREMENT RESULTS<sup>5</sup>

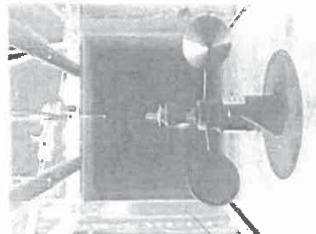
The cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

$V_{std}$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$V_{true}$ (m/s)	Error (m/s)	$\frac{\Delta V}{V}$ (%)
1.037	24.24	24.45	0.9	-0.1	0.31
2.032	24.70	24.45	1.9	-0.1	0.31
3.054	24.46	24.45	3.0	-0.1	0.31
4.217	24.70	24.45	4.0	-0.2	0.31
5.02	24.40	24.45	4.9	-0.1	0.31
5.99	24.70	24.45	5.9	-0.1	0.31
7.04	24.40	24.45	6.9	-0.1	0.31
8.17	24.62	24.45	8.1	-0.1	0.31
9.07	24.34	24.45	9.0	-0.1	0.31
10.07	24.40	24.45	10.0	-0.1	0.31
11.13	24.50	24.45	11.1	0.0	0.31
12.12	24.36	24.45	12.0	-0.1	0.34
13.18	24.50	24.45	13.1	-0.1	0.33
14.24	24.40	24.45	14.2	-0.1	0.31
15.22	24.40	24.45	15.0	-0.3	0.31
16.27	24.40	24.45	15.1	-0.2	0.41

ภาคผนวก

Remark:  
Calibration results only count for the tested circumstances and environmental conditions during which calibration took place  
<sup>5</sup> Velocity of standard  
<sup>6</sup> Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set-up is not true to scale due to imaging geometry.



CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Wind Direction Sensor  
MANUFACTURER : Novalynx  
MODEL/TYPE : Sensor: WS-02F  
SERIAL NUMBER : Data logger: 200-WS-25LB  
ID NUMBER : Sensor: WAC01  
CONDITION AS-RECEIVED : Data logger: AS041  
CUSTOMER : Used item  
: Water Analysis Center Co., Ltd.  
94/1 Moo 5, T.Xanham, A.U-thai, Ayutthaya 13210

RECEIVED DATE : 10 Mar 2023  
MEASUREMENT DATE : 13 Mar 2023  
ISSUE DATE : 13 Mar 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:  
Temperature : 23.0 ± 3.0 °C  
Relative Humidity : 55.0 ± 15.0 %RH  
Atmospheric Pressure : 1010 ± 10 hPa

PLACE OF CALIBRATION

: Effel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION

: Wind tunnel cross-section area<sup>1</sup> 900 cm<sup>2</sup>  
Win direction frontal area<sup>2</sup> 129 cm<sup>2</sup>  
Diameter of mounting pipe<sup>3</sup> mm  
Blockage ratio of test object<sup>4</sup> 0.143 %

Preconditioning Measurement Condition

: 24 hours at ambient conditions.  
: The average values during measurement are (24.0)°C, (41.1) %RH and (1012.8) hPa.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:  
☒ Mr. Sarawit Thirachai  
☐ Miss Jitraton Jiratanaporn



Approved signatory: .....  
Ca

Remark:  
1. Nozzle cross-section area of the wind tunnel  
2. Projected cross-section area of the tested object include mounting pipe  
3. Diameter of mounting pipe  
4. Ratio  $\frac{A_o}{A_t}$  %

Calibration procedure:  
The wind direction sensor was calibrated against Standard Rotary Encoder model: AX40075-DMM-P3-S-U0 in an close test-section of Effel-type wind tunnel with 900 cm<sup>2</sup> cross test-section area. The WI-CL-008 based on IEC 61400-12-1, Wind energy generation systems - Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:  
This certificate provides a traceability of the measurement to recognized the national standards, aid to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: DA-0043-22

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



MEASUREMENT RESULTS<sup>5</sup>

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed m/s	D <sub>std</sub> Degree (°)	D <sub>unc</sub> Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.03	45.000	43	-2	1.0
	90.001	88	-2	1.0
	135.000	133	-2	1.0
	180.000	180	-1	1.0
	225.000	227	2	1.0
	270.000	272	2	1.0
	315.000	318	3	1.0
	360.000	359	-1	1.0

## Remarks:

<sup>5</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

<sup>6</sup> Direction of standard

<sup>7</sup> Direction of Unit Under Calibration

ภาคผนวก ข - 8



## JIRANATEE ASSOCIATES CO., LTD.

Jiranatee Associates Co., Ltd.  
63/14-15, 67/85-86  
Petchkasem 17/1, Rd. Witthapra, Bangkokkyl,  
Bangkok 10600 (Thailand)  
Tel: +66 (0)8 680812  
Mobile: +66 (0)8 3990453  
E-mail: jnac-calibration@jiranatee.com  
Web site: www.jiranatee.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
NSC-TIS-TIS 17025  
CALIBRATION D367

Air speed measurement laboratory  
Calibration services department.

Certificate Number

CL-029-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

## MEASUREMENT ITEM

: Cup anemometer

## MANUFACTURER

: Novalynx

## MODEL/TYPE

: Sensor: WS-02F

## SERIAL NUMBER

: Data logger: 20D-WS-25LB

## ID NUMBER

: Sensor: WAC01

## CONDITION AS-RECEIVED

: Data logger: AS041

## CUSTOMER

: Used item

: Water Analysis Center Co., Ltd.

: 94/1 Moo 5, T. Kantham, A.U.-thai, Ayutthaya 13210

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: 13 Mar 2023

**Calibration procedure:**  
The cup anemometer was calibrated against Standard air velocity transducer model: 8455-32 and plot tube with precision differential pressure meter model: DPM2500 in an open test section of Effel-type wind tunnel with 900 cm<sup>2</sup> cross test section area. The WH-CL-002 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

**Traceability:**  
This certificate provides a traceability of the measurement to recognize the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MN-0052-21 and MN-0066-22

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

: Elfel-type wind tunnel of Jiranatee Associates Co., Ltd.

Wind tunnel cross-section area<sup>1</sup> 900 cm<sup>2</sup>  
Win direction frontal area<sup>2</sup> 100 cm<sup>2</sup>  
Diameter of mounting pipe<sup>3</sup> - mm  
Blockage ratio of test object<sup>4</sup> 0.111 [-]

: 24 hours at ambient conditions.

: The average values during measurement are (24.1 °C, (43.9) %RH and (1007.8) hPa.

## TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☒ Mr. Sorawat Thirapaisit☐ Miss Jiraporn Lersomphol

## Remarks:

<sup>1</sup> Nozzle cross-section area of the wind tunnel<sup>2</sup> Projected cross-section area of the tested object include mounting pipe<sup>3</sup> Diameter of mounting pipe<sup>4</sup> Ratio <sup>2</sup> to

Approved signatory: ...



Certificate Number
CL-029-66

MEASUREMENT RESULTS<sup>5</sup>

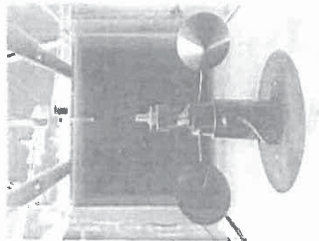
The cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer<sup>6</sup> and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle. UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

$V_{std}$ (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	$V_{unc}$ (m/s)	Error (m/s)	$\frac{V_{unc}}{V_{std}}$ (%)
1.027	24.06	24.05	0.8	-0.2	0.31
2.028	24.12	24.05	1.8	-0.2	0.31
3.003	24.14	24.05	2.8	-0.2	0.31
4.208	24.10	24.05	3.9	-0.3	0.31
5.02	23.88	24.05	4.8	-0.2	0.31
6.00	24.06	24.05	5.8	-0.2	0.31
7.05	23.70	24.05	6.8	-0.3	0.31
8.16	24.08	24.05	7.9	-0.2	0.31
9.09	23.84	24.05	8.9	-0.2	0.31
10.06	24.00	24.05	10.0	-0.1	0.31
11.13	23.98	24.05	10.9	-0.2	0.31
12.13	24.10	24.05	12.0	-0.1	0.31
13.20	24.00	24.05	13.0	-0.2	0.31
14.24	24.02	24.05	14.0	-0.3	0.31
15.23	24.00	24.05	14.8	-0.3	0.31
16.28	23.96	24.05	16.0	-0.3	0.31

ภาคผนวก

Remark:  
<sup>5</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place  
<sup>6</sup> Velocity of standard  
<sup>7</sup> Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of Iranate Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set-up is not true to scale due to imaging geometry.



W	FO.LAB 6.4-1/28	แก้ไขครั้งที่ : 0	วันที่บังคับใช้ : 1 ม.ค. 2562	หน้า : 1 ของ 1
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แบบบันทึกการทวนสอบเครื่อง Sound Level Meter

เครื่อง CA1111 Sound Calibrator S/N 520272 รหัสเครื่องมือ SR004 เกณฑ์การยอมรับ 93.78 ± 0.3, 113.84 ± 0.3  
วันที่สอบเทียบ 15/05/66 วันที่สอบเทียบเครื่องต่อไป 14/05/67  
เครื่อง Digital Thermohygro Meter S/N 105091609 รหัสเครื่องมือ WWL 0055  
วันที่สอบเทียบ 29/11/66 วันที่สอบเทียบครั้งต่อไป 28/11/67  
เครื่อง Sound Level Meter S/N 00396801 รหัสเครื่องมือ WWL 0159  
วันที่สอบเทียบ 12/02/67 วันที่สอบเทียบครั้งต่อไป 11/02/69

การทวนสอบหลังออกโรงงาน

การทวนสอบก่อนออกโรงงาน

อุณหภูมิ (°C) 24 เกณฑ์การยอมรับ 23.0 ± 3.0 อุณหภูมิ (°C) 24 เกณฑ์การยอมรับ 23.0 ± 3.0  
ความชื้นสัมพัทธ์ (%) 50 เกณฑ์การยอมรับ 50.0 ± 15.0 ความชื้นสัมพัทธ์ (%) 52 เกณฑ์การยอมรับ 50.0 ± 15.0  
วันที่ทวนสอบ 18/03/67 วันที่ทวนสอบ 26/03/67

Item	ระดับเสียงที่วัดได้ (dB) (ความดังที่ 94.0dB)	ระดับเสียงที่วัดได้ (dB) (ความดังที่ 114.0dB)	ระดับเสียงที่วัดได้ (dB) (ความดังที่ 94.0dB)	ระดับเสียงที่วัดได้ (dB) (ความดังที่ 114.0dB)
1	93.8	113.8	93.8	113.8
2	93.8	113.8	93.8	113.8
3	93.8	113.8	93.8	113.8
4	93.8	113.8	93.8	113.8
5	93.8	113.8	93.8	113.8
6	93.8	113.8	93.8	113.8
7	93.8	113.8	93.8	113.8
8	93.8	113.8	93.8	113.8
9	93.8	113.8	93.8	113.8
10	93.8	113.8	93.8	113.8
X	93.80	113.80	93.80	113.80
SD	0.00	0.00	0.00	0.00
%RSD (≤ 10)	0.00	0.00	0.00	0.00
ผลการ ทวนสอบ	ผ่าน	ผ่าน	ผ่าน	ผ่าน

ผู้บันทึก  
ผู้ตรวจสอบ

W	FO.LAB 6.4-1 /28	แก้ไขครั้งที่ : 0	วันที่บังคับใช้ : 1 ม.ค. 2562	หน้า : 1 ของ 1
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แบบบันทึกการทวนสอบเครื่อง Sound Level Meter

เครื่อง CA111 Sound Calibrator S/N 520272 รหัสเครื่องมือ SR004 เกณฑ์การยอมรับ 93.77 ± 0.3, 113.84 ± 0.3

วันที่สอบเทียบ 15/05/66

วันที่สอบเทียบครั้งที่ : 14/05/67

เครื่อง Digital Thermohygro Meter S/N 105091609 รหัสเครื่องมือ WWL 0055

วันที่สอบเทียบ 29/11/66

วันที่สอบเทียบครั้งที่ : 28/11/67

เครื่อง Sound Level Meter S/N 00396923 รหัสเครื่องมือ WWL 0161

วันที่สอบเทียบ 31/05/66

วันที่สอบเทียบครั้งที่ : 30/05/68

การทวนสอบก่อนออกห่างงาน

อุณหภูมิ (°C) 24 เกณฑ์การยอมรับ 23.0±3.0

ความชื้นสัมพัทธ์ (%) 50 เกณฑ์การยอมรับ 50.0±15.0

วันที่ทวนสอบ 18/03/67

Item	ระดับเสียงที่วัดได้ (dB) (ความดังที่ 94.0dB)	ระดับเสียงที่วัดได้ (dB) (ความดังที่ 114.0dB)
1	93.8	113.8
2	93.8	113.8
3	93.8	113.8
4	93.8	113.8
5	93.8	113.8
6	93.8	113.8
7	93.8	113.8
8	93.8	113.8
9	93.8	113.8
10	93.8	113.8
X	93.80	113.80
SD	0.00	0.00
%RSD ( ≤ 10)	0.00	0.00
ผลการ ทวนสอบ	ผ่าน	ผ่าน

Item	ระดับเสียงที่วัดได้ (dB) (ความดังที่ 94.0dB)	ระดับเสียงที่วัดได้ (dB) (ความดังที่ 114.0dB)
1	93.8	113.8
2	93.8	113.8
3	93.8	113.8
4	93.8	113.8
5	93.8	113.8
6	93.8	113.8
7	93.8	113.8
8	93.8	113.8
9	93.8	113.8
10	93.8	113.8
X	93.80	113.80
SD	0.00	0.00
%RSD ( ≤ 10)	0.00	0.00
ผลการ ทวนสอบ	ผ่าน	ผ่าน

ผู้บันทึก

ผู้ตรวจสอบ

เอกสารสอบเทียบเครื่องมือตรวจวัดคุณภาพน้ำเสีย น้ำผิวดิน ดิน  
พื้นที่สีเขียว และ ตะกอนประปา

## CERTIFICATE OF CALIBRATION

Certificate No.: CO-1808005/23

Page 1 of total 4 pages

**Customer**  
WATER ANALYSIS CENTER CO., LTD.  
1/94 Moo 5, T.Kanham,  
A.U-thai, Ayutthaya 13210

**Equipment**  
**Manufacturer** METTLER TOLEDO  
**Serial No.** B327527211  
**Description** pH Meter  
Range : 0 - 14 pH, Resolution : 0.01 pH

**Model** SevenCompact S220  
**ID No.** WWL 0068

**Environmental Conditions**  
**Ambient Temperature:** (20 ± 2) °C  
**Relative Humidity:** (50 ± 10) %  
**Atmospheric Pressure:** -

**Calibration Location** Jayhawks Laboratory (CL&GL)  
**Received Date** 18 August 2023  
**Calibration Date** 18 August 2023  
**Date of Issue** 21 August 2023

**Condition of Artifacts** Used conditions but can be calibrated

**Checked by**

( ) ( Krisyosl )  
( ) ( Patiphan K. ) (✓) ( Onnapa P. )  
( ) ( Pongsak H. ) ( ) ( Nitiphong K. )  
( ) ( Kanung C. ) ( ) ( Nonthachai K. )  
( ) ( Pramong P. ) ( ) ( Noppol P. )

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FE-169

REV.02 02/24/21

Certificate No.: CO-1808005/23

Page 2 of total 4 pages

**Reference Method:**

- The calibration method used was CP-178 based on an in-house method.
- This certificate can be traceable to the national standards, which is realized the shown measurement units according to the International System of Units (SI Units).

**Reference Standard:**

Type	pH Value	Lot No.	Due Date	Traceability
pH Standard Solution	4.01	030822	Feb. 9, 2024	NIMT
	7.01	300522	Feb. 9, 2024	
	10.01	230822	Feb. 7, 2024	

Type	Model	Serial No.	Certificate No.	Due Date	Traceability
Documenting Process Calibrator	754	2630521	10-2412001/22	Dec. 23, 2023	THC
Digital Thermometer with Sensor	1523 / 5622	1709138 / 4605984-005	10-0806001/23	Jun. 8, 2024	

**Remark:** This certificate is traceable to the International System of Unit (SI Unit) through:

- NIMT, National Institute of Metrology (Thailand).
- THC, Thai Heart Calibration Co., Ltd.

**Measurement Results:**

1. Function Simulated pH Meter

Standard Applied (mV)	Nominal Value (pH)	UUC Reading		Uncertainty (± mV)
		pH	mV	
177.48	4.00	4.01	177.4	0.060
0.00	7.00	7.00	0.0	0.060
-177.48	10.00	10.01	-177.4	0.060

UUC : Unit Under Calibration

Note : Adjust Curve to simulate pH (4,7,10)



Certificate No.: CO-1808005/23

Page 3 of total 4 pages

Measurement Results (Cont.):

2. Calibration of pH Electrode (Serial No.: 3222623)

pH Standard Solution (pH)	Measured Value		Uncertainty (± pH)
	(pH)	(mV)	
4.01	4.01	180.0	0.013
7.01	7.00	4.0	0.013
10.01	10.01	-172.0	0.013

Note : Adjust Curve to Buffer Solution pH (4,7,10)  
Temperature stability of micro bath :  $25 \pm 0.2^{\circ}\text{C}$

The above reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor  $k = 2.00$ , providing a level of confidence approximately 95%.

Certificate No.: CO-1808005/23

Page 4 of total 4 pages

Reference Method:

- The calibration method used was CP-096 based on an in-house method.
- The temperature scale used was an ITS-90.
- This certificate can be traceable to the national standards, which is realized the shown measurement units according to the International System of Units (SI Units).

Reference Standard Instruments:

Type	Model	Serial No.	Cert. No.	Due Date	Traceability
Thermometer Readout	1529-R	B7C853	10-0911001/22	Nov. 9, 2023	THC
Platinum Resistance Thermometer	5626	4854	COA30047	Oct. 22, 2023	FLUKE
Liquid Bath	XORTS-40A	XO111019	10-2405001/23	May 25, 2025	THC

Remark: This certificate is traceable to the International System of Unit (SI Unit) through:

- THC, Thai Heart Calibration Co., Ltd.
- FLUKE, Fluke Corporation, U.S.A.

Measurement Results:

(X) Without Adjustment

Dimension of probe : Diameter 4 mm. Sensor Type : RTD (PT100)

Immersion Depth (mm.)	Standard Reading ( $^{\circ}\text{C}$ )	UUC Reading ( $^{\circ}\text{C}$ )	Correction ( $^{\circ}\text{C}$ )	Uncertainty ( $\pm ^{\circ}\text{C}$ )
120	22.00	22.2	-0.20	0.065
120	25.00	25.2	-0.20	0.065
120	28.00	28.2	-0.20	0.065

UUC : Unit Under Calibration

The above reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor  $k = 2.00$ , providing a level of confidence approximately 95%.

- End of Certificate -



Certificate No.: MC 2307702

Page 2 of 3

**The Reference Standard Instrument :**

Description : Certificate No. Serial No. Due date Tracable thru  
Data Acquisition/Switch Unit MC 2303173 MY41010916 9 Mar 2024 MCAL  
With Thermocouple Type "T" ID. No.1711 to 1719

**Traceability :**

The measurement standard traceable to the international system of units (SI) through certificate as mentioned above

**1. Calibration Procedure:**

This Instrument was calibration according to TLAS G-20 by comparison with calibrated thermocouple type T under no load condition. The Thermocouples were placed on nine points and located one thermocouple in each of the eight corners of the chamber and was away from the each wall of 5 cm to 10 cm. And placed the ninth thermocouple within 2.5 cm of the geometric center of the chamber.

**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. The reference sensor should preferably be located at the geometric center of the chamber.

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

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

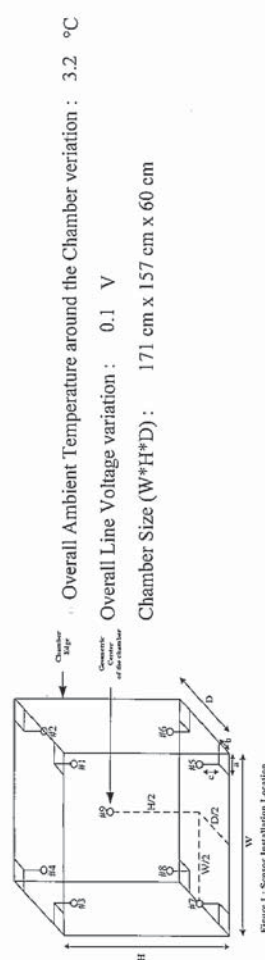


Figure 1 : Sensor Installation Location

Checked by : *Thangim*

**Certificate of Calibration**

TEMPERATURE  
CONTROLLER ENCLOSURES



Certificate No.: MC 2307702

Page 1 of 3



Customer : Water Analysis Center Co., Ltd.  
1/94 Moo 5, T.Kanlham, A.U.-Thai, Ayuthaya 13210.  
Reference Job No. : 23-1577 Received Date : 11 July 2023  
Description : Refrigerator  
Manufacturer : SANDEN INTERCOOL Model : SEC-1500SBD  
Serial No. : SEC1500201A-0708-00304 ID. No. : WWL0038  
Marking : Additionally for the purpose of identification by this laboratory a label marked with this certificate number ( MC 2307702 ) has been attached to the case.

Method : In-House calibration procedure MWL-T-033 this method is reference to TLAS G-20 "Temperature Controlled Enclosures".

Location of Calibration : Water Analysis Center Co., Ltd. ; Laboratory.

Environmental Conditions : Ambient Temperature : ( 25.3 to 25.9 ) °C

Relative Humidity : ( 65.2 to 67.9 ) %

Date of Calibration : 11 July 2023 Date of Issue : 12 July 2023

Checked



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

This certificate is issued in accordance with the conditions of accreditation granted by the National Standardization Council of Thailand-Office of the National Standardization Council that 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 Master Calibration Co.,Ltd.

Certificate No.: MC 2307702

Page 3 of 3

## 2. Result of calibration :

### Temperature Measurement Accuracy Test

Indicating Temperature (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (±°C)
	#1	#2	#3	#4	#5	#6	#7	#8	Ref. #9	
2.5	4.4	4.2	4.2	4.2	4.0	3.9	4.1	4.0	3.8	0.86

### Chamber Characterization Result

Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
2.0	2.5	1.50	1.01	3.3

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 %.

This certificate will certify of the calibrated equipment only.

End of Certificate



THAI HEART CALIBRATION CO., LTD.  
102/1 Moo 5, Phad Sri Somburi, Samut Prakan 10260  
Tel. 0-2394-0162, 0-274-2987-8 Fax : 0-274-2518, 0-274-2989



# CERTIFICATE OF CALIBRATION

Certificate No.: C0-1907007/23 Page 1 of total 2 pages

**Customer**  
WATER ANALYSIS CENTER CO., LTD.  
1/94 Moo 5, T.Kanham,  
A.U-dhai, Ayuthaya 13210

**Equipment** Conductivity Meter  
**Manufacturer** EUTECH  
**Serial No.** 2657889  
**Description** -  
**Model** CON 2700  
**ID No.** WWL 0136

**Environmental Conditions**  
Ambient Temperature: (20 ± 2) °C  
Relative Humidity: (50 ± 10) %  
Atmospheric Pressure: -

**Calibration Location**  
Jayhawks Laboratory (CL&GL)

**Received Date**  
19 July 2023

**Calibration Date**  
19 July 2023

**Date of Issue**  
20 July 2023

**Condition of Artifacts**  
Used conditions but can be calibrated

Checked by

( ) ( Krisyos )  
( ) ( Patiphan K. ) (✓) ( Onnapa P. )  
( ) ( Pongsak H. ) ( ) ( Nitiphong K. )  
( ) ( Kanung C. ) ( ) ( Nonthachai K. )  
( ) ( Pramong P. ) ( ) ( Noppol P. )

This calibration certificate shall not be reproduced other than in full except with the prior written approval of the Thai Heart Calibration Co., Ltd.

FE-169

REV.02 02/24/21

Certificate No.: CO-1907007/23

Page 2 of total 2 pages

Reference Method:

- The calibration method used was CP-177 based on an in-house method.
- This certificate can be traceable to the national standards, which is realized the shown measurement units according to the International System of Units (SI Units).

Reference Standard :

Material	Batch Value	Lot Number	Due Date	Traceability
Conductivity Standard Solution	147.8 $\mu\text{S/cm}$	S220611005	Dec. 6, 2023	SCP Science
	1.425 $\text{mS/cm}$	S220812006	May 31, 2024	

Remark: This certificate is traceable to the International System of Unit (SI Unit) through:

- SCP Science.

Measurement Results: (Probe Serial No. : 93X219065)

Conductivity Standard Solution	Measured Value	Correction	Uncertainty ( $\pm$ )
147.8 $\mu\text{S/cm}$	147.5 $\mu\text{S/cm}$	0.3 $\mu\text{S/cm}$	2.5 $\mu\text{S/cm}$
1.425 $\text{mS/cm}$	1.427 $\text{mS/cm}$	-0.002 $\text{mS/cm}$	0.0051 $\text{mS/cm}$

Note : Adjustment points: 147.8 $\mu\text{S/cm}$  1.425 $\text{mS/cm}$

The above reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor  $k = 2.00$ , providing a level of confidence approximately 95%.

- End of Certificate -

Calibrated by

SV 201005/2024

Cert. No. WAC-065  
Page 1 of 2

## CERTIFICATE OF CALIBRATION

Instrument : DO Meter  
Model : DO-31P  
Serial No. : 780065  
Manufacturer : TOA-DKK  
Measuring Range : 0.00 ~ 20.00 mg/l

Machine : -  
Location : -

Customer : Water Analysis Center Co.,Ltd.  
1/94 Moo.5 T.Kanham, A.U-Thai  
Ayutthaya 13210 Thailand

Date Of Received : 11 / 01 / 2024  
Date Of Calibration : 11 / 01 / 2024

Ambient Condition : Temperature 26  $^{\circ}\text{C}$   
Humidity 58 % RH

Calibrated By :

Approved By :

Date Of Issue : 15 / 01 / 2024

This Certificate may not be reproduced other than in full, except with the prior written approval of the head of the industrial instruments calibration center.





AUTOMATION SERVICE CO.,LTD.  
CALIBRATION LABORATORY

Instrument : DO Meter  
Model : DO-31P  
Serial No. : 780065

Cert. No. WAC-065  
Page 2 of 2

Calibrate Procedure

- ☐ This instrument was calibrated by comparison with standard solution (PH/ORP)  
☐ This instrument was calibrated by comparison with scattering plate value (Turbidity)  
☐ This instrument was calibrated by comparison with conductivity (Conductivity)  
☒ This instrument was calibrated by comparison with Sodium sulfite anhydrous (DO)

Condition of this result of calibration

- 1). Reference Standard Solution

Standard Lot No Batch Cert. No. Due Date

Sodium Sulfite Power 408K1405 - - -

- 2). Traceability This certification is traceable to

- ☒ Kanto Chemical Co.,INC.  
☐ DKK Corporation

Result Of Calibration

Standard Solution (mg/l) at 25.7°C	Before Adjust		After Adjust	
	Indicator	Error	Indicator	Error
Zero	0.00	+ 0.10	0.00	-
Span	8.02	- 1.57	8.02	-

DO Electrode No. OE270AA(5) S/N 111F0029

Calibrated By



Intech Metrological Center Co.,Ltd.  
39/1 Soi 82, Sukhapiban 5 Rd., O ngoen,  
Salmal, Bangkok 10220, Thailand  
Tel. (662) 909-8820 (Auto 10 lines) www.imcinstrument.com



Certificate of Calibration

Certificate No. : MT24-3208  
Page : 1 of 2

Customer : Water Analysis Center Co.,Ltd.  
Address : 1/94 M.5, Rojana Industrial Park, T.Kanham, A.U.-Thai, Ayutthaya 13210  
Description : Hot Air Oven  
Manufacturer : Memmert  
Model : UF 260  
Serial No. : B620.0814  
Identification No. : WWL 0212  
Calibration Place : Customer Laboratory  
Order No. : 1152/24  
Received date : Mar 22, 2024  
Calibration date : Mar 22, 2024  
Environment Condition :  
Temperature : (25+/-10) °C  
Humidity : (50+/-30) %RH

Calibration Method : Calibration were conducted using In-house calibration procedure CP-MT-006 According to comparison with LXI Data Acquisition Switch Unit with sensor. The calibration methods based on Euramet Calibration Guide No.20 - guidelines on the Calibration of Temperature and/or Humidity Controlled Enclosures.

Reference Standard Instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
LXI Data Acquisition Switch Unit with Sensor	34972A	MY49020096	MT23-7163	Nov 30, 2024

The effect that the result relate only to the items calibrated. It was found accurate as shown on date and place of calibration only.

Traceability : This measurement are traceable to the International System of Unit (SI), through National Institute of Metrology Thailand ( NIMT )



The reported expanded uncertainty of measurement was based on standard uncertainty multiplied by coverage factor 2, providing a level of confidence of not less than 95%

Calibrated by : Mr.Yuttakorn Jamneansri

Approved by :

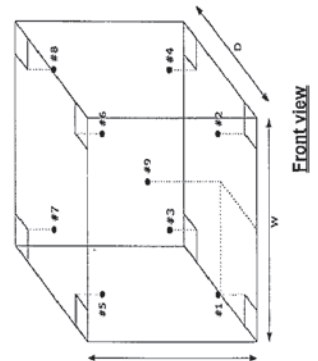
Issue date :

This calibration certificate shall not be reproduced other than in full except with the prior written approval of Intech Metrological Center Co.,Ltd

Function : Temperature measurement  
Calibration point : 104, 180 °C  
Result : Without adjustment  
Resolution : 0.1 °C  
Certificate No. : MT24-3208  
Page : 2 of 2

Calibration point (°C)	Temperature of UUC* at each position (°C)									Uncertainty of measurement (+/- °C)
	Ch.1	Ch.2	Ch.3	Ch.4	Ch.5	Ch.6	Ch.7	Ch.8	Ch.9	
104	103.494	103.933	103.871	103.988	103.990	104.081	103.843	104.217	104.022	0.45
180	179.985	179.953	180.047	179.985	179.908	180.088	180.065	180.273	180.105	0.54

Setting temperature (°C)	Indicating Temperature (°C)	Measured stability (+/- °C)	Measured uniformity (°C)	Overall variation (°C)
104.0	104.0	0.34	0.66	1.3
180.0	180.0	0.41	0.86	1.2



UUC\* = Unit under calibration  
Uniformity = Maximum and Minimum difference of measured temperature at any probes and the measured temperature at the reference and same time.  
Overall Variation = Difference of temperature value between the maximum and minimum any time.  
Stability = One half of the maximum difference of measured temperatures at any one probe.



# Certificate of Calibration

Equipment: Balance  
Model: BL 210S  
Serial No. (or ID.): 15808131 (WWL 0022)  
Manufacturer: Sartorius  
Condition: In condition  
Certificate No.: C01241754  
Issued Date: 05 June 2024  
Job No.: WO-00030302  
Page: 1 of 2  
Customer: Water Analysis Center Co., Ltd.  
1/94 Moo 5, Rojana Industrial Park, Rojana Road,  
Tambol Kanham, Amphur U-Thai, Ayuthaya 13210 Thailand

Environment Condition: Temperature 26 °C ± 0.2 °C  
Humidity 50 %RH ± 2.6 %RH

Calibration Place: Water Analysis Center Co., Ltd. ( น้ำเต้าหู้ )  
1/94 Moo 5, Rojana Industrial Park, Rojana Road,  
Tambol Kanham, Amphur U-Thai, Ayuthaya 13210 Thailand

Calibration By: Mr. Polawad Ruamirup  
Calibration Date: 05 June 2024  
The Method used: In-house method, CAL-WJ-47, based on UKAS Lab 14  
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Co., Ltd. Certificate No. C02240400



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

DKSH Technology Limited  
2533 Sukhumvit Road, Bangkok, Phraekong, Bangkok 10260  
Phone: +66 2339 7000 Email: [info.calibration@dksh.com](mailto:info.calibration@dksh.com) Website: [www.dksh.com/scientific-thailand](http://www.dksh.com/scientific-thailand)

Delivering Growth - in Asia and Beyond.



Certificate No.: C01241754

Page: 2 of 2

#### Calibration Results:

##### Without Adjustment

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

Nominal Test Value	Reference Points (g)				
	A	B	C	D	E
-	0.0000	0.0001	0.0000	0.0000	-0.0002

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

Nominal test value (g)	Standard Deviation
20	0.00004
200	0.00006

Error of indication from nominal or conventional mass value., Readability 0.0001 (g)

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
1	1.00001	1.0000	0.0000	0.00011	2.04
2	2.00002	2.0000	0.0000	0.00011	2.04
5	5.00002	5.0000	0.0000	0.00011	2.04
10	10.00001	10.0000	0.0000	0.00011	2.04
20	20.00001	20.0000	0.0000	0.00012	2.03
50	50.00003	50.0000	0.0000	0.00013	2.02
70	70.00004	70.0000	0.0000	0.00016	2.01
100	99.99996	100.0001	0.0001	0.00017	2.01
120	119.99997	120.0002	0.0002	0.00021	2.00
150	149.99999	150.0002	0.0002	0.00024	2.00
200	199.99996	200.0004	0.0004	0.00030	2.00

The End of Certificate

DKSH Technology Limited  
2533 Sukhumvit Road, Bangkok, Prachinburi 10260  
Phone: +66 2537 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

Delivering Growth - in Asia and Beyond.

CAL-FM-C01-14: 12 Sep 2022



Master Calibration Co., Ltd.

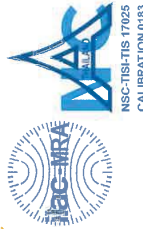
547 Soi Rachadaniwet, Kwaeng Samseonok, Khet Huaykwang, Bangkok 10310

Tel : (02) 274 2978-9, (02) 2742987-8 Fax : (02) 274 2518, (02) 274 2989

Website : www.mastercalibration.com E-mail : calibrate@mastercalibration.com

## Certificate of Calibration

### LIQUID BATH



Certificate No.: MC 2314268

Page 1 of 3



Customer : Water Analysis Center Co., Ltd.  
1/94 Moo 5, T. Kantham, A.U.-Thai, Ayutthaya 13210.

Reference Job No. : 23-2833 Received Date : 15 December 2023  
Description : Water Bath  
Manufacturer : ESSTELL Model : EWB-122D  
Serial No. : 20180508122 ID. No. : WWL 0214  
Marking : Additionally for the purpose of identification by this laboratory a label marked with this certificate number ( MC 2314268 ) has been attached to the case.  
Method : In-House calibration procedure MWL-T-029 this method is reference to ASTM E715 "Liquid Bath".  
Location of Calibration : Water Analysis Center Co., Ltd. ; Laboratory.  
Environmental Condition : Ambient Temperature : ( 29.4 to 29.8 ) °C  
Relative Humidity : ( 49.0 to 52.0 ) %  
Date of Calibration : 15 December 2023 Date of Issue : 19 December 2023

Checked

The uncertainties are for a confidence probability of approximately 95%

This certificate is issued in accordance with the conditions of accreditation granted by the National Standardization Council of Thailand-Office of the National Standardization Council that 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 Master Calibration Co., Ltd.

[MCF-Q-077 ; Rev.6 ; Date : 22/04/2021]



Certificate No.: MC 2314268

Page 2 of 3

## Reference Standard Instrument :

Description	Certificate No.	Serial No.	Due date	Traceable thru
Data Acquisition/Switch Unit With Thermocouple Type " T " ID. No.27/1 to 27/5	MC 2301270	MY44020009	9 Mar 2024	MCAL

## Traceability :

The measurement standard traceable to the international system of units (SI) through certificate as mentioned above

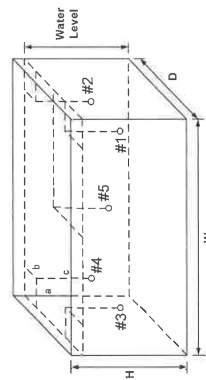
## 1. Calibration Procedure:

This Instrument was calibration according to ASTM E715 - 2007 by comparison with calibrated sensor under no load condition. The sensor were placed on five points and located one sensor in each of the eight corners of the chamber and was away from the each wall of 5 cm to 10 cm. And placed the five sensor within 2.5 cm of the geometric center of the chamber.

*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. The reference sensor should preferably be located at the geometric center of the chamber.

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

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



- Overall Ambient Temperature around the Chamber variation : 1.3 °C
- Overall Line Voltage variation : 0.0 V
- Chamber Size (W\*H\*D) : 50 cm x 12 cm x 30 cm
- Water Level : 7 cm

Certificate No.: MC 2314268

Page 3 of 3

## 2. Result of calibration :

### Temperature Measurement Accuracy Test

Indicating Temperature (°C)	Measured Temperature (°C) at Spread Locations					Uncertainty (±°C)
	#1	#2	#3	#4	Ref. #5	
45.0	44.5	44.4	44.5	44.5	44.6	0.45

### Chamber Characterization Result

Desired Temperature (°C)	Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
44.5	45.0	45.0	0.62	0.88	1.5

The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor  $k = 2.0$ , providing a level of confidence of approximately 95 %.

**This certificate will certify of the calibrated equipment only.**

**End of Certificate**

Certificate No.: MC 2314270

Page 2 of 3

**Reference Standard Instrument :**

Description	Certificate No.	Serial No.	Due date	Traceable thru
Data Acquisition/Switch Unit	MC 2214032	MY41029992	26 Dec 2023	MCAL
With Thermocouple Type " T " ID. No.31/1 to 31/9				

**Traceability :**

The measurement standard traceable to the international system of units (SI) through certificate as mentioned above

**1. Calibration Procedure:**

This Instrument was calibration according to TLAS G-20 by comparison with calibrated thermocouple type T under no load condition. The Thermocouples were placed on nine points and located one thermocouple in each of the eight corners of the chamber and was away from the each wall of 5 cm to 10 cm. And placed the ninth thermocouple within 2.5 cm of the geometric center of the chamber.

*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. The reference sensor should preferably be located at the geometric center of the chamber.

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

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

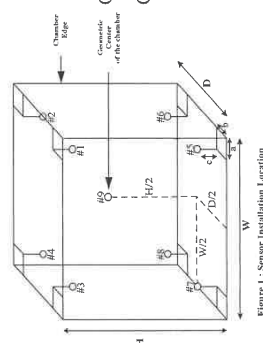
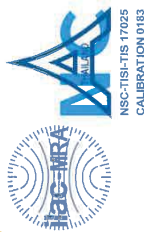


Figure 1 : Sensor Installation Location

Overall Ambient Temperature around the Chamber variation : 0.4 °C  
Overall Line Voltage variation : 0.0 V  
Chamber Size (W\*H\*D) : 65 cm x 80 cm x 50 cm

*Certificate of Calibration*

**TEMPERATURE  
CONTROLLER ENCLOSURES**



Page 1 of 3

Certificate No.: MC 2314270

Customer : Water Analysis Center Co., Ltd.  
1/94 Moo 5, T. Kantham, A.U.-Thai, Ayutthaya 13210.

Reference Job No.	: 23-2833	Received Date	: 15 December 2023
Description	: Incubator		
Manufacturer	: Memmert	Model	: IN260
Serial No.	: D619.0170	ID. No.	: WWL 0192
Marking	: Additionally for the purpose of identification by this laboratory a label marked with this certificate number ( MC 2314270 ) has been attached to the case.		
Method	: In-House calibration procedure MWI-T-033 this method is reference to TLAS G-20 "Temperature Controlled Enclosures".		
Location of Calibration	: Water Analysis Center Co., Ltd. ; Laboratory.		
Environmental Conditions	: Ambient Temperature : ( 25.2 to 25.6 ) °C Relative Humidity : ( 65.4 to 66.2 ) %		
Date of Calibration	: 15 December 2023	Date of Issue	: 19 December 2023

Checked by :



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

This certificate is issued in accordance with the conditions of accreditation granted by the National Standardization Council of Thailand-Office of the National Standardization Council that 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 Master Calibration Co., Ltd.

Certificate No.: MC 2314270

Page 3 of 3

## 2. Result of calibration :

### Temperature Measurement Accuracy Test

Indicating Temperature (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (±°C)
	#1	#2	#3	#4	#5	#6	#7	#8	#9	
35.0	35.2	35.2	35.2	35.2	35.1	35.1	35.0	35.1	35.1	0.44

### Chamber Characterization Result

Desired Temperature (°C)	Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
35.0	35.0	35.0	0.13	0.21	0.4

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 %.

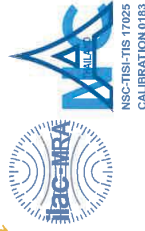
**This certificate will certify of the calibrated equipment only.**

**End of Certificate**



# Certificate of Calibration

## AUTOClave



Certificate No.: MC 2314269

Page 1 of 3



Customer : Water Analysis Center Co., Ltd.  
1/94 Moo 5, T.Kantham, A.U.-Thai, Ayutthaya 13210.

Reference Job No. : 23-2833 Received Date : 15 December 2023  
Description : Autoclave  
Manufacturer : TOMY Model : Autoclave ES-315  
Serial No. : 51135128 ID. No. : WWL 0083  
Marking : Additionally for the purpose of identification by this laboratory a label marked

Method : with this certificate number ( MC 2314269 ) has been attached to the case.  
In-House calibration procedure MWI-T-036 this method is reference to based on BS 2646 : 1993 Part 5 "Autoclave".

Location of Calibration : Water Analysis Center Co., Ltd. ; Laboratory.

Environmental Condition : Ambient Temperature : ( 29.4 to 30.7 ) °C

Relative Humidity : ( 50.0 to 52.0 ) %

Date of Calibration : 15 December 2023 Date of Issue : 19 December 2023

Checked by :



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

This certificate is issued in accordance with the conditions of accreditation granted by the National Standardization Council of Thailand-Office of the National Standardization Council that 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 Master Calibration Co., Ltd.



Certificate No.: MC 2314269

Page 2 of 3

**Reference Standard Instrument :**

Description	Certificate No.	Serial No.	Due date	Traceable thru
Temperature Recorder RTD 100 Ohm	MC 2300163	M79252	9 Jan 2024	MCAL
Temperature Recorder RTD 100 Ohm	MC 2300164	5978194	9 Jan 2024	MCAL
Temperature Recorder RTD 100 Ohm	MC 2300165	M79251	9 Jan 2024	MCAL

**Traceability :**

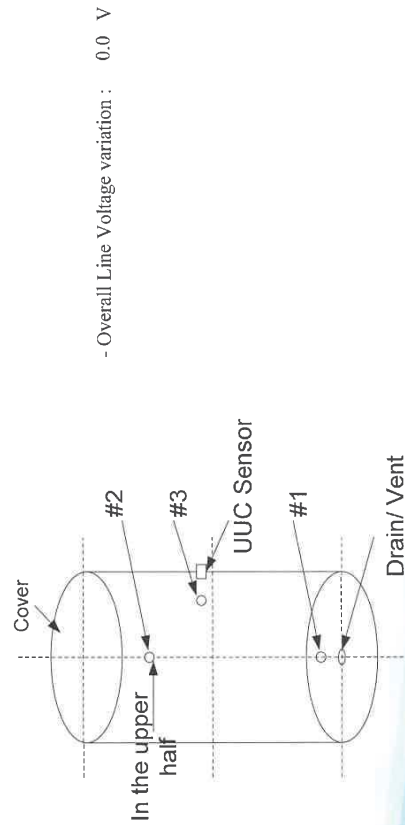
The measurement standard traceable to the international system of units (SI) through certificate as mentioned above

**1. Calibration Procedure:**

The equipment list above was calibrated an accuracy of temperature in a chamber of the sterilizer.

The calibration was performed by direct measurement of generated temperatures using the standard thermometer with three temperature sensors. The data was recorded in a period of fifteen minutes of the sterilizing status. The temperature scale used was based on ITS-90.

The calibration of sterilizer was carried out at the point indicated by following the In-house calibration method No. MWI-T-036 based on BS 2646 : 1993 : Part 5 in Tests for performance section.



Certificate No.: MC 2314269

Page 3 of 3

**2. Result of calibration :**

**Temperature Measurement Accuracy Test**

Indicating Temperature (°C)	Measured Temperature (°C) at Spread Locations			Uncertainty (±°C)
	#1	#2	#3	
121	121.72	121.73	121.95	0.61

**Characterization Result**

Desired Temperature (°C)	Setting Temperature (°C)	Timer Setting (min)	Indicating Temperature (°C)	Indicating Pressure (kPa)	Measured Stability (±°C)	Measured Uniformity (°C)	Overall Variation (°C)
121	121	15.0	121	120	0.60	0.35	1.35

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 %.

**This certificate will certify of the calibrated equipment only.**

**End of Certificate**

## เอกสารสอบเทียบเครื่องมือตรวจวัดปล่องเตาเผาขยะ

Enviro Equipment Service Co., Ltd.

110/254 Moo 3, Tambon Bang Rak Phatthana, Amphur Bang Bua Thong, Nonthaburi 11110

Tel. 098 362 9152, 089 478 7885

E-mail: sales@enviro-ees.com

Certificate No. : E23-08062

Page : 1 of 3

## CERTIFICATE OF CALIBRATION

Customer : S.P.J. Scientific Co., Ltd.  
Address : 80 Soi Nukkeera Lamthong 3, Thap Chang, Saphansong, Bangkok 10250  
Description of Equipment : Standard Probe Method 5  
Manufacturer : Apex Instrument  
Model Number : PS-5HV  
Serial Number : -  
ID/Control No. : -  
Environment Conditions : Temperature (25 ± 2) °C  
Humidity (50 ± 15) % RH  
Cal. Date : 01/08/2023  
Issue Date : 01/08/2023

### Calibration Method or Calibration Process used

US EPA Method (United State Environmental Protection Agency)

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

### Result of Calibration

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

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

Calibrated by



Certificate No. : E23-08062

Page : 2 of 3

## CALIBRATION RESULTS

### S-Type Geometric Pitot Tube Calibration

#### Sampling System Equipment Information

Probe Model : PS-5HV  
Probe Number : -  
Pitot Number : -  
Pitot Tube Type : S-type

#### Calibration Condition

Date : 1 August 2023  
Barometric Pressure : 757.49 mm Hg  
Digital Caliper : CD-6" ASX  
Serial number : A18008059

Pitot tube/Probe: # P-5HV			
Parameter	Value	Allowable Range	Check
Assembly level?	Yes	Yes	Pass
Port Damage?	No	No	Pass
$\alpha 1$	0	$-10^\circ < \alpha 1 < +10^\circ$	Pass
$\alpha 2$	1	$-10^\circ < \alpha 2 < +10^\circ$	Pass
$\beta 1$	0	$-5^\circ < \beta 1 < +5^\circ$	Pass
$\beta 2$	0	$-5^\circ < \beta 2 < +5^\circ$	Pass
$\gamma$	0	N/A	-
$\theta$	0	N/A	-
Dt	0.373	.188" to .375"	Pass
A	0.995	$2.1D1 \leq A \leq 3D1$	Pass
A/2D1	1.333	$1.05 \leq P_A/D_1 \leq 1.5$	Pass
Z = A tan $\theta$	0.074	$Z \leq .125"$	Pass
W = A tan $\theta$	0.018	$W \leq .031"$	Pass

#### Remark:

I certified that probe model: PS-5HV meets or exceeds all specifications, criteria and/or applicable design and is hereby assigned a pitot tube certification factor of 0.84. See 40 CFR Pt. 60, App. A, EPA Method 2.





Certificate No. : E23-08062  
Page : 3 of 3

# THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information	
Probe Model Number	PS-5HV
Probe Serial Number	-
Meter Box Model Number	JENCO 765 KF
Meter Box Serial Number	JC 13129

Calibration Conditions	
Date	01/05/2023
Time	14:00 PM
Calibration Reference No.	SER-08026
Reference Thermometer	DIGICON
Serial Number	183169105

Thermocouple of Standard Dual Probe - length 5 foot			
Set Point	Reference Thermocouple	Probe Thermocouple	Difference
100	100.0	98.0	0.54
250	250.0	247.5	0.57
300	300.0	298.0	0.35
350	350.0	348.0	0.32



Enviro-Service Co., Ltd.  
110/254 Moo 3, Tambon Bang Rak Phatthana, Amphur Bang Bua Thong, Nonthaburi 11110  
Tel. 098 362 9152, 089 478 7885  
E-mail: sales@envi-ees.com

Certificate No. : E23-08063  
Page : 1 of 3

# CERTIFICATE OF CALIBRATION

Customer : S.P.J. Scientific Co., Ltd.  
Address : 80 Soi Nakkeera Lamthong 3, Thup Chang, Saphansoong, Bangkok 10250  
Description of Equipment : Standard Probe Method 5  
Manufacturer : Apex Instrument  
Model Number : PS-6HV  
Serial Number : -  
ID./Control No. : -  
Environment Conditions : Temperature (25 ± 2) °C  
Humidity (50 ± 15) % RH  
Cal. Date : 01/05/2023  
Issue Date : 02/08/2023

## Calibration Method or Calibration Procedure Used

US EPA Method (Unit: Scale Environmental Protection Agency)

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

## Result of Calibration

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

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

Calibrated by



## THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information	
Probe Model Number	PS-6HV
Probe Serial Number	-
Meter Box Model Number	JENCO 765 KF
Meter Box Serial Number	JC 13129

Date	Time	Calibration Certificate No.
02/08/2023	02:30 PM	SER23-08026
		DIGICON
		183169105

Pitot tube/Probe: # PS-6HV			
Parameter	Value	Allowable Range	Check
Assembly level?	Yes	Yes	Pass
Ports Damage?	No	No	Pass
$\alpha 1$	0	$-10^\circ < \alpha 1 < +10^\circ$	Pass
$\alpha 2$	1	$-10^\circ < \alpha 2 < +10^\circ$	Pass
$\beta 1$	0	$-5^\circ < \beta 1 < +5^\circ$	Pass
$\beta 2$	0	$-5^\circ < \beta 2 < +5^\circ$	Pass
$\gamma$	0	N/A	-
$\theta$	0	N/A	-
Dt	0.375	.188" to .375"	Pass
A	0.876	$2.1Dt \leq A \leq 3Dt$	Pass
A/2Dt	1.168	$1.05 \leq P_o/D_o \leq 1.5$	Pass
$Z = A \tan \gamma$	0.065	$Z \leq .125"$	Pass
$W = A \tan \theta$	0.020	$W \leq .031"$	Pass

certified that probe model: PS-611V and Pitot tube no. A10985 meets or exceeds all specifications, criteria and/or applicable design and is hereby assigned a pitot tube certification factor of 0.84. See 40 CFR Pt. 60, App. A, EPA Method 2.





## CERTIFICATE OF CALIBRATION

Customer : S.P.J. Scientific Co., Ltd.  
Address : 80 Soi Nakkeera Lamthong 3, Thap Chang, Suan Luang, Bangkok 10250  
Description of Equipment : Console meter  
Manufacturer : Apex Instrument  
Model Number : XC-572-OV  
Serial Number : 1105032  
ID/Control No. : -  
Environment Conditions : Temperature (25 ± 2) °C  
Humidity (50 ± 15) % RH  
Cal. Date : 18/10/2023  
Issue Date : 18/10/2023

### Calibration Method or Calibration Procedure Used

US EPA Method (Units: State Environmental Protection Agency)

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

### Result of Calibration

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

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

Calibrated by



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

Meter Console Information			Calibration Conditions			Factors/Conversions		
Console Model Number	XC-572-OV		Date	Time	18/10/2023	10:25 AM	Std Temp	293 K
Console Serial Number	1105032		Calibration Reference No.	SER23-08032			Std Press	760 mmHg
DGM Model Number	SK25EX		Barometric Pressure	759.99			K <sub>1</sub>	0.386
DGM Serial Number	00009890		Calibration Meter Gamma	0.999			Console Leak Check	PASS

Calibration Data											
Metering Console						Calibration Meter					
Run Time	DGM Orifice DH	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final		
Elapsed (Q)	(P <sub>m</sub> )	(V <sub>m</sub> )	(V <sub>mf</sub> )	(t <sub>mf</sub> )	(t <sub>mf</sub> )	(V <sub>wf</sub> )	(V <sub>wf</sub> )	(t <sub>wf</sub> )	(t <sub>wf</sub> )		
min	mm H <sub>2</sub> O	m <sup>3</sup>	m <sup>3</sup>	°C	°C	m <sup>3</sup>	m <sup>3</sup>	°C	°C		
12.52	13.0	0.1390	0.2790	29	29	177.12918	177.26696	29	29		
12.47	13.0	0.2790	0.4190	28	28	177.26696	177.40352	29	29		
8.63	26.0	0.4260	0.5660	28	28	177.40722	177.54364	28	28		
8.63	26.0	0.5660	0.7060	28	28	177.54364	177.67978	28	28		
13.93	40.0	0.7120	0.9920	28	28	177.68154	177.96128	28	28		
13.90	40.0	0.9920	1.2720	28	28	177.96128	178.24020	28	28		
19.47	70.0	1.2840	1.5640	28	28	178.25542	178.53342	27	27		
10.50	70.0	1.5640	1.8440	29	29	178.53342	178.81236	27	27		
9.22	90.0	1.8550	2.1350	29	29	178.83678	179.11452	27	27		
9.22	90.0	2.1350	2.4150	29	29	179.11452	179.39258	27	27		



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

Meter Console Information				Calibration Conditions				Factors/Conversions			
Console Model	XC-572-OV			Date	Time	18/10/2023	10:25 AM	Std Temp	293	K	
Console Serial Number	1105032			Calibration Reference No.		SER23-08032		Std Press	760	mm Hg	
DGM Model Number	SK25EX			Barometric Pressure		759.99		K1	0.386		
DGM Serial Number	00009890			Calibration Meter Gamma		0.999		Console Leak Check			
								PASS			

Calibration Data											
Results											
Standardized Data				Dry Gas Meter							
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate		Variation			
(V <sub>std</sub> )	(Q <sub>std</sub> )	(V <sub>ref</sub> )	(Q <sub>ref</sub> )	Value	Y	Std & Corr	(Q <sub>std</sub> )	Value	Y	Std & Corr	(Q <sub>std</sub> )
m <sup>3</sup>	m <sup>3</sup> /min	m <sup>3</sup>	m <sup>3</sup> /min	(V <sub>ref</sub> )	(Q <sub>ref</sub> )	(Q <sub>std</sub> )	(Q <sub>std</sub> )	(V <sub>ref</sub> )	(Q <sub>ref</sub> )	(Q <sub>std</sub> )	(Q <sub>std</sub> )
0.136	0.011	0.134	0.011	0.982	0.000	0.011	0.011	0.982	0.000	0.011	0.011
0.136	0.011	0.132	0.011	0.973	-0.009	0.011	0.011	0.973	-0.009	0.011	0.011
0.137	0.016	0.133	0.015	0.971	-0.011	0.015	0.015	0.971	-0.011	0.015	0.015
0.137	0.016	0.132	0.015	0.969	-0.013	0.015	0.015	0.969	-0.013	0.015	0.015
0.274	0.020	0.272	0.020	0.994	0.012	0.020	0.020	0.994	0.012	0.020	0.020
0.274	0.020	0.271	0.020	0.991	0.009	0.020	0.020	0.991	0.009	0.020	0.020
0.275	0.026	0.271	0.026	0.985	0.003	0.026	0.026	0.985	0.003	0.026	0.026
0.275	0.026	0.272	0.026	0.989	0.006	0.026	0.026	0.989	0.006	0.026	0.026
0.276	0.030	0.271	0.029	0.982	0.000	0.029	0.029	0.982	0.000	0.029	0.029
0.276	0.030	0.271	0.029	0.984	0.001	0.029	0.029	0.984	0.001	0.029	0.029
				Y Average		ΔH@		Average			
				0.982		47.714		47.714			

**Note:** For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ±0.02.

For ΔH<sub>std</sub>, orifice pressure differential that equates to 0.75 cfm (0.0212 m<sup>3</sup>/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1mm)

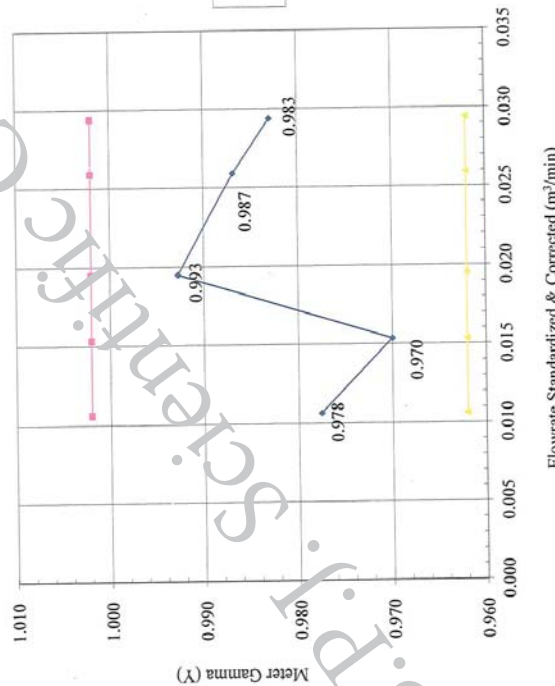


Meter Console Information				Calibration Conditions				Factors/Conversions			
Console Model	XC-572-OV			Date	Time	18/10/2023	10:25 AM	Std Temp	293	K	
Console Serial Number	1105032			Calibration Reference No.		SER23-08032		Std Press	760	mm Hg	
DGM Model Number	SK25EX			Barometric Pressure		759.99		K1	0.386		
DGM Serial Number	00009890			Calibration Meter Gamma		0.999		Console Leak Check			
								PASS			

Calibration Date: 18-10-2023

Calibration Reference No.: SER23-08032

**Meter Gamma vs Flowrate**



Console Serial: 1105032



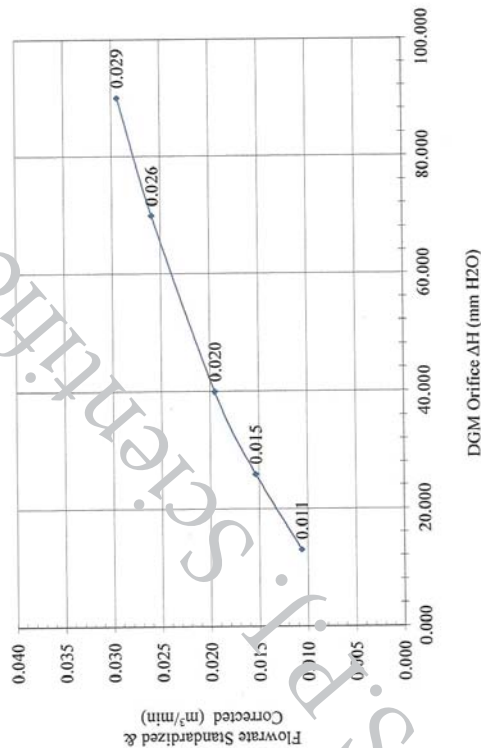
Console Model: XC-572-OV



Meter Console Information			Calibration Conditions			Factors/Conversions		
Console Model	XC-572-OV		Date	Time	18/10/2023	10:25 AM	Std Temp	293 K
Console Serial Number	1105032		Calibration Reference No.	SER23-08032			Std Press	760 mm Hg
DGM Model Number	SK25EX		Barometric Pressure	759.99			K <sub>1</sub>	0.35%
DGM Serial Number	00009890		Calibration Meter Gamma	0.999			Console Leak Check	PASS

Calibration Date: 18-10-2023 Calibration Reference No: SER23-08032

Meter Pressure vs Flowrate



Console Serial: 1105032

Console Model: XC-572-OV



## THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information			Calibration Conditions		
Console Model Number	XC-572-OV		Date	Time	18/10/2023 00:20 PM
Console Serial Number	1105032		Calibration Reference No.	SER23-08032	
DGM Model Number	SK25EX		Reference Thermometer	DIGICON	
DGM Serial Number	00009890		Serial Number	183169105	
Meter Box Model Number	JENCO 765 KF				
Meter Box Serial Number	JC 10953				

### Results

Console Thermocouple Simulator												
Channel and test point		Meter Box Channel Temperature Reading (°C)										
Stack		-18.0	25.0	38.0	93.0	147.0	200.0	371.0	482.0	593.0	816.0	1038.0
		-18.0	24.0	36.0	91.0	147.0	257.0	368.0	479.0	590.0	812.0	1032.0
Aux		-18.0	24.0	36.0	91.0	147.0						
		-18.0	24.0	36.0	91.0	147.0						
Probe		-18.0	24.0	36.0	91.0	147.0						
		-18.0	24.0	36.0	91.0	147.0						
Filter		-18.0	24.0	36.0	91.0	147.0						
		-18.0	24.0	36.0	91.0	147.0						
Oven		-18.0	24.0	36.0	91.0	147.0						
		-18.0	24.0	36.0	91.0	147.0						
Exit		-18.0	24.0	36.0								
		-18.0	24.0	36.0								

### Tolerance Range

Stack	± 1.50%	Absolute
Probe	± 3.0 °C	
Filter	± 3.0 °C	

Meter	± 3.0 °C
Exit	± 2.0 °C



Enviro Equipment Service Co., Ltd.

1110/254 Moo 3, Tambon Bang Rak Phatthana, Amphur Bang Bua Thong, Nonthaburi 11110

Tel. 098 362 9152, 089 478 7885

E-mail: sales@envi-ees.com

Certificate No. : E23-08061

Page : 1 of 2

## CERTIFICATE OF CALIBRATION

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

Description of Equipment : Stainless Steel Nozzle  
Manufacturer : Apex Instrument  
Model Number : NS SET  
Serial Number : -  
ID./Control No. : -

Environment Conditions : Temperature (20 ± 2) °C  
Humidity (50 ± 15) % RH

Cal. Date : 07/07/2023  
Issue Date : 02/08/2023

### Calibration Method or Calibration Procedure Used

US EPA Method (United State Environmental Protection Agency)

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

### Level of Calibration

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

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

Calibrated by :



Certificate No. : E23-08061

Page : 2 of 2

## CALIBRATION RESULTS

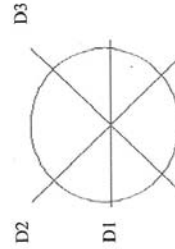
Sampling System Equipment Information :  
Nozzle Model : NS SET  
Nozzle Number : -  
Nozzle Type : Stainless Steel

Calibration Condition :  
Date : 2 August 2023  
Barometric Pressure : 756.74 mm Hg  
Calibration Device : Vernier 0-50 mm  
Method Reference : IS, EPA Method

Nozzle ID	Nozzle Diameter				Different	(D1 + D2 + D3) / 3
	Size	D1	D2	D3		
	mm	mm	mm	mm	mm	mm
NS-4	3.18	3.21	3.22	3.22	0.005	3.217
NS-6	4.76	4.68	4.69	4.68	0.006	4.683
NS-8	6.35	6.18	6.17	6.18	0.006	6.177
NS-10	7.94	7.75	7.73	7.75	0.012	7.743
NS-12	9.52	9.57	9.58	9.59	0.010	9.580
NS-14	11.11	10.84	10.85	10.84	0.006	10.843
NS-16	12.70	12.61	12.60	12.60	0.006	12.603

### Remark:

D1, D2, D3 = Three difference nozzle diameters, mm; diameter must be within 0.025 mm  
D = Maximum difference between any two diameters, must be ≤ 0.100 mm  
Davg = (D1 + D2 + D3) / 3



Instrument description : Flue Gas Analyzer  
Instrument model : Testo 350 New  
Instrument serial no. : 02512133/304  
Control unit serial no. : 02536316/304  
ID no. or control no. : SPI-FGAB-05  
Manufacturer : Testo SE & Co. KGaA  
Probe description : -  
Probe model : -  
Probe serial : -  
Customer name : S.P.J SCIENTIFIC CO.,LTD.  
Customer address : 80 SOI NAKKILA LAEM THONG 3, THAP CHANG, KHET SAPHAN SING, BANGKOK 10250

Total pages of certificate : 2 Pages  
Receiving no. : L-232342  
Receiving date. : 24-Jul-23  
Parameter of calibration : Gas Calibration(Oxygen 2.498,10.04,21.02 %vol, Carbon Monoxide 80.14,1003 ppm Nitrogen Dioxide 80.96 ppm, Nitric Oxide 151.5 ppm, Sulphur Dioxide 100.8 ppm)  
Condition of UUC. : Used  
Ambient condition : All of the Measurement were carried out in the stabilized laboratory  
Temperature : 23 ±5 °C  
Humidity : 55 ± 15 %RH  
Calibration place : 17/121 Soi Ngamwongwan 47, Yaek 48, Toongsonghong, Laksi, Bangkok 10210

Calibration procedure no.: This instrument was calibrated by comparison with Standard gas mixture according to calibration work instruction no. WI-CL-19-C

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

Date of calibration : 24-Jul-23



Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen ( O <sub>2</sub> ) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen ( O <sub>2</sub> ) 10.04 % Vol	CG-0153-21	Nimit	18-Nov-26
Oxygen ( O <sub>2</sub> ) 21.02 % Vol	CG-0041-22	Nimit	10-Feb-27
Carbon monoxide ( CO ) 80.14 ppm	CG-0040-22	Nimit	14-Feb-27
Carbon monoxide ( CO ) 1003 ppm	2583/22	Linde	09-Aug-24
Nitrogen Dioxide ( NO <sub>2</sub> ) 80.96 ppm	3240/21	Linde	26-Jun-24
Nitric Oxide ( NO ) 151.5 ppm	0161/23	Linde	2-Jan-25
Sulphur Dioxide ( SO <sub>2</sub> ) 100.8 ppm	3507/22	Linde	09-Nov-24

Measured room conditions

Temperature : 22.5 °C Humidity : 65.3 %RH Pressure : 1004.6 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,200 ml/min Gas pressure : 1022.2 mbar

Calibration Results (before adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O <sub>2</sub> (%Vol)	2.498	2.58	0.082	0.15
O <sub>2</sub> (%Vol)	10.04	10.09	0.05	0.20
O <sub>2</sub> (%Vol)	21.02	21.08	0.06	0.30
CO (ppm)	80.14	83	2.86	3.0
CO (ppm)	1003	1015	12	12
NO <sub>2</sub> (ppm)	80.96	76.4	-4.56	8.0
NO (ppm)	151.5	144	-7.5	8.0
SO <sub>2</sub> (ppm)	100.8	102	1.2	6.0

Calibration Results (after adjustment) (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O <sub>2</sub> (%Vol)	2.498	2.58	0.082	0.15
O <sub>2</sub> (%Vol)	10.04	10.09	0.05	0.20
O <sub>2</sub> (%Vol)	21.02	21.08	0.06	0.30
CO (ppm)	80.14	83	2.86	3.0
CO (ppm)	1003	1015	12	12
NO <sub>2</sub> (ppm)	80.96	81.2	0.24	8.0
NO (ppm)	151.5	151	-0.5	8.0
SO <sub>2</sub> (ppm)	100.8	102	1.2	6.0

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

End of Report