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## เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์

เอกสารสอบเทียบเครื่องมือ ตรวจวัดคุณภาพอากาศ  
ในบรรยากาศ และ คุณภาพ เสียง

รายการเครื่องมือที่ใช้ในการตรวจวัด/วิเคราะห์

No	Model	Serial Number	Part	Remark
1	Test WS/WMD Report	A5040	1-4	Windspeed/บ้านคลองบางหงส์ (A1)
2	Test WS/WMD Report	A5041	5-8	Windspeed/วัดบ้านพาสน์ (A2)
3	Variable Resistance Calibration Kit	3271	9-10	TSP
4	Electronic Balance	1121501689	11-12	TSP
5	TE-5170 (TSP)	2727	13	TSP/บ้านคลองบางหงส์ (A1)
6	TE-5170 (TSP)	2726	14	TSP/วัดบ้านพาสน์ (A2)
7	Multi-Gas Calibrator 6100	7462	15	NO <sub>2</sub> , SO <sub>2</sub>
8	Zero Air 701	349	16	NO <sub>2</sub> , SO <sub>2</sub>
9	APNA-370	P1EJ99E5	17	NO <sub>2</sub> /บ้านคลองบางหงส์ (A1)
10	APNA-370	705KA9JJ	18	NO <sub>2</sub> /วัดบ้านพาสน์ (A2)
11	APSA-370	YDL839W0	19	SO <sub>2</sub> /บ้านคลองบางหงส์ (A1)
12	APSA-370	Y8SW7T00	20	SO <sub>2</sub> /วัดบ้านพาสน์ (A2)
13	Sound Calibrator	520272	21-23	Noise
15	แบบบันทึกการสอบเทียบเครื่อง Level Meter	-	24	Noise
16	Sound Level Meter	00396803	25-32	Noise/บ้านคลองบางหงส์ (A1)
17	แบบบันทึกการสอบเทียบเครื่อง Level Meter	-	33	Noise
18	Sound Level Meter	00396923	34-41	Noise/วัดบ้านพาสน์ (A2)



Accredited calibration laboratory  
ISO/IEC 17025:2017  
NAC-TIS-115 17025  
CALIBRATION 0367

JIRANAE ASSOCIATES CO., LTD.

Jiranae Associates Co., Ltd.  
63/14-15, 67/35-36  
Petchkasem 77/1, Rd. Warthapra, Bangkoknoi,  
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Air speed measurement laboratory  
Calibration services department

Certificate Number
CL-026-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Wind Direction Sensor  
MANUFACTURER : Novalynx  
MODEL/TYPE : Sensor: WS-02F  
SERIAL NUMBER : Data logger: 200-WS-25LB  
ID NUMBER : Sensor: K6-040  
CONDITION AS-RECEIVED : Data logger: AS040  
CUSTOMER : Used item  
: Water Analysis Center Co., Ltd.  
94/1 Moo 5, T. Kanham, 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 : 1010.5 hPa

PLACE OF CALIBRATION : Eiffel-type wind tunnel of Jiranate 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 : 24 hours at ambient conditions.  
Measurement Condition : 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. Sorawit Thichajad  
☐ Miss Jitraporn Lertsomphol



Approved signatory: .....

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 to 1

Calibration procedure:  
The wind direction sensor was calibrated against Standard Rotary Encoder model AX4009TS-DN04-P3-S-U0 in an class test-section of Eiffel-type wind tunnel with 900 cm<sup>2</sup> cross test section area. The WI-CL-008 based on IEC 63400-12-1, Wind energy generation systems - Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:  
The certificate provides a traceability of the measurement to recognized the national standards, and 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

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

**Remark:**<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

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

**J NAC**  
JIRANATEE ASSOCIATES CO., LTD.

Jirarattee Associates Co., Ltd.  
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Web site: www.jiranatee.com

Accredited calibration laboratory  
ISO/IEC 17025:2017  
MSC-TSI-TS 17025  
CALIBRATION 0367

Air speed measurement laboratory  
Calibration services department

Certificate Number
CL-026-66

**CERTIFICATE OF CALIBRATION**

Page 1 of 2 Pages

**MEASUREMENT ITEM**  
MANUFACTURER : Cup anemometer  
MODEL/TYPE : Novalynk  
SERIAL NUMBER : Data logger: 200-WS-2SLB  
ID NUMBER : Sensor: RG-040  
CONDITION AS-RECEIVED : Data logger: ASD40  
CUSTOMER : Used item  
94/1 Moo 5, T. Iamham, A.U-thai, Ayutthaya 13210

**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 close test-section of Effel-type wind tunnel with 500 cm<sup>2</sup> cross test section area. The WI-CL-032 based on EC 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 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<sup>6</sup>

**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**

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

**CALIBRATION CONDITIONS**

: 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 [-]

**Preconditioning**

: 24 hours at ambient conditions.  
The average values during measurement are (24.5) °C, (42.9) %RH and (1009.6) hPa.

**TABULATION OF RESULTS:**

The table on next page give the measured values.

Calibrated by:  
☒ Mr. Sorawit Thachalad  
☒ Miss Jittaporn Lertsomphol

**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 signatory: .....

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



Certificate Number

CL-028-56

Page 2 of 2 Pages

MEASUREMENT RESULTS<sup>1</sup>

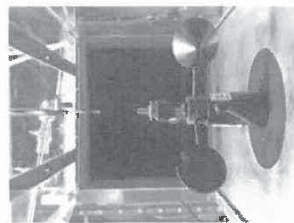
The cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s by a pitot tube with precision differential pressure meter 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)	$U(k=2)$ (m/s)
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	14.1	-0.1	0.31
15.22	24.40	24.45	15.0	-0.3	0.31
16.27	24.40	24.45	16.1	-0.2	0.41

Remark:

<sup>1</sup> Calibration results only count for the tested circumstances and environmental conditions during which calibration took place<sup>2</sup> Velocity of standard<sup>3</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.



JIRANATEE ASSOCIATES CO., LTD.

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Accredited calibration laboratory

ISO/IEC 17025:2017

NSC-TIS-115 17025

CALIBRATION 0367

Air speed measurement laboratory

Calibration services department.

Certificate Number

CL-027-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Wind Direction Sensor

MANUFACTURER : Novallux

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. Khanom, 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> : minBlockage 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. Sorawit Thachalad☐ Miss Jittragoon Lertsongphol

Approved signatory:



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 "b" to "D"

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

Certificate Number  
CL-027-66

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 <sup>std</sup> Degree (°)	D <sup>unc</sup> 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

Remark:

<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



\*\*\*End of certificate of calibration\*\*\*



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

Air speed measurement laboratory  
Calibration services department.

Certificate Number  
CL-029-66

## CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

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

: Cup anemometer  
: Novolynx  
: Sensor: WS-02F  
: Data logger: 200-WS-25LB  
: Sensor: WAC01  
: Data logger: AS041  
: -  
: Used Item  
: Water Analysis Center Co., Ltd.  
94/1 Moo 5, T. Kanham, A.U. Thal, 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> 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 [-]

#### Preconditioning

Measurement Condition

: 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. Sorawit Thachaiad  
☐ Miss Jitaporn Lertsomphol

Approved signature

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>/<sub>1</sub>

**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 obse test-section of Eiffel-type wind tunnel with 900 cm<sup>2</sup> cross test section area. The Win-CL-502 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 realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate Number: MN-0052-21 and MN-0056-22

#### 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<sup>6</sup>

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

Certificate Number
CL-029-66

MEASUREMENT RESULTS<sup>5</sup>

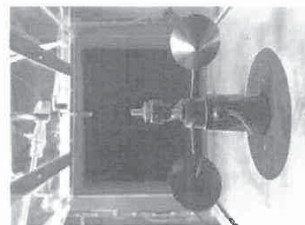
The cup anemometer, Unit Under Calibration (UUC) was exercised at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 500 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)	$\pm U(k=2)$ (m/s)
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	14.9	-0.3	0.31
16.28	23.96	24.05	16.0	-0.3	0.31

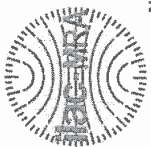
Remark:

<sup>4</sup> 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.



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

Flow measurement laboratory  
Calibration services department.

JIRANATEE ASSOCIATES CO., LTD.

Jiranatee Associates Co., Ltd.  
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Mobile: +66863599453  
E-mail: jnac-calibration@jiranatee.com  
Web site: www.jiranatee.com

## CERTIFICATE OF CALIBRATION

Certificate No. : CL-005-66

Page 1 of 2 Pages

MEASUREMENT ITEM : Top Load Orifice

MANUFACTURER : TISCH

MODEL/TYPE : TE-5028A

SERIAL NUMBER : 3271

ID NUMBER : -

CONDITION AS-RECEIVED : Used item

CUSTOMER : Water Analysis Center Co., Ltd  
94/1 Moo 5, T. Lantham, A.U.-Bhai, 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

## CALIBRATION CONDITION:

Preconditioning : 24 hours at ambient conditions.

Measurement Condition : The average values during measurement are 24.5 °C and 57.0%RH.

## TABULATION OF RESULTS:

The table on next page give the measured values.

**Calibration procedure:**  
The Office gas flow device was calibrated against Standard Rotary Displacement Meter (Rohr's Heier) Model G55/IMC/M2-2p. The VP-CL-004 was used as a calibration guideline.

## Traceability:

This certificate provides a traceability of the measurement to recognized the national standards and to realization of the International system of units (SI) through the VSL (National Metrology Institute of Netherlands) via Certificate number: 62271901

## 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'



Calibrated by:

☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn Lertsomphol

Approved signatory:



**MEASUREMENT RESULTS:**

The Orifice gas flow device was calibrated by direct comparison method with the Standard Rotary Displacement Meter (Roots Meter). The Humid air was used as a medium in the system. The standard conditions are 25 °C (298.15 K) and 760 mmHg for standard temperature and standard pressure respectively.

Table 1: The results of Q Standard calibration data

Plate	Flow rate m <sup>3</sup> /min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Trn] °C	Ap_meter mmHg	Δp_Orifice inH <sub>2</sub> O	Y	Standard Flow [Qs] m <sup>3</sup> /min
1	0.701	757.946	24.50	23.96	53.515	1.043	1.021	0.652
2	1.000	757.893	24.54	24.03	39.165	2.224	1.491	0.948
3	1.118	757.858	24.23	23.88	33.774	2.837	1.684	1.069
4	1.167	757.823	24.26	23.75	31.881	3.111	1.764	1.119
5	1.422	757.854	24.37	24.16	20.780	4.758	2.180	1.383

Slope (m): 1.58747  
Intercept (b): -0.02405  
Correlation coefficient (r): 0.99980  
Uncertainty (k=2): 0.015 m<sup>3</sup>/min

Table 2: The results of Q actual calibration data

Plate	Flow rate m <sup>3</sup> /min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Trn] °C	Ap_meter mmHg	Δp_Orifice inH <sub>2</sub> O	Y	Standard Flow [Qs] m <sup>3</sup> /min
1	0.701	757.946	24.50	23.96	53.515	1.043	0.640	0.653
2	1.000	757.893	24.54	24.03	39.165	2.224	0.935	0.950
3	1.118	757.858	24.23	23.88	33.774	2.837	1.055	1.069
4	1.167	757.823	24.26	23.75	31.881	3.111	1.105	1.119
5	1.422	757.854	24.37	24.16	20.780	4.758	1.367	1.384

Slope (m): 0.99429  
Intercept (b): -0.00880  
Correlation coefficient (r): 0.99980  
Uncertainty (k=2): 0.015 m<sup>3</sup>/min



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



## Certificate of Calibration

**Equipment:**

Balance

Certificate No.: C01223712

**Model:**

AX205DR

Issued Date: 07 December 2022

**Serial No. (or ID.):**

1121501669 (WWL 0154)

Job No.: KSPR2215471

**Manufacturer:**

Mettler Toledo

Page: 1 of 2

**Condition:**

In condition

**Customer:**

Water Analysis Center Co., Ltd.

1/94 Moo 5, Rojana Industrial Park, Rojana Road,

Tambol Kanham, Amphur U-Thai, Ayutthaya 13210 Thailand

**Environment Condition:**

Temperature 26 °C ± 0.7 °C

Humidity 60 %RH ± 2.6 %RH

**Calibration Place:**

Water Analysis Center Co., Ltd. ( น้ำประจักษ์ )

1/94 Moo 5, Rojana Industrial Park, Rojana Road,

Tambol Kanham, Amphur U-Thai, Ayutthaya 13210 Thailand

**Calibration By:**

Mr. Adinan Nirviboon

**Calibration Date:**

07 December 2022

**The Method used:**

In-house method, CAL-WI-47, based on UKAS Lab 14

**Traceability:**

This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Co., Ltd. Certificate No. C02221881

**Person in charge****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 laboratory.

The measurement uncertainty stated in this report is calculated by 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).

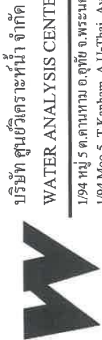
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

DKSH Technology Limited  
2533 Sukhumvit Road, Bangkok 10110, Thailand  
Phone: +66 2628 7900 Email: info.dksh@dksh.com Website: www.dksh.com/thailand-branch

Delivering Growth - In Asia and Beyond.







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

High Volume Air Sampler Calibration Worksheet

Project Site : ข้อมูลสถานที่เก็บน้ำ (ไฮเทค)

Location : รับน้ำพาสน์

Date of measurement : 6/11/2023

Worksheet No. : C-061123-WWL0097

Calibration Office

High Volume ID : WWL0097 WWL0103

High Volume Model : TE-5170 (TSP) TE-5028A

High Volume S/N : 2726 3271

Ambient Condition

Calibrate Date : 11/02/2022

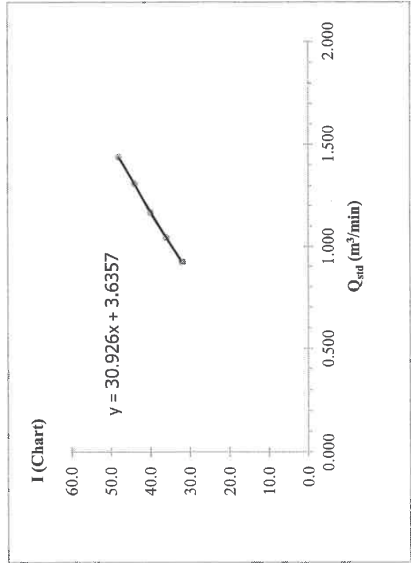
Quality Standard Slope : 1.61297

Quality Standard Inte : -0.04609

Temperature (°C) : 26

Barometric Pressure (mmHg) : 756

Test No.	delta H <sub>2</sub> O (inch)	Q <sub>std</sub> (m <sup>3</sup> /min)	I (Chart)	IC (Corrected)	Linear Regression
1	5.20	1.437	48.0	47.81	Slope : 30.80 Intercept : 3.621 Correlation Coefficient : 0.9995
2	4.30	1.309	44.0	43.82	
3	3.40	1.167	40.0	39.84	
4	2.70	1.043	36.0	35.85	
5	2.10	0.923	32.0	31.87	



Calibrated by :

Approved by :

ENVIR SERVICE

42 Raminthra 14 yeak 9, Tha Raeng, Bangkokhen, Bangkok 10230

Tel : 02-9435814-5 Fax : 02-9438201 Tax id : 0105555170865



บริษัท เอ็นไวร์ เซอร์วิส จำกัด  
ENVIR SERVICE CO., LTD.

REPORT QA. GAS-CALIBRATOR

CALIBRATE DATE: 10 Jan 23

GAS CALIBRATOR

MANUFACTURER : Enviroitics

MODEL : 6100

S/N: 7462

FLOW CALIBRATOR :

DryCal® DC-Lite

MODEL : DCL-H

S/N: 107934

MODEL : DCLT 5K

S/N: 2105

MANUFACTURER : Bios International Corporation

REPORT QA. GAS-CALIBRATOR

AIR	SETTING	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000	AVG
FLOW	REF	996.00	2003.00	3004.00	3995.00	5001.00	5994.00	6991.00	7995.00	9005.00	9870.00	
(CCM)	%ERROR	-0.400	0.150	0.133	-0.125	0.020	-0.100	-0.129	-0.063	0.056	-1.300	-0.18
GAS	SETTING	10	20	30	40	50	60	70	80	90	100	AVG
FLOW	REF	10.11	20.14	30.02	40.08	50.24	60.02	70.11	80.21	90.23	100.02	
(CCM)	%ERROR	1.100	0.700	0.067	0.200	0.480	0.033	0.157	0.262	0.256	0.020	0.33

Standard Reference

Reference Photometer Zero Air Brand : API Analyzer Model 701 S/N 349

Calibration Test Results

Expected Ozone (PPM)	REF Photometer Reading before adjust	REF Photometer Reading after adjust	% Error	Status
0.000	0.131	0.000	0.000	pass
0.100	0.088	0.100	0.000	pass
0.200	0.176	0.199	-0.503	pass
0.300	0.286	0.298	-0.671	pass
0.400	0.388	0.396	-1.010	pass

TEMPERATURE : 26.5 DEG.C

PRESSURE : 752 mmHg

TESTED BY



บริษัท ศูนย์วิเคราะห์น้ำ จำกัด  
WATER ANALYSIS CENTER COMPANY LIMITED  
1/94 หมู่ 5 ต.สามหมื่น อ.อุทัย จ.พระนครศรีอยุธยา 13210  
1/94 Moo 5, T. Kamhuan, A. U-Thai, Ayutthaya 13210, Thailand  
Tel: 0-35226-383, 0-35800-593 Fax: 0-35800-594

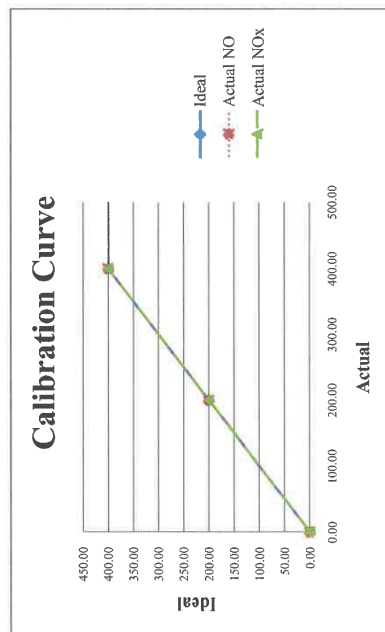
### Nitrogen Dioxide Analyzer Calibration Worksheet

Project Site : **นิคมอุตสาหกรรมบ้านหว้า(ไผ่เทก)**  
Location : **บ้านคลองบางหมาก**  
Date of measurement : **06 November 2023**  
Worksheet No. : **C-061123-WWL 0114**  
Ambient NOx Analyzer ID : **WWL 0114**  
Manufacturer : **HORIBA**  
Ambient NOx Analyzer Model : **APNA-370**  
Ambient NOx Analyzer S/N : **PIEJ99E5**

**Multi Gas Calibrator**  
Calibrator ID : **WWL0128**  
Calibrator Model : **Series 6100**  
Calibrator S/N : **S/N 7462**  
Calibrate Date : **20 June 2020**

**Cylinder Std. Gas**  
Std. Gas Concentration (PPM) : **50.90**  
Cylinder Pressure (psi) : **2000**  
Certified Date : **07 December 2017**  
Expired Date : **07 December 2021**  
Serial No. : **CC241587**

Point	CALIBRATION RESULTS					
	Ideal	Actual NO	Error NO	%Error NO	Actual 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	200.20	0.20	0.10	200.20	0.20
SPAN 400 ppb	400.00	400.30	0.30	0.08	400.10	0.10
AVERAGE (%)				0.09		0.06



Calibrated by \_\_\_\_\_  
(Mr. \_\_\_\_\_)

Approved by \_\_\_\_\_  
(Mr. \_\_\_\_\_)



ENVIR SERVICE  
42 Ramintra 14 yeak 9, Tha Raeng, Bangkok, Bangkok 10230  
Tel : 02-9435814-5 Fax : 02-9438201 Tax id : 0105555170865

### Standard Reference

Reference Photometer

Brand :

Zero Air

API Analyzer

Model 701 S/N 349

### Calibration Test Results

Expected Ozone (PPM)	REF Photometer Reading before adjust	REF Photometer Reading after adjust	% Error	Status
0.000	0.020	0.000	0.000	pass
0.100	0.088	0.100	0.000	pass
0.200	0.176	0.199	-0.500	pass
0.300	0.286	0.298	-0.667	pass
0.400	0.388	0.396	-1.000	pass



TEMPERATURE : 26.5 DEG.C

PRESSURE : 752 mmHg

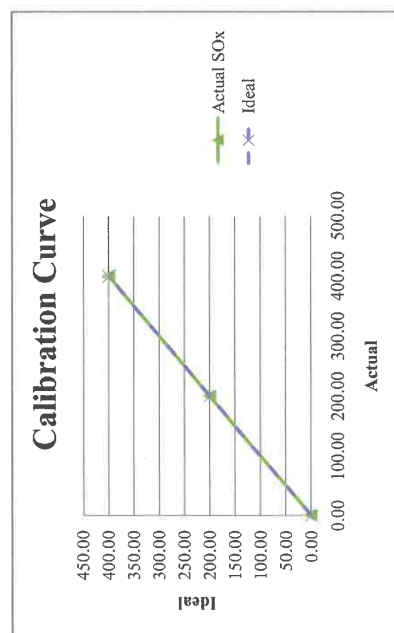
TESTED

บริษัท เอ็นไวร์ เซอร์วิส จำกัด  
ENVIR SERVICE CO., LTD.

### Sulfur Dioxide Analyzer Calibration Worksheet

Project Site :	นิคมอุตสาหกรรมบ้านหวด (โชนก)	Multi Gas Calibrator
Location :	บ้านคองบึงหงษ์	Calibrator ID : WWL0128
Date of measurement :	06 November 2023	Calibrator Model : Series 6100
Worksheet No. :	C-061123-WWL 0109	Calibrator S/N : S/N 7462
Ambient SO <sub>2</sub> Analyzer ID :	WWL 0109	Calibrate Date : 20 June 2020
Manufacturer :	HORIBA	Cylinder Std. Gas
Ambient SO <sub>2</sub> Analyzer Model :	APSA-370	Std. Gas Concentration (PPM) : 49.68
Ambient SO <sub>2</sub> Analyzer S/N :	YDL839W0	Cylinder Pressure (psi) 2000
		Certified Date : 07 December 2017
		Expired Date : 07 December 2021
		Serial No. : CC241587

CALIBRATION RESULTS				
Point	Ideal	Actual SO <sub>2</sub>	Error SO <sub>2</sub>	%Error SO <sub>2</sub>
ZERO	0.00	0.10	0.10	-
SPAN 200 ppb	200.00	200.20	0.20	0.10
SPAN 400 ppb	400.00	400.20	0.20	0.05
AVERAGE (%)				
				0.07

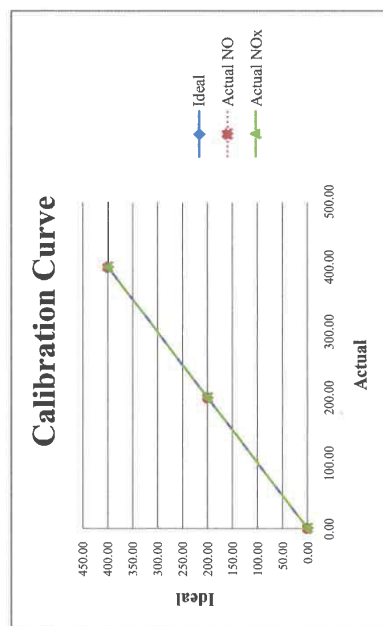


Calibrated by (M) \_\_\_\_\_ Approved by (N) \_\_\_\_\_

### Nitrogen Dioxide Analyzer Calibration Worksheet

Project Site :	นิคมอุตสาหกรรมบ้านหวด (โชนก)	Multi Gas Calibrator
Location :	บ้านคองบึงหงษ์	Calibrator ID : WWL0128
Date of measurement :	06 November 2023	Calibrator Model : Series 6100
Worksheet No. :	C-061123-WWL 0115	Calibrator S/N : S/N 7462
Ambient NO <sub>x</sub> Analyzer ID :	WWL 0115	Calibrate Date : 20 June 2020
Manufacturer :	HORIBA	Cylinder Std. Gas
Ambient NO <sub>x</sub> Analyzer Model :	APNA-370	Std. Gas Concentration (PPM) : 50.90
Ambient NO <sub>x</sub> Analyzer S/N :	705KA9JJ	Cylinder Pressure (psi) 2000
		Certified Date : 07 December 2017
		Expired Date : 07 December 2021
		Serial No. : CC241587

CALIBRATION RESULTS				
Point	Ideal	Actual NO	%Error NO	Error NO <sub>x</sub>
ZERO	0.00	0.10	0.10	0.10
SPAN 200 ppb	200.00	200.10	0.05	0.20
SPAN 400 ppb	400.00	400.20	0.05	0.20
AVERAGE (%)				
				0.07



Calibrated by (M) \_\_\_\_\_ Approved by (N) \_\_\_\_\_



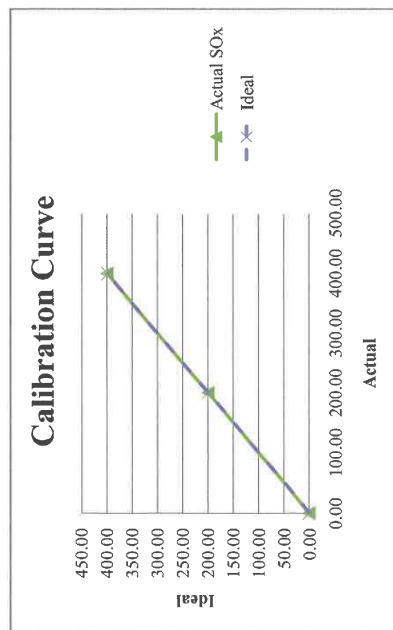
Sulfur Dioxide Analyzer Calibration Worksheet

Project Site : นิคมอุตสาหกรรมบ้านหวด (โกลด)  
Location : บ้านหวด  
Date of measurement : 06 November 2023  
Worksheet No. : C-071123-WWL 0110  
Ambient SOx Analyzer ID : WWL 0110  
Manufacturer : HORIBA  
Ambient SOx Analyzer Model : APSA-370  
Ambient SOx Analyzer S/N : Y8SW7T00

Multi Gas Calibrator  
Calibrator ID : WWL0128  
Calibrator Model : Series 6100  
Calibrator S/N : S/N 7462  
Calibrate Date : 20 June 2020

Cylinder Std. Gas  
Std. Gas Concentration (PPM) : 49.68  
Cylinder Pressure (psi) : 2000  
Certified Date : 07 December 2017  
Expired Date : 07 December 2021  
Serial No. : CC241587

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



Calibrated by : [Redacted]  
Approved by : [Redacted]



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0506 MTC No. EEL. BP. 58/0565

CALIBRATION CERTIFICATE

Submitted by : WATER ANALYSIS CENTER CO.,LTD.  
Address : 1/94 Moo 5, T.Kanham, A.U.-Thai, Ayutthaya 13120.  
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.  
: Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated :  
Description : Sound Calibrator  
Manufacturer : BSWA TECH  
Model : CA111  
Serial No. : 520272  
Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.  
2. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.  
3. Programmable Attenuator Tanigawa TPA-303A S/N OF 2214.  
4. Digital Multimeter Agilent 34401A S/N MY44005560.  
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.  
6. Audio Analyzer Keithley 2015-P S/N 4106495.  
7. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.

Ambient Environment  
Temperature : (23 ± 3) °C  
Relative Humidity : (50 ± 15) %  
Ambient Pressure : (101.325 ± 1.500) kPa

Calibration Procedure: CP-102-04 based on IEC 60942-2003. The sound pressure level of instrument was measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 20 May 2022

Date of Calibration : 24 May 2022

1 / 3

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.

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Office/Laboratory 50 1C, Bangpoo Industrial Estate, Sukhumvit Road, Amphoe Muang, Chongst 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, Chauchak, Bangkok 10900, Thailand  
Tel. (66) 0 2579 1121-90 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : suna@tistr.or.th



NSC-TIS-1025  
CALIBRATION 007

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0506 MTC No. EEL. BP. 38/0565

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

Nominal Output of Unit Under Test = 94 dB re 20  $\mu$ Pa at 1000 Hz

Acoustic Output in dB re 20  $\mu$ Pa, Corrected to Reference Conditions: 101.325 kPa, 23.0 °C and 50 % RH

#### 1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit
1/2 inch Brüel&Kjær 4180	93.77	-0.23	$\pm 0.10$	$\pm 0.40$ dB

#### 2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit
1/2 inch Brüel&Kjær 4180	1001.0	1.0	$\pm 1.5$	$\pm 1.0$ %

#### 3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit
1/2 inch Brüel&Kjær 4180	1.98	$\pm 0.50$	$\pm 3.0$ %

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Date of Calibration : 24 May 2022

2 / 3

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.

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Changwat Pathumthani 12120, Thailand  
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Fax. (66) 0 2577 9009  
E-mail : tump@tistr.or.th Website: www.tistr.or.th

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

FAEL-MTC-002 Rev.4



NSC-TIS-1025  
CALIBRATION 007

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0506 MTC No. EEL. BP. 38/0565

Nominal Output of Unit Under Test = 114 dB re 20  $\mu$ Pa at 1000 Hz

Acoustic Output in dB re 20  $\mu$ Pa, Corrected to Reference Conditions : 101.325 kPa, 23.0 °C and 50 % RH

#### 1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit
1/2 inch Brüel&Kjær 4180	113.84	-0.16	$\pm 0.10$	$\pm 0.40$ dB

#### 2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit
1/2 inch Brüel&Kjær 4180	1001.1	1.1	$\pm 1.5$	$\pm 1.0$ %

#### 3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit
1/2 inch Brüel&Kjær 4180	0.62	$\pm 0.50$	$\pm 3.0$ %

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :



(Mr. Tawakiat Iamsamran)

Date of Calibration : 24 May 2022

Date of Issue : 24 May 2022

Ref : 2011265052002210001

End of Certificate

The results relate only to the items tested/calibrated or value assigned.

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

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

FAEL-MTC-002 Rev.4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0137

MTC No. EEL. BP. 105/1164

## CALIBRATION CERTIFICATE

Submitted by : WATER ANALYSIS CENTER CO., LTD.

Address : 1/94 MOO 5, T.KANHAM, A.U-THAI, AYUTTHAYA 13210.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

## Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00396803 (WWL 0160)

Microphone : Type UC-52 No.180449

Preamplifier : Type NH-24 No.87814

## Standards used :

1. Band Pass Filter: Stamford Research Systems SR 650 S/N 28712.
2. Condenser Microphone: Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator: Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator: Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer: NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter: Fluke 8520A S/N 4985007.
7. Pistonphone: Rion NC-72 S/N 00402446.
8. Measuring Amplifier: Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 26 Nov. 2021

Date of Calibration : 13-16 Dec. 2021

1/8

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.BLMTC.002 Rev.4

## Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9009  
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## Office/Laboratory

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W	FO.LAB 6.4-1/28	แก้ไขครั้งที่ : 0	วันที่รับแจ้งใช้ : 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 93.78 ± 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 30/11/65	วันที่สอบเทียบเครื่องต่อไป 29/11/66	
เครื่อง Sound Level Meter S/N 00396803	รหัสเครื่องมือ WWL 0160	
วันที่สอบเทียบ 31/05/66	วันที่สอบเทียบเครื่องต่อไป 30/05/68	

## การทวนสอบก่อนออกห้องงาน

อุณหภูมิ (°C) 24	เกณฑ์การยอมรับ 23.0 ± 3.0
ความชื้นสัมพัทธ์ (%) 47	เกณฑ์การยอมรับ 50.0 ± 15.0
วันที่ทวนสอบ 07/11/66	วันที่ทวนสอบ 11/11/66

## การทวนสอบหลังจากออกห้องงาน

อุณหภูมิ (°C) 24	เกณฑ์การยอมรับ 23.0 ± 3.0
ความชื้นสัมพัทธ์ (%) 49	เกณฑ์การยอมรับ 50.0 ± 15.0
วันที่ทวนสอบ 11/11/66	

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

ผู้บันทึก

ผู้ตรวจสอบ



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Request No. 21-65/0137

MTC No. EEL. BP. 105/1164

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

**Calibration Procedure :**

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 13-16 Dec.2021

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MTC No. EEL. BP. 105/1164

**1. Absolute Sensitivity**

Reference Acoustic Signal (dB)	Unit Under Test			Tolerance Limit Class 2 (±dB)
	Measured Value (dB)	Deviation (dB)	Uncertainty (±dB)	
113.91	Before adjust 114.1	After adjust 113.9	0.0	0.30
				1.4

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

**2. Self-generated noise****2.1 Normal test**

Measured value (dB)	Uncertainty (±dB)
16.5	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	12.6	0.10
C-Weighting	17.8	0.10
Flat	23.2	0.10

Date of Calibration : 13-16 Dec.2021

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## 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	-0.2	-0.1	-0.1	0.40	2.0
1 000	-0.1	-0.1	-0.1	0.40	1.4
4 000	-0.8	-0.7	-0.7	0.40	3.6

## 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	0.0	-0.1	-0.1	0.20	2.5
125	-0.1	0.0	-0.1	0.20	2.0
250	0.0	0.0	0.0	0.20	1.9
500	0.0	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	-0.1	0.0	-0.1	0.20	2.6
4 000	0.0	0.0	0.0	0.20	3.6
8 000	0.1	0.1	0.0	0.20	5.6

Date of Calibration : 13-16 Dec. 2021

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## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.0	0.0	0.20	0.4

## 5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

## 6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
137	137.0	0.0	0.30	1.4
136	136.1	0.1	0.30	1.4
135	135.0	0.0	0.30	1.4
134	134.1	0.1	0.30	1.4
133	133.1	0.1	0.30	1.4
132	132.0	0.0	0.30	1.4
131	131.0	0.0	0.30	1.4

Date of Calibration : 13-16 Dec. 2021

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MTC No. EEL. BP. 105/1164

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

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
130	130.0	0.0	0.30	1.4
129	129.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	84.1	0.1	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.0	0.0	0.30	1.4
54	54.0	0.0	0.30	1.4
49	48.9	-0.1	0.30	1.4
44	44.0	0.0	0.30	1.4
39	39.0	0.0	0.30	1.4
34	34.0	0.0	0.30	1.4
29	28.9	-0.1	0.30	1.4
28	28.0	0.0	0.30	1.4

Date of Calibration : 13-16 Dec.2021

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NSC-TIS-TIS 17025  
CALIBRATION 0037

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MTC No. EEL. BP. 105/1164

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

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
27	27.0	0.0	0.30	1.4
26	25.9	-0.1	0.30	1.4
25	25.0	0.0	0.30	1.4

7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
20-130	125	125.0	0.0	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	126.0	0.0	0.20	±1.3
	2	109.0	0.0	0.20	+1.3; -2.8
	0.25	99.9	-0.1	0.20	+1.8; -5.3
Slow	200	119.5	-0.1	0.20	±1.3
	2	99.9	-0.1	0.20	+1.3; -5.3
	200	120.0	0.0	0.20	±1.3
SEL	2	100.0	0.0	0.20	+1.3; -2.8
	0.25	90.9	-0.1	0.20	+1.8; -5.3

Date of Calibration : 13-16 Dec.2021

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Request No. 21-65/0137

MTC No. EEL. BP. 105/1164

## 9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	125.4	125.4	0.0	0.20	2.4
Positive half cycle	124.4	124.1	-0.3	0.20	1.4
Negative half cycle	124.4	124.1	-0.3	0.20	1.4

## 10. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	Negative one-half cycle	0.0	0.30	1.8
136.6	136.6			

Calibrated by :



(Mr. Tawikiat Iamsamran)

Date of Calibration : 13-16 Dec.2021

Date of Issue : 17 Dec. 2021

End of Certificate

8 / 8

Approved by :

Mr. Prawate Kuaypa  
Acting Director

Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Ref : 2011264112604939002

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<b>W</b>	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 วันที่สอบเทียบครั้งที่ต่อไป 14/05/67

เครื่อง Digital Thermohygro Meter S/N 105091609 รหัสเครื่องมือ WWL 0055

วันที่สอบเทียบ 30/11/65 วันที่สอบเทียบครั้งที่ต่อไป 29/11/66

เครื่อง Sound Level Meter S/N 00396923 รหัสเครื่องมือ WWL 0161

วันที่สอบเทียบ 31/05/66 วันที่สอบเทียบครั้งที่ต่อไป 30/05/68

การทวนสอบก่อนออกหน้างาน

อุณหภูมิ (°C) 24 เกณฑ์การยอมรับ 23.0±3.0

ความชื้นสัมพัทธ์ (%) 47 เกณฑ์การยอมรับ 50.0±15.0

วันที่ทวนสอบ 07/11/66

การทวนสอบหลังจากออกหน้างาน

อุณหภูมิ (°C) 24 เกณฑ์การยอมรับ 23.0±3.0

ความชื้นสัมพัทธ์ (%) 49 เกณฑ์การยอมรับ 50.0±15.0

วันที่ทวนสอบ 11/11/66

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
ผลการทวนสอบ	ผ่าน	ผ่าน	ผ่าน	ผ่าน

ผู้บันทึก

ผู้ตรวจสอบ

ผู้บันทึก

ผู้ตรวจสอบ





THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0137

MTC No. EEL. BP. 104/1164

## CALIBRATION CERTIFICATE

Submitted by : WATER ANALYSIS CENTER CO., LTD.  
 Address : 1/94 MOO 5, T.KANHAM, A.U-THAI, AYUTHAYA 13210.  
 Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

## Instrument Calibrated :

Description : Sound Level Meter  
 Manufacturer : Rion  
 Model : NL-42  
 Serial No. : 00396923 (WWL 0161)  
 Microphone : Type UC-52 No.180583  
 Preamplifier : Type NH-24 No.87936

## Ambient Environment

Temperature :  $(23 \pm 3) ^\circ\text{C}$   
 Relative Humidity :  $(50 \pm 15) \%$   
 Ambient Pressure :  $(101.325 \pm 1.5) \text{ kPa}$

## Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistophone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 26 Nov. 2021

Date of Calibration : 13-16 Dec.2021

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Request No. 21-65/0137

MTC No. EEL. BP. 104/1164

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

## Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

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

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

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

Date of Calibration : 13-16 Dec.2021

2 / 8

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Request No. 21-65/0137

MTC No. EEL. BP. 104/1164

## 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test				Tolerance Limit Class 2 (±dB)
	Measured Value (dB)		Deviation (dB)	Uncertainty (±dB)	
	Before adjust	After adjust			
	113.91	114.2	113.9	0.0	

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 124.9 dB.

## 2. Self-generated noise

## 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
16.4	0.10

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

Frequency Weighting	Measured Value (dB)	Uncertainty (±dB)
A-Weighting	12.5	0.10
C-Weighting	17.7	0.10
Flat	23.4	0.10

Date of Calibration : 13-16 Dec. 2021

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Request No. 21-65/0137

MTC No. EEL. BP. 104/1164

## 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	-0.1	0.0	0.0	0.40	2.0
1 000	-0.3	-0.3	-0.3	0.40	1.4
4 000	-0.6	-0.6	-0.6	0.40	3.6

## 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	0.0	0.0	0.0	0.20	2.5
125	0.0	0.0	0.0	0.20	2.0
250	0.0	0.0	0.0	0.20	1.9
500	0.0	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	0.0	0.1	0.0	0.20	2.6
4 000	0.0	0.1	0.0	0.20	3.6
8 000	0.1	0.2	0.0	0.20	5.6

Date of Calibration : 13-16 Dec. 2021

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Request No. 21-65/0137

MTC No. EEL. BP. 104/1164

## 5. Frequency and time weightings at 1 kHz

## 5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.0	0.0	0.20	0.4

## 5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

## 6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
137	137.0	0.0	0.30	1.4
136	136.0	0.0	0.30	1.4
135	135.0	0.0	0.30	1.4
134	134.0	0.0	0.30	1.4
133	133.0	0.0	0.30	1.4
132	132.0	0.0	0.30	1.4
131	131.0	0.0	0.30	1.4

Date of Calibration : 13-16 Dec.2021

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## 6. Level linearity on the reference level range (cont.)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
130	130.0	0.0	0.30	1.4
129	129.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	84.1	0.1	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.0	0.0	0.30	1.4
54	54.0	0.0	0.30	1.4
49	49.0	0.0	0.30	1.4
44	44.0	0.0	0.30	1.4
39	39.0	0.0	0.30	1.4
34	34.0	0.0	0.30	1.4
29	28.9	-0.1	0.30	1.4
28	27.9	-0.1	0.30	1.4

Date of Calibration : 13-16 Dec.2021

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NSC-TIS-TIS 17025  
CALIBRATION 0037

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

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
27	26.9	-0.1	0.30	1.4
26	25.9	-0.1	0.30	1.4
25	24.9	-0.1	0.30	1.4

7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
20-130	125	125.0	0.0	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured		Deviated		Uncertainty	Tolerance Limits
		Value (dB)	Value (dB)	Value (dB)	Value (dB)		
Fast	200	126.0	0.0	0.20	±1.3		
	2	108.9	-0.1	0.20	+1.3; -2.8		
	0.25	99.9	-0.1	0.20	+1.8; -5.3		
Slow	200	119.5	-0.1	0.20	±1.3		
	2	99.9	-0.1	0.20	+1.3; -5.3		
	200	120.0	0.0	0.20	±1.3		
SEL	2	100.0	0.0	0.20	+1.3; -2.8		
	0.25	90.9	-0.1	0.20	+1.8; -5.3		

Date of Calibration : 13-16 Dec.2021

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9. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (±dB)	Tolerance limits Class 2 (±dB)
Complete cycle	125.4	125.4	0.0	0.20	2.4
Positive half cycle	124.4	124.1	-0.3	0.20	1.4
Negative half cycle	124.4	124.1	-0.3	0.20	1.4

10. Overload indication

Measured value (dB)	Deviated value (dB)		Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	Positive one-half cycle	Negative one-half cycle		
136.7	136.7	0.0	0.30	1.8

Calibrated by:



(Mr. Tawikiat Jamsamran)

Date of Calibration : 13-16 Dec.2021

Date of Issue : 17 Dec. 2021

End of Certificate

8/8

Approved by:



(Mr. Prawate Klauaypa)  
Acting Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref: 2011264112604939001

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พื้นที่สีเขียว และ ตะกอนประปา



## CERTIFICATE OF CALIBRATION

Certificate No.: C0-1908005/22

Page 1 of total 4 pages

Customer

WATER ANALYSIS CENTER CO., LTD.  
30/5 Soi Vipavadee 60, Viphavadee Rangsit Road,  
Kwaeng Taladbangkhen, Khet Lakxi, Bangkok 10210

Equipment

pH Meter  
Manufacturer METTLER TOLEDO Model SevenCompact S220  
Serial No. B327527211 ID No. WWL 0068

Description

Range : 0 - 14 pH, Resolution : 0.01 pH

Environmental Conditions

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

Calibration Location

Jayhawks Laboratory (CL&GL)

Received Date

19 August 2022

Calibration Date

19 August 2022

Date of Issue

22 August 2022

Checked by

Approved by

( ) (Krisyosl K.) ( ) (Sakda Y.)  
( ) (Patiphan K.) ( ) (Onnapa P.)  
( ) (Pongsak H.) ( ) (Nitiiphong K.)  
( ) (Kanung C.) ( ) (Nonthachai K.)  
( ) (Pramong P.) ( ) (Noppol P.)

(Dr. Ekachai Puritwong)

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FE-169

REV.02 02/24/21

Certificate No.: C0-1908005/22

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	081020	Jan. 22, 2023	NIMT
	7.01	020221	Jan. 18, 2023	
	10.00	091020	Feb. 7, 2023	

Type	Model	Serial No.	Certificate No.	Due Date	Traceability
Documenting Process Calibrator	753	3101007	10-0804001/22	Apr. 7, 2023	THC
Digital Thermometer with Sensor	1523 / 5622	1709138 / 4605984-005	10-1006004/22	Jun. 9, 2023	

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	Nominal Value	UUC Reading		Uncertainty
(mV)	(pH)	pH	mV	(± 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)

Calibrated by

FE-169

Certificate No.: C0-1908005/22

Page 3 of total 4 pages

Measurement Results (Cont.):

2. Calibration of pH Electrode (Serial No.: 3322791)

pH Standard Solution (pH)	Measured Value		Uncertainty (± pH)
	(pH)	(mV)	
4.01	4.01	185.9	0.013
7.01	7.01	9.3	0.013
10.00	10.01	-164.9	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.: C0-1908005/22

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	10-1011001/21	Nov. 10, 2022	THC
Platinum Resistance Thermometer	5626	4854	COA30047	Oct. 22, 2023	FLUKE
Liquid Bath	XORTS-40A	XO111019	10-0306002/21	Jun. 3, 2023	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	22.0	0.00	0.060
120	25.00	25.0	0.00	0.060
120	28.00	28.0	0.00	0.060

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 OF CALIBRATION

Certificate No.: C0-2007006/22 Page 1 of total 2 pages

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WATER ANALYSIS CENTER CO., LTD.  
30/5 Soi Viphavadee 60, Viphavadee Rangsit Road,  
Kwaeng Taladbangkhen, Khet Laksi, Bangkok 10210

**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** 20 July 2022  
**Calibration Date** 20 July 2022

**Date of Issue** 21 July 2022

**Checked by** [Redacted] **Approved by** [Redacted]  
( ) (Krisyosl K.) ( ) (Sakda Y.)  
( ) (Patiphan K.) ( ) (Omapa P.)  
( ) (Pongsak H.) ( ) (Nitiphong K.)  
( ) (Kanung C.) ( ) (Nonthachai K.)  
( ) (Pramong P.) ( ) (Noppol P.)  
( ) (Dr. Ekachai Putititwong)

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

REV.02 02/24/21

FE-169

Certificate No.: C0-2007006/22 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	151.1 µS/cm 1.421 mS/cm	S211008031 S220112015	Jan. 18, 2023 May 16, 2023	SCP Science

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

- SCP Science.

Measurement Results:

Conductivity Standard Solution	Measured Value	Correction	Uncertainty (±)
151.1 µS/cm	150.9 µS/cm	0.2 µS/cm	1.5 µS/cm
1.421 mS/cm	1.423 mS/cm	-0.002 mS/cm	0.0052 mS/cm

Note : Adjustment points: 151.1µS/cm 1.421mS/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

FE-169



SV 201003/2023

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 : 05 / 01 / 2023  
Date Of Calibration : 05 / 01 / 2023

Ambient Condition : Temperature 25 °C  
Humidity 50 % RH

Calibrated By :



Technician

Approved By :



Technician

Date Of Issue : 09 / 01 / 2023

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.

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	1.06657.0500	K54224057	-	30 Sep 2023

2). Traceability This certification is traceable to

- ☒ Merek KGaA 64271 Darmstadt
- ☐ DKK Corporation

### Result Of Calibration

Standard Solution		Before Adjust		After Adjust	
(mg/l) at 24.1°C		Indicator	Error	Indicator	Error
Zero	0.00	0.05	+ 0.05	0.00	-
Span	8.25	7.13	- 1.12	8.25	-

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

Calibrated By



Technician



Certificate No.: MC 2207678

Page 2 of 3

**The Reference Standard :**

Description	Certificate No.	Serial No.	Due date
Data Acquisition/Switch Unit	MC 2114432	MY44096104	20 December 2022
With Thermocouple Type " T " ID. No.2/1 to 2/9			

**This certificate is traceable to the international system of units maintained at:**

- Master Calibration Co., Ltd.

**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.

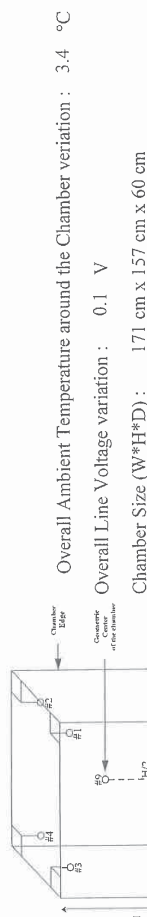
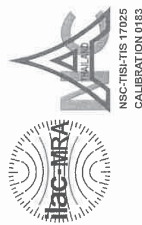


Figure 1 : Sensor Installation Location

Checked by :



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



**TEMPERATURE  
CONTROLLER ENCLOSURES**

Certificate No.: MC 2207678

Page 1 of 3



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

Reference Job No. : 22-1601 Received Date : 12 July 2022  
Description : Refrigerator  
Manufacturer : SANDENINTERCOOL 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 2207678) 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 : ( 25.8 to 27.5 ) °C

Relative Humidity : ( 48.8 to 52.2 ) %

Date of Calibration : 12 July 2022 Date of Issue : 19 July 2022

Checked by :



(Calibration Supervisor)

Approved by :



( Technical Manager )

**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 2207678

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	3.5	3.6	3.7	3.5	3.6	3.4	3.4	3.3	3.4	1.1

### Chamber Characterization Result

Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
2.0	2.5	1.5	0.6	3.1

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 report will certify of the calibrated equipment only.

End of Certificate

Checked by :



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

## Certificate of Calibration



Certificate No.: MC 2203933

Page 1 of 3



### TEMPERATURE CONTROLLER ENCLOSURES

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

Reference Job No. : 22-0740 Received Date : 24 March 2022  
Description : Oven

Manufacturer : Memmert Model : UF260  
Serial No. : B620.0814 ID. No. : WWL0212  
Marking : Additionally for the purpose of identification by this laboratory a label marked with this certificate number ( MC 2203933 ) 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 : ( 30.5 to 32.6 ) °C  
Relative Humidity : ( 56.2 to 61.2 ) %

Date of Calibration : 24 March 2022 Date of Issue : 28 March 2022

Checked by :



( Calibration Supervisor )

Approved by :



( Technical Manager )

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 2203933

Page 2 of 3

## The Reference Standard :

Description	Certificate No.	Serial No.	Due date
Data Acquisition/Switch Unit With Thermocouple Type " T " ID. No.30/1 to 30/9	MC 2106035	93000641	8 August 2022

This certificate is traceable to the international system of units maintained at:

- Master Calibration Co., Ltd.

## 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.

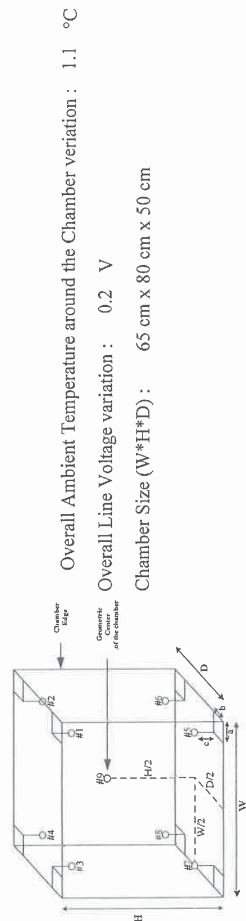


Figure 1: Sensor Installation Location

Checked by :

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

Certificate No.: MC 2203933

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	
104.0	103.9	103.9	103.9	104.1	104.3	104.2	104.2	104.1	104.0	0.67
180.0	179.3	179.3	179.3	179.5	180.1	180.3	180.5	180.4	180.1	0.99

### Chamber Characterization Result

Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
104.0	104.0	0.27	0.45	0.92
180.0	180.0	0.29	1.00	1.65

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 report will certify of the calibrated equipment only.

End of Certificate

Checked by :

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



## Certificate of Calibration

**Equipment:** Balance  
**Model:** BL210S  
**Serial No. (or ID.):** 15808131 (WWL 0022)  
**Manufacturer:** Sartorius  
**Condition:** In condition

**Certificate No.:** C01221685  
**Issued Date:** 08 June 2022  
**Job No.:** KSPR2206906  
**Page:** 1 of 2

**Customer:** Water Analysis Center Co., Ltd.  
1/94 Moo 5, Rojana Industrial Park, Rojana Road,  
Tambol Kanham, Amphur U-Thai, Ayutthaya 13210 Thailand

**Environment Condition:** Temperature 27 °C ± 0.5 °C  
Humidity 42 %RH ± 4.7 %RH

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

**Calibration By:** Mr. Preecha Phooarsai  
**Calibration Date:** 08 June 2022  
**The Method used:** In-house method, SPCC-WI-47, based on UKAS Lab 14  
**Traceability:** This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through SPC RT Co., Ltd. Certificate No. C02220794



Person in charge



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 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.

Certificate No.: C01221685

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				
	A	B	C	D	E
	-	0.0001	0.0001	-0.0002	-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	0.00004

**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	0.99998	1.0000	0.0000	0.000097	2.02
2	1.99999	2.0000	0.0000	0.000098	2.02
5	5.00000	5.0000	0.0000	0.000099	2.02
10	10.00002	10.0000	0.0000	0.00010	2.02
20	19.99995	20.0000	0.0000	0.00011	2.01
50	50.00002	50.0000	0.0000	0.00012	2.01
70	69.99997	70.0000	0.0000	0.00015	2.00
100	100.00007	100.0001	0.0000	0.00017	2.00
120	120.00002	120.0000	0.0000	0.00020	2.00
150	150.00009	150.0002	0.0001	0.00023	2.00
200	199.99993	200.0003	0.0004	0.00029	2.00

The End of Certificate



## BSC Certification Test Report

Page 1 of 6

**Certificate No. :** M01075/22

**Customer Name :** LABORATORY WATER ANALYSIS CENTER COMPANY LIMITED

**Customer Address :** 1/94 Moo 5 T.Kanharm, A.U-Thai,  
Phra Nakhon Si Ayutthaya 13210

**Equipment :** Biological Safety Cabinet **Class** II **Type** A2

**Manufacturer :** Microtech

**Model :** V6-T

**Serial No. :** 0972

**ID No. :** WWL0084

**Were in accordance with** ☒ EN 12469 ☐ NSF 49 ☐ Manufacturer's specification

**Test Date :** 23/09/2022

**Due Date :** 23/09/2023 **or after HEPA filters are replaced or unit is moved**

**Test by :** Mr. Piyapong Pusua

**Approved by :**

**Issued Date :** 26/09/2022  
Authorized Signatory

This calibration certificate documents the traceability to national standards, which realize the unit of measurement according to the International System of Units (SI).

This certificate may not be reproduced other than in full except with the prior written approval of the Megafil Company Limited.

Page 2 of 6

**Certificate No. :** M01075/22

**Procedure Used :**

- : European Standard EN12469 : 2000 has the status of British Standard, Biotechnology Performance criteria for microbiological safety cabinets.
- : NSF International Standard / American National Standard NSF / ANSI 49-2008 Biosafety Cabinet : Design, Construction, Performance and Field Certification.
- : Australian Standard : AS 1807.23-2000 Determination of intensity of radiation from germicidal ultraviolet lamps.
- : Manufacturer's specification.

### 1. Downflow velocity test.

#### Measurement Information

No. of Rows	No. of Readings	Grid Spacing Front-Back	Grid Spacing Side-Side	Probe height
2	8	1/4,3/4	1/8,3/8	Above sash 100mm

#### Measurement Data.

0.36	0.42	0.43	0.41
0.40	0.34	0.34	0.33

**Average velocity** 0.38 m/s ( 75 FPM.) **Velocity range** 0.25-0.50 m/s ( 49-98 FPM.)

**Uniformity( EN: +/-20%avg.)** 0.30 - 0.46 m/s ( 60 - 90 FPM.)

**Supply filter dimension** 24 x 72 (inch x inch) **Supply filter area** 10.69 SQ.FT

**Downflow volume (Q)** 802 CFM.

**Result Summary** ☒ Pass ☐ Fail

**Equipment used :** Thermo Anemometer **Model** 425 **S/N** : 02623979 **Calibration date :** 14/07/2022

Certificate No. : M01075/22

## 2. Inflow velocity test.

Select method. : ☐ DIM ☒ Exhaust velocity. ☐ MFG's Specifications

0.53	0.47	0.48	0.50	0.51
0.57	0.46	0.52	0.53	0.50
0.54	0.57	0.55	0.52	0.53
0.53	0.51	0.57	0.54	0.51
0.51	0.48	0.53	0.55	0.56

Average Inflow velocity 0.44 m/s (86 FPM.) Velocity range  $\geq 0.40$  m/s (  $\geq 79$  FPM.)

Inflow dimension 8 x 72 (inch x inch) Inflow area 4.00 SQ.FT

Inflow volume(Q) 344 CFM

Result Summary ☒ Pass ☐ Fail

Adjustments Required ☐ Fan Speed ☐ Damper

Equipment used : Thermo Anemometer Model 425 S/N : 02623979 Calibration date : 14/07/2022

## 3. HEPA filter leak test.

Measurement Data

HEPA Filter	PAO Upstream Conc.(calculated)	Specification	Measured leak penetration
Supply HEPA Filter	18 $\mu\text{g/L}$	<0.003%	<0.003%
Exhaust HEPA Filter	18 $\mu\text{g/L}$	<0.003%	<0.003%

Certificate No. : M01075/22

## Leak location

Supply HEPA Filter

Back



Exhaust HEPA Filter

Back



Result Summary ☒ Pass ☐ Fail

Equipment used : Aerosol Photometer Model 21 S/N : 26468 Calibration date 14/07/2022

Equipment used : Smoke Generator Model TDA-6D S/N : 26530

## 4. Airflow smoke patterns test

Measurement Information

- Downflow Pattern test : Smoke shall be passed from one end of the cabinet to the other, along the centerline of the work surface, at a height of 4 inch (10 cm) above the top of the access opening
- View screen retention test : Smoke shall be passed from one end of the cabinet to the other, 1.0 in (2.5 cm) behind the view screen, at a height 6.0 inch (15 cm) above the top of the access opening.
- Work opening edge retention test : Smoke shall be passed along the entire perimeter of the work opening  
Particular attention should be paid to corners and vertical edges.
- Sash/window seal test : Smoke shall be passed up the inside of the window 2 in (5 cm) from the sides and along the top of the work area.

Certificate No. : M01075/22

**Result Summary**

Downflow Pattern test	<input checked="" type="checkbox"/> Accept	<input type="checkbox"/> Non-Conforming
View screen retention test	<input checked="" type="checkbox"/> Accept	<input type="checkbox"/> Non-Conforming
Work opening edge retention test	<input checked="" type="checkbox"/> Accept	<input type="checkbox"/> Non-Conforming
Sash/window seal test	<input checked="" type="checkbox"/> Accept	<input type="checkbox"/> Non-Conforming

**5. Site installation**

Sash Alarm.	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input checked="" type="checkbox"/> N/A
Interlock System.	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input checked="" type="checkbox"/> N/A
Exhaust System Performance	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail	<input checked="" type="checkbox"/> N/A

**Remark / Recommendation**

ระบบ Site installation ไม่มีการตรวจสอบ เนื่องจากตู้ไม่มีฟังก์ชันนี้

**6. Illumination Test (Lighting) : Option**

Lighting should be adequate for safe working within the cabinet. Illumination measured at the work surface.

Lux

620	965	938	561
867	1446	1492	768

**Remark :**

Certificate No. : M01075/22

**7. Ultraviolet Lamp Test (UV) : Option**

Ultraviolet radiation where UV Lamp are fitted, the intensity of radiation at a wavelength of 254 nm. Shall be not less than 400 mW/m<sup>2</sup> when measures at work floor surface.

mW/m<sup>2</sup>

720	1510	1540	760
470	980	990	450

**Remark :**

-o0o-

## เอกสารสอบเทียบเครื่องมือตรวจวัดปล่องเตาเผาขยะ



## CERTIFICATE OF CALIBRATION

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

Description of Equipment : Standard Probe Method 5

Manufacturer : Apex Instrument

Model Number : PS-4HV

Serial Number : 1801780

ID./Control No. : -

Environment Conditions

Temperature : (5 ± 2) °C

Humidity : (50 ± 15) % RH

Cal. Date : 17/1/2022

Issue Date : 17/1/2022

### Calibration Method or Calibration Procedure Used

US EPA Method (United State Environmental Protection Agency)

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

### Result of Calibration

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

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

Calibrated by : [Redacted]

Approved by : [Redacted]

Technical Manager



## CALIBRATION RESULTS

### S-Type Geometric Pitot Tube Calibration

Sampling System Equipment Information Calibration Condition

Probe Model : PS-4HV Date : 17 November 2022  
Probe Number : 1801780 Barometric Pressure : 755.24 mm Hg  
Pitot Number : - Digital Caliper : CD 3" ASX  
Pitot Tube Type : S-type Serial number : A18008059

Pitot tube/Probe: # PS-4HV			
Parameter	Value	Allowable Range	Check
Assembly level?	Yes	Yes	Pass
Port's Diameter?	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	-
$\phi$	0	N/A	-
Dt	0.372	.188" to .375"	Pass
A	0.925	$2.1D \leq A \leq 3D$	Pass
A/2Dt	1.243	$1.05 \leq A/D_t \leq 1.5$	Pass
Z = A tan $\gamma$	0.065	$Z \leq .125"$	Pass
W = A tan $\phi$	0.020	$W \leq .031"$	Pass

### Remark:

I certified that probe number: 1801780 not 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. : E22-11052  
Page : 3 of 3

### THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information	
Probe Model Number	PS-4HV
Probe Serial Number	1801780
Meter Box Model Number	JENCO 765 KF
Meter Box Serial Number	JC 18236

Calibration Conditions	
Date	17/11/2022
Time	06:30 PM
Calibration Reference No.	E22-11052
Reference Thermometer	DIGICON
Serial Number	183169105

Thermocouple of Standard Probe method 5 = length 6 foot			
Set Point	Reference Thermocouple	Probe Thermocouple	Difference
100	100.0	96.5	0.54
250	250.0	249.0	0.19
300	300.0	298.0	0.35
350	350.0	349.0	0.16



Enviro Equipment Service Co., Ltd.  
110254 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. : E22-11051  
Page : 1 of 6

### CERTIFICATE OF CALIBRATION

Customer : S.P.J. Scientific Co., Ltd.  
Address : 80 Soi Nakkeera Lamthong 3, Thap Chang, Saphanooing, Bangkok 10250  
Description of Equipment : Console meter  
Manufacturer : Apex Instrument  
Model Number : XC-572-V  
Serial Number : A2107584  
ID./Control No. : -  
Environment Conditions : Temperature (25 ± 2) °C  
Humidity (50 ± 15) % RH  
Cal. Date : 17/11/2022  
Issue Date : 17/11/2022

#### Calibration Method or Calibration Procedure Used

US EPA Method (Unit of State Environmental Protection Agency)

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

#### Result of Calibration

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

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

Calibrated by : [Redacted]

Approved by : [Redacted]

Technical Manager





Certificate No. : E22-11051  
 Page : 2 of 6

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

Meter Console Information				Calibration Conditions				Factors/Conversions			
Console Model Number	XC-572-V			Date	Time	17/11/2022	01:50 AM	Std Temp	293	K	
Console Serial Number	A2107584			Calibration Reference No.		E22-11051		Std Press	760	mm Hg	
DGM Model Number	SK25EX			Barometric Pressure		755.24	mmHg	K <sub>i</sub>	0.386		
DGM Serial Number	00007532			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	Volume Initial	Volume 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> )	(V <sub>wf</sub> )	(V <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	m <sup>3</sup>	m <sup>3</sup>
12.95	13.0	1.9800	2.1200	29	29	102.47298	102.61438	29	29	102.47298	102.61438
12.97	13.0	2.1200	2.2600	29	29	102.61438	102.75546	28	28	102.75546	102.89654
8.67	26.0	2.2690	2.4090	29	29	102.77152	102.91152	28	28	102.91152	103.05118
8.35	26.0	2.4090	2.5490	29	29	102.91152	103.05118	28	28	103.05118	103.19182
13.97	40.0	2.5560	2.8360	30	30	103.05814	103.33780	27	27	103.33780	103.61436
13.87	40.0	2.8360	3.1160	30	30	103.33780	103.61436	26	26	103.61436	103.89682
10.58	70.0	3.1340	3.4140	31	31	103.63200	103.90824	26	26	103.90824	104.18512
10.53	70.0	3.4140	3.6940	31	31	103.90824	104.18512	26	26	104.18512	104.46732
9.32	90.0	3.7070	3.9870	32	32	104.19562	104.47312	26	26	104.47312	104.75020
9.30	90.0	3.9870	4.2670	32	32	104.47312	104.75020	26	26	104.75020	105.03268



Certificate No. : E22-11048  
 Page : 3 of 6

Meter Console Information				Calibration Conditions				Factors/Conversions			
Console Model Number	XC-572-V			Date	Time	17/11/2022	01:50 PM	Std Temp	293	K	
Console Serial Number	A2107584			Calibration Reference No.		E22-11051		Std Press	760	mm Hg	
DGM Model Number	SK25EX			Barometric Pressure		755.24	mmHg	K <sub>i</sub>	0.386		
DGM Serial Number	00007532			Calibration Meter Gamma		0.999		Console Leak Check			
								PASS			

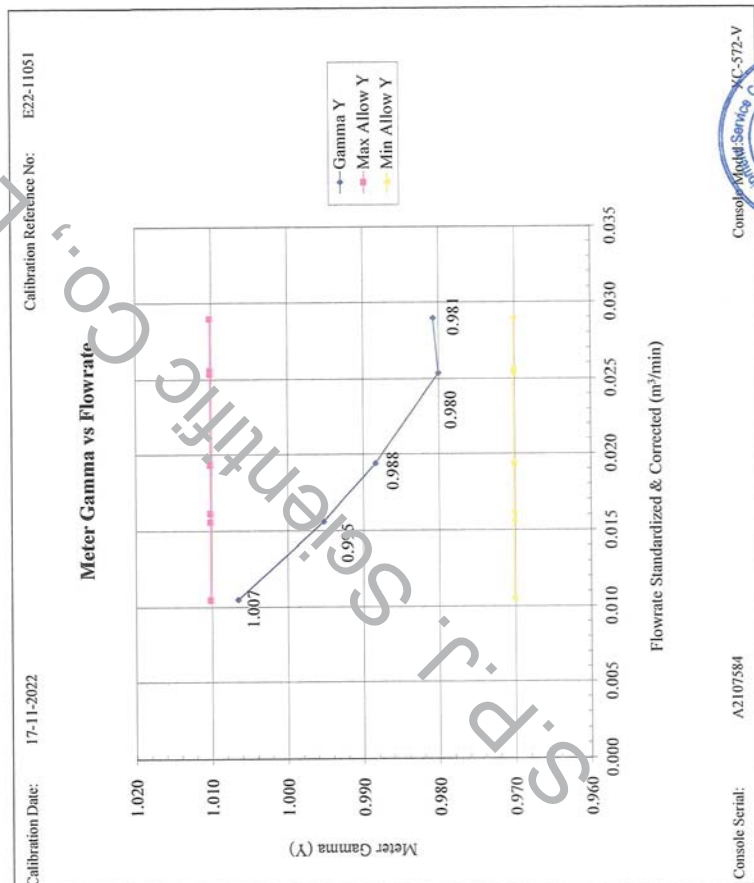
Calibration Data											
Standardized Data						Dry Gas Meter					
Dry Gas Meter (V <sub>mf</sub> )	Dry Gas Meter (Q <sub>mf</sub> )	Calibration Meter (V <sub>wf</sub> )	Calibration Meter (Q <sub>wf</sub> )	Calibration Factor Value (Y)	Calibration Factor Variation (ΔY)	Std & Corr (Q <sub>mf</sub> )	Std & Corr (Q <sub>wf</sub> )	Variation (ΔH <sub>mf</sub> )	Variation (ΔH <sub>wf</sub> )	Variation (ΔH <sub>mf</sub> )	Variation (ΔH <sub>wf</sub> )
m <sup>3</sup>	m <sup>3</sup> /min	m <sup>3</sup>	m <sup>3</sup> /min	(Y)	(ΔY)	m <sup>3</sup> /min	m <sup>3</sup> /min	mm H <sub>2</sub> O	mm H <sub>2</sub> O	mm H <sub>2</sub> O	mm H <sub>2</sub> O
0.135	0.010	0.136	0.011	1.008	0.007	0.011	0.011	51.228	51.228	3.351	3.351
0.136	0.010	0.136	0.011	1.008	0.015	0.011	0.011	51.423	51.423	3.545	3.545
0.136	0.016	0.135	0.016	0.994	0.006	0.016	0.016	46.774	46.774	-1.104	-1.104
0.136	0.016	0.135	0.016	0.994	0.004	0.016	0.016	43.630	43.630	-4.248	-4.248
0.273	0.020	0.271	0.020	0.994	0.004	0.020	0.020	46.806	46.806	-1.072	-1.072
0.273	0.020	0.268	0.019	0.983	-0.007	0.019	0.019	47.178	47.178	-0.699	-0.699
0.275	0.026	0.269	0.025	0.979	-0.011	0.025	0.025	48.324	48.324	0.446	0.446
0.275	0.026	0.269	0.026	0.981	-0.009	0.026	0.026	47.647	47.647	-0.231	-0.231
0.275	0.030	0.270	0.029	0.981	-0.009	0.029	0.029	47.897	47.897	0.019	0.019
0.275	0.030	0.270	0.029	0.980	-0.010	0.029	0.029	47.871	47.871	-0.007	-0.007
						Y Average					
						47.878					

**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>mf</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) H<sub>2</sub>O.



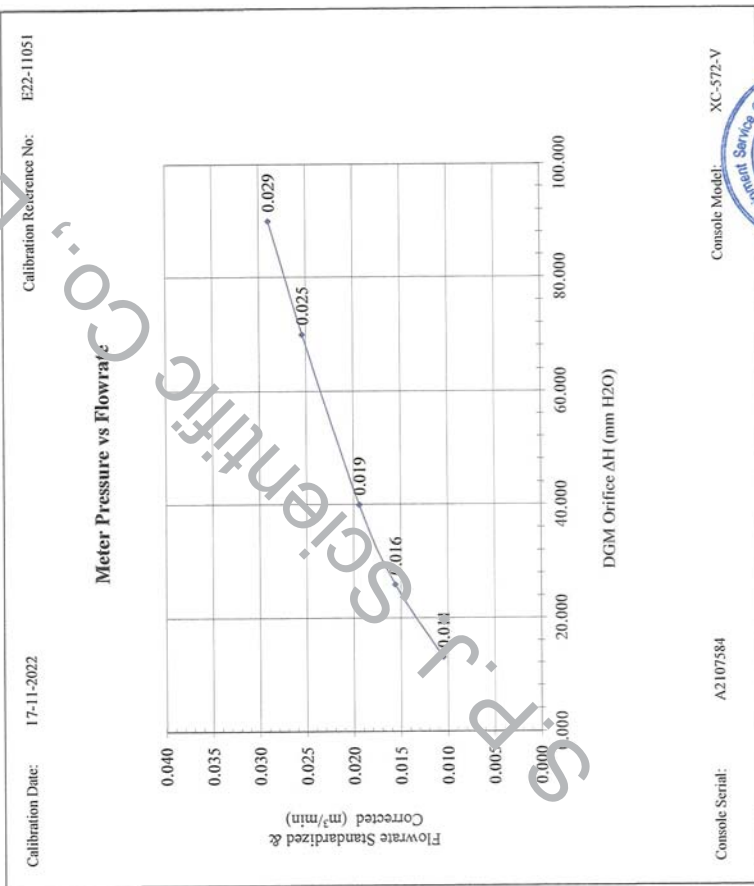
Certificate No. : E22-11048  
Page : 4 of 6

Meter Console Information			Calibration Conditions			Factors/Conversions		
Console Model Number	XC-572-V		Date	Time	17/11/2022	01:50 PM	Std Temp	293 K
Console Serial Number	A2107584		Calibration Reference No.		E22-11051		Std Press	760 mm Hg
DGM Model Number	SK25EX		Barometric Pressure		755.24	mmHg	K <sub>1</sub>	0.386
DGM Serial Number	00007532		Calibration Meter Gamma		0.999		Console Lead Check	PASS



Certificate No. : E22-11048  
Page : 5 of 6

Meter Console Information			Calibration Conditions			Factors/Conversions		
Console Model Number	XC-572-V		Date	Time	17/11/2022	01:50 PM	Std Temp	293 K
Console Serial Number	A2107584		Calibration Reference No.		E22-11051		Std Press	760 mm Hg
DGM Model Number	SK25EX		Barometric Pressure		755.24	mmHg	K <sub>1</sub>	0.386
DGM Serial Number	00007532		Calibration Meter Gamma		0.999		Console Lead Check	PASS





Certificate No. : E22-11048  
Page : 6 of 6

Enviro Equipment Service Co., Ltd.  
110254 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

# THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information		Calibration Conditions	
Console Model Number	XC-572-V	Date	17/11/2022
Console Serial Number	A2107534	Time	05:15 PM
DCM Model Number	SK25EX	Calibration Reference No.	E22-11051
DCM Serial Number	00007532	Reference Thermometer	DIGICON
Meter Box Model Number	JENCO 765 KF	Serial Number	18-169105
Meter Box Serial Number	JC 18236		

Results									
Console Thermocouple Simulator									
Channel and test point		Meter Box Channel Temperature Reading (°C)							
Stack	-18.0	25.0	38.0	93.0	149.0	160.0	371.0	482.0	593.0
	-18.0	24.0	37.0	92.0	149.0	157.0	369.0	480.0	591.0
Aux	-18.0	24.0	37.0	92.0	149.0	157.0	369.0	480.0	591.0
	-18.0	24.0	37.0	92.0	149.0	157.0	369.0	480.0	591.0
Probe	-18.0	24.0	37.0	92.0	149.0	157.0	369.0	480.0	591.0
	-18.0	24.0	37.0	92.0	149.0	157.0	369.0	480.0	591.0
Oven	-18.0	24.0	37.0	92.0	149.0	157.0	369.0	480.0	591.0
	-18.0	24.0	37.0	92.0	149.0	157.0	369.0	480.0	591.0
Filter	-18.0	24.0	37.0	92.0	149.0	157.0	369.0	480.0	591.0
	-18.0	24.0	37.0	92.0	149.0	157.0	369.0	480.0	591.0
Exit	-18.0	24.0	37.0	92.0	149.0	157.0	369.0	480.0	591.0
	-18.0	24.0	37.0	92.0	149.0	157.0	369.0	480.0	591.0

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



Certificate No. : E22-11053  
Page : 1 of 2

# CERTIFICATE OF CALIBRATION

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

Description of Equipment : Nozzle  
Manufacturer : Apex Instrument  
Model Number : NS SET  
Serial Number : -  
ID./Control No. : -  
Environment Conditions : Temperature (25 ± 2) °C  
Humidity (50 ± 15) % RH  
Cal. Date : 17/ 1/2022  
Issue Date : 17/ 1/2022

## Calibration Method or Calibration Procedure Used

US EPA Method (Single State Environmental Protection Agency)

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

## Result of Calibration

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

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

Calibrated by : [Redacted] Approved by : [Redacted]

Technical Manager



## CALIBRATION RESULTS

### Sampling System Equipment Information

Nozzle Model : NS SET  
Nozzle Number : -  
Nozzle Type : Stainless Steel

### Calibration Condition

Date : 17 November 2022  
Barometric Pressure : 755.21 mm Hg  
Calibration Device : Vernier, 1.50 mm  
Method Reference : U.S. EPA Method

Nozzle ID	Nozzle Diameter			Different		(D1 + D2 + D3) / 3
Size	mm	D1	D2	D3	ΔD	Davg
NS-4	3.18	3.19	3.18	3.18	0.006	3.183
NS-6	4.76	4.66	4.66	4.66	0.006	4.660
NS-8	6.35	6.20	6.20	6.20	0.000	6.200
NS-12	9.53	9.58	9.57	9.57	0.006	9.573
NS-14	11.11	10.86	10.87	10.86	0.006	10.863
NS-16	12.70	12.62	12.63	12.61	0.010	12.620

### Remark:

D1, D2, D3 = Three different nozzle diameters, mm; diameter must be within 0.025 mm  
ΔD = 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. : 61946807  
ID no. or control no. : SPJ-FGA-02  
Manufacturer : Testo SE & Co. KGaA  
Probe description : -  
Probe model : -  
Probe serial : -  
Customer name : S. P. J. SCIENTIFIC CO., LTD.  
Customer address : 80 Soi Nakkhlaienthong 3, Thap Chang, Saphansong, Bangkok 10230

Total pages of certificate : 2 Pages  
Receiving no. : L-221004  
Receiving date. : 29-Mar-22  
Parameter of calibration : Gas Calibration (Oxygen 2,498, 10.00, 21.40 %vol, Carbon Monoxide 80.97, 309.9, 1003 ppm, Nitrogen Dioxide 80.62 ppm, Nitric Oxide 1.00 ppm, Sulphur Dioxide 100.9 ppm)

Condition of UUC. : Used  
Ambient condition : All of the Measurement were carried out the stabilized laboratory

Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210  
Temperature : 23.5 ± 0.5 °C  
Humidity : 55 ± 15 %RH

Calibration procedure no. : WI-020-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by coverage factor,  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%. This certificate is applied only to item under test Environmental condition.

This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificate does without signature and seal not valid.

The calibration certificate documents are traceability to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 30-Mar-22

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> ) 10.00 % Vol	2453/19	Linde	18-Jul-23
Oxygen ( O <sub>2</sub> ) 21.00 % Vol	2426/19	Linde	16-Jul-23
Carbon monoxide ( CO ) 80.97 ppm	2842/21	Linde	24-Jun-23
Carbon monoxide ( CO ) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide ( CO ) 1003 ppm	2829/21	Linde	23-Apr-23
Nitrogen Dioxide ( NO <sub>2</sub> ) 80.62 ppm	2340/21	Linde	25-Jul-23
Nitric Oxide ( NO ) 150.9 ppm	2857/21	Linde	27-Jun-23
Sulphur Dioxide ( SO <sub>2</sub> ) 100.9 ppm	4942/20	Linde	30-Nov-22

Measured room conditions

Temperature : 22.5 °C Humidity : 58.1 %RH Pressure : 1013.3 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,200 ml/min Gas pressure : 1024.3 mbar

Calibration Results Before Adjustment (Table 2)

Parameter of Standard	Standard Values		Mean of UUC	Error	Uncertainty (±)
	Values	UUC			
O <sub>2</sub> (%Vol)	2.498	0.02	0.02	0.022	0.20
O <sub>2</sub> (%Vol)	10.00	10.07	0.07	0.07	0.40
O <sub>2</sub> (%Vol)	21.00	21.12	0.12	0.12	0.80
CO (ppm)	80.97	69	-11.97	-11.97	2.8
CO (ppm)	309.9	266	-43.9	-43.9	11
CO (ppm)	1003	862	-141	-141	5.0
*NO <sub>2</sub> (ppm)	80.62	79.9	-0.72	-0.72	5.0
*NO (ppm)	150.9	149	-1.9	-1.9	5.0
*SO <sub>2</sub> (ppm)	100.9	99	-1.9	-1.9	5.0

Calibration Results After Adjustment (Table 3)

Parameter of Standard	Standard Values		Mean of UUC	Error	Uncertainty (±)
	Values	UUC			
O <sub>2</sub> (%Vol)	2.498	2.52	2.52	0.022	0.20
O <sub>2</sub> (%Vol)	10.00	10.07	10.07	0.07	0.40
O <sub>2</sub> (%Vol)	21.00	21.12	21.12	0.12	0.80
CO (ppm)	80.97	81	81	0.03	2.8
CO (ppm)	309.9	312	312	2.1	11
CO (ppm)	1003	1007	1007	4	34
*NO <sub>2</sub> (ppm)	80.62	79.9	79.9	-0.72	5.0
*NO (ppm)	150.9	149	149	-1.9	5.0
*SO <sub>2</sub> (ppm)	100.9	99	99	-1.9	5.0

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

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

End of Report

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



Accuracy Calibration Certificate

Customer

Company: S.P.J. SCIENTIFIC CO., LTD.  
Address: 80 Soi NuukKreelad.ernthong 3  
City: Saphansong  
Zip / Postal: 10240  
State / Province: Bangkok  
Order Number: 0033244411

Contact: Ratikan Sripak

Weighing Device

Manufacturer: Mettler Toledo  
Model: ME204T/00  
Serial No.: B950781446  
Building: N/A  
Floor: 1  
Room: BALANCE  
Weighing Instrument Type: SPJ-TE-039  
Asset Number: N/A  
Terminal Model: N/A  
Terminal Serial No.: N/A  
Terminal Asset No.: N/A

Range	Max. Capacity	Readability (g)
1	220 g	0.0001 g

Procedure

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

As Found	Temperature	Humidity
	Start: 23.2 °C End: 23.3 °C	Start: 57.9 % End: 60.1 %

As Found Calibration Date: 05-May-2022  
As Left Calibration Date: N/A  
Issue Date: 06-May-2022

Approved Signatory:



Technical Center



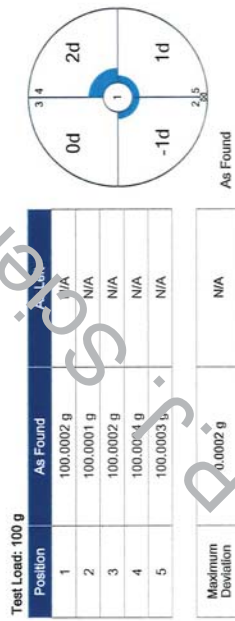
## Measurement Results

### Repeatability



The "1d" 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.

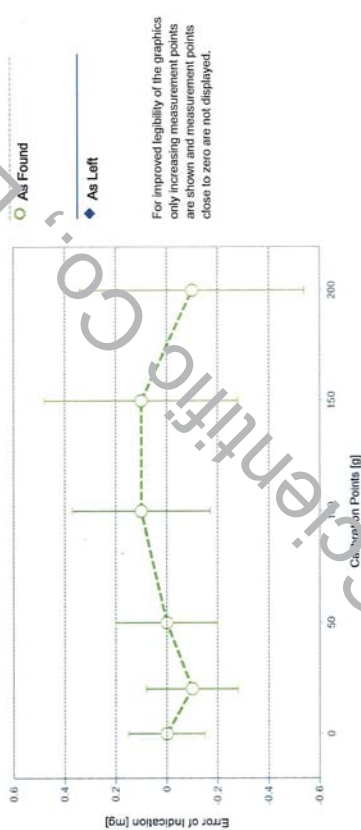
### Eccentricity



The "1d" 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	0.0000 g	0.0000 g	0.0000 g	0.15 mg	2
2	0.1000 g	0.1000 g	0.0000 g	0.16 mg	2
3	0.5000 g	0.5000 g	0.0000 g	0.16 mg	2
4	1.0000 g	1.0000 g	0.0000 g	0.16 mg	2
5	5.0000 g	5.0000 g	0.0000 g	0.16 mg	2
6	10.0000 g	10.0000 g	0.0000 g	0.17 mg	2
7	20.0000 g	19.9999 g	-0.0001 g	0.18 mg	2
8	50.0000 g	50.0000 g	0.0000 g	0.20 mg	2
9	100.0001 g	100.0002 g	0.0001 g	0.27 mg	2
10	150.0001 g	150.0002 g	0.0001 g	0.38 mg	2
11	200.0000 g	199.9999 g	-0.0001 g	0.44 mg	2



For improved legibility of the graphics only increasing measurement points are shown and measurement points close to zero are not displayed.

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 E2

Weight Set No.:	WS41	Date of Issue:	27-Jan-2021
Certificate Number:	171212	Calibration Due Date:	26-Jul-2022

### Thermo Hygrometer

Equipment No.:	IN159	Date of Issue:	09-Jul-2021
Certificate Number:	21H1471	Calibration Due Date:	28-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:  $2.0 \cdot 10^{-6} / K$

Temperature range on site for the evaluation of the measurement uncertainty in use:  $4 K$

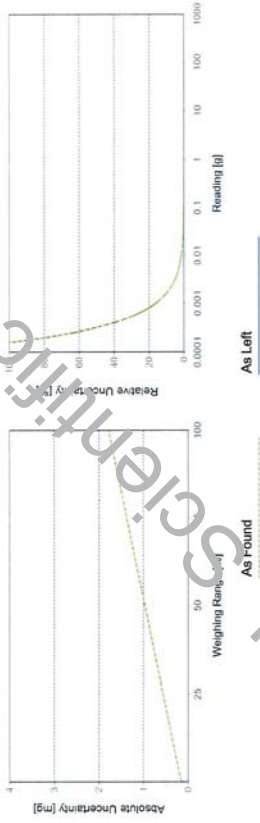
Linearization of Uncertainty Equation

	Range		As Found	As Left
	d	Max		
1	0.0001 g	220 g	$U_1 = 0.16 \text{ mg} + 0.00739 \text{ mg/g} \cdot R$	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
0.0220 g	0.16 mg	0.73%
0.2200 g	0.16 mg	0.073%
2.2000 g	0.18 mg	0.0080%
22.0000 g	0.32 mg	0.0015%
220.0000 g	1.8 mg	0.00081%



## Certificate of Calibration

Certificate No.: PTC/07/22285  
Page: 1 of 2  
Equipment: Digital Balance  
Condition: Normal  
Manufacturer: Mettler Toledo  
Serial No: B405267423  
Model: XP205  
Type of Balance: Single interval  
Customer: ECO CONSUL TANT CO.,LTD  
32-3-4, Moo.4 Tai Koh,  
Samkhon, Pathumthani 12160

Environment Condition: Temperature 22.3 °C ± 0.3 °C  
Humidity 50.0 %RH ± 2.0 %RH  
Air density 1.18 kg/m<sup>3</sup>

Calibration Place: ECO CONSUL TANT CO.,LTD ( ห้างเครื่องตั้ง )  
32-3-4, Moo.4 Tai Koh,  
Samkhon, Pathumthani 12160

The Method used: In house method, PTC-WI-07, base on Euramet cg. 18  
Traceability: This certificate is traceable to the SI Units through Thai Calibration Service Co.,Ltd.  
, NSC-ONSC Accreditation No.: Calibration 0189

Date Received: September 20, 2022  
Calibration Date: September 20, 2022  
Issued Date: September 23, 2022  
Calibration By: Mr. Keattisak Kerdto

Approved By :

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognised national standard laboratories.  
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The effect that the results relate only to the items calibrated.  
This calibration certificate shall not be reproduced except in full only, without written approval from penta calibration co., ltd



Certificate No.: PTC/07/22285

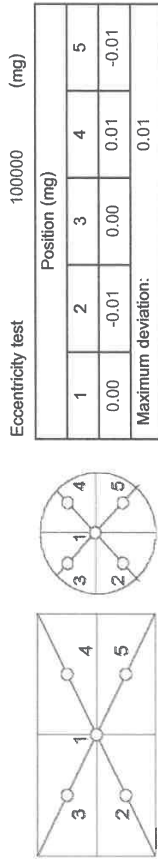
Page: 2 of 2

### Measurement Results:

Without Adjustment :

Function Calibration: Internal Calibration

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



Repeatability Test : Weight to be 1/2 ≤ L<sub>1</sub> ≤ Maximum capacity

Determination of the standard deviation of weighing balance., Readability 0.01 (mg)

Nominal test value (mg)	Standard Deviation
200000	0.004

Error of indication : from nominal value., Readability 0.01 (mg)

Nominal Value (mg)	Conventional Mass (mg)	Indication (mg)	Correction of Balance (mg)	Uncertainty (mg)	k
0	0.000	0.00	0.00	0.013	2.37
1	1.000	1.00	0.00	0.017	2.05
10	10.004	9.99	0.01	0.017	2.05
20	20.002	20.00	0.00	0.018	2.05
50	50.003	49.99	0.01	0.018	2.04
100	99.998	99.99	0.01	0.018	2.04
1000	999.995	1000.00	-0.01	0.021	2.00
50000	50000.012	50000.03	-0.02	0.070	2.00
100000	100000.039	100000.05	-0.01	0.11	2.00
150000	150000.051	150000.06	-0.01	0.18	2.00
200000	200000.010	200000.05	-0.04	0.21	2.00

Note: Weight of adjust - (mg)

The End of Certificate



Document Type	Calibration Certificate (CC)
Description	CC for 925 Eco IC
Document ID	CC.925.Version 1.1 / 8.925.3002EN

# Metrohm Compliance Service

## Calibration Certificate (CC) for 925 Eco IC

### Instrument details

Type:	19250020
Serial No.:	221565/ME (1925002002425)
Manufacturer:	Metrohm AG Ionenstrasse CH-9100 Herisau Switzerland
Firmware:	5.850.0113
Customer instrument ID:	N/A
System Designation Number:	CAL220486/ME

### Customer details

Name of company:	ECO CONSULTANT COMPANY LIMITED
Address:	32/3-4 หมู่ 4 ซ.พหลโยธิน อ.สามโคก จ.ปทุมธานี 12160
Department:	Laboratory
Responsible person:	K.Thitima
Calibration place:	Laboratory ECO CONSULTANT COMPANY LIMITED
Date and time of calibration:	05/07/2022 - 08:30



Document Type	Calibration Certificate (CC)
Description	CC for 925 Eco IC
Document ID	CC.925.Version 1.1 / 8.925.3002EN

## Calibration Certificate (CC)

### Introduction

The instrument stated above has been inspected in accordance with the corresponding test instructions of Metrohm Ltd. Servicing instructions are compiled and checked for correctness with account taken of the technical apparatus and ambient conditions available to the service engineer at the servicing location. This Calibration Certificate (CC) declares the results regarding calibration and operational status obtained when carrying out the test instructions referred to below.

### Calibration status

We certify that the instrument stated above meets or exceeds the electrical specifications at the points tested. Test equipment is calibrated and traceable back to national and/or international standards (ISO 17025, NIST).

### Operational status

We certify that the instrument stated above executes the instrument's specific functions tested except where detailed overleaf.

## Declaration

### Document

Test instructions used:	C.1 Test instructions for 925 Eco IC, Version 1.1
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### Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date
Multimeter	Fuke	88480190	EU1022184	25/05/2023
High pressure gauge	Melchm	05108	CAL0252-21Q0119	22/09/2022

### Protocol

	Yes	No
Instrument had to be repaired beforehand	<input type="checkbox"/>	<input checked="" type="checkbox"/>
If yes, see Calibration Certificate (CC) No.:		
Instrument had to be readjusted beforehand	<input type="checkbox"/>	<input checked="" type="checkbox"/>
If yes, see Calibration Certificate (CC) No.:		



Document Type	Calibration Certificate (CC)
Description	CC for 925 Eco IC
Document ID	CC.925 Version 1.1 / 8.925.3002EN



Document Type	Calibration Certificate (CC)
Description	CC for 925 Eco IC
Document ID	CC.925 Version 1.1 / 8.925.3002EN

Conclusion of test results

Instrument satisfies the specified technical requirements	Yes	No
Recommended date for next maintenance:	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Comments

Metrohm representative

Metrohm representative confirms correct execution of instrument calibration	Yes	No
Date	Name	Signature
05/07/2022	Mr.Prutchaya Kumpaiee	

Customer representative

Customer representative accepts results of instrument calibration	Yes	No
Date	Name	Signature
05/07/2022	K.Thitima	

Test results

No.	Title	Comments	Yes	No	Pass
100	Visual test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	N/A
101	Safety test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
102	LED		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
103	Fan		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
104	Communication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
105	Column plug interface		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title	Comments	Yes	No	Pass
106	IC pump		<input checked="" type="checkbox"/>	<input type="checkbox"/>	N/A
106.1	Installation		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
106.2	Pump head detection		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
106.3	Deareate		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
106.4	Pump dynamics		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



No.	Title	Comments	Yes	No	Pass
106.5 Pulsation					
		Maximum [MPa]	Difference [%]		
	Standard pump head	9.92	<5.0	<input type="checkbox"/>	<input type="checkbox"/>
	Macro pump head	N/A	<10.0	<input type="checkbox"/>	<input checked="" type="checkbox"/>
106.6 Pressure transducer					
		Nominal value [MPa]	Measured value [MPa]	Tolerance [%]	
		9.75	10	± 10.0	<input type="checkbox"/>
106.7 Flow rate					
		Nominal value [mL]	Measured value [mL]	Tolerance [mL]	
	Standard pump head	4.0	4.1	± 0.2	<input type="checkbox"/>
	Macro pump head	20.0	N/A	± 1.0	<input checked="" type="checkbox"/>
106.8 Shut off at minimum pressure			<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
106.9 Shut off at maximum pressure			<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
106.10 Leak test					
		Maximum [MPa]	Minimum [MPa]	Difference [MPa]	
		19.17	18.88	<1.0	<input type="checkbox"/>

## CC.925 Document history

Date	Version	Author	Description/Changes
14.12.2016	1.0	pr	Creation of document 8.925.3002EN
31.03.2021	1.1	pr	Test no. 103 Fan depends on the installed power supply version according C.3 notice of modification CRM-28908.

End of CC Document



Document Type	Calibration Certificate (CC)
Description	CC for 850.9010 Conductivity Detector
Document ID	CC.850.Version 1.3 / 8.850.3022EN

# Metrohm Compliance Service

## Calibration Certificate (CC) for 850.9010 Conductivity Detector

### Instrument details

Type:	18509010
Serial No.:	221566 (1850901053300)
Manufacturer:	Metrohm AG, Ionenstrasse, CH-9100 Herisau
	Switzerland
Customer instrument ID:	N/A
System Designation Number:	CAL220486/ME

### Control device details

Type:	1.925.0020
Serial No.:	1925002002425
Firmware:	5.850.0113

### Customer details

Name of company:	ECO CONSULTANT COMPANY LIMITED
Address:	32/3-4 หมู่4 ต.สีหราช อ.เสนาใหม่ จ.หนองบัว 12160
Department:	Laboratory
Responsible person:	K.Thitima
Calibration place:	Laboratory ECO CONSULTANT COMPANY LIMITED
Date and time of calibration:	05/07/2022 - 08:30

System Designation Number: **CAL220486/ME**  
Calibration Certificate (CC) No.: 221566 (1850901053300) - 05/07/2022 - 08:30



Document Type	Calibration Certificate (CC)
Description	CC for 850.9010 Conductivity Detector
Document ID	CC.850.Version 1.3 / 8.850.3022EN

## Calibration Certificate (CC)

### Introduction

The instrument stated above has been inspected in accordance with the corresponding test instructions of Metrohm Ltd. Servicing instructions are compiled and checked for correctness with account taken of the technical apparatus and ambient conditions available to the service engineer at the servicing location. This Calibration Certificate (CC) declares the results regarding calibration and operational status obtained when carrying out the test instructions referred to below.

### Calibration status

We certify that the instrument stated above meets or exceeds the electrical specifications at the points tested. Test equipment is calibrated and traceable back to national and/or international standards (ISO 17025, NIST).

### Operational status

We certify that the instrument stated above executes the instrument's specific functions tested except where detailed overleaf.

## Declaration

### Document

Test instructions used: C.1 Test instructions for 850.9010 Conductivity Detector, Version 1.3

### Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date
Temperature meas. Instr.	Fuke	82080101	TMU221923	10/06/2023
Conductivity standard (opt.)	Mettlhm	26590115	12-0488	12/02/2023

### Protocol

	Yes	No
Instrument had to be repaired beforehand	<input type="checkbox"/>	<input checked="" type="checkbox"/>
If yes, see Calibration Certificate (CC) No.:		
Instrument had to be readjusted beforehand	<input type="checkbox"/>	<input checked="" type="checkbox"/>
If yes, see Calibration Certificate (CC) No.:		

System Designation Number: **CAL220486/ME**  
Calibration Certificate (CC) No.: 221566 (1850901053300) - 05/07/2022 - 08:30



Document Type	Calibration Certificate (CC)
Description	CC for 850.9010 Conductivity Detector
Document ID	CC.850.3022EN



Document Type	Calibration Certificate (CC)
Description	CC for 850.9010 Conductivity Detector
Document ID	CC.850.3022EN

#### Conclusion of test results

Instrument satisfies the specified technical requirements	Yes	No
Recommended date for next maintenance:	<input checked="" type="checkbox"/>	<input type="checkbox"/>

#### Comments


#### Metrohm representative

Metrohm representative confirms correct execution of instrument calibration	Yes	No
Date	Name	Signature
05/07/2022	Mr.Prutchaya Kumpairee	

#### Customer representative

Customer representative accepts results of instrument calibration	Yes	No
Date	Name	Signature
05/07/2022	K.Thitima	

## Test results

No.	Title	Comments	Yes	No	Pass
100	Communication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title	Yes	No	N/A
101	Temperature absolute			
		Nominal value [°C]	Measured value [°C]	Tolerance [°C]
	Temperature 1	34.999	35.4	± 1.0
	Temperature 2	39.998	40.4	± 1.0

No.	Title	Yes	No	N/A
102	Temperature stability			
		Maximum t [°C]	Minimum t [°C]	Difference [°C]
		40.001	39.998	< 0.010

No.	Title	Yes	No	N/A
103	Signal noise			
		Drift compensated [nS/cm]	Tolerance [nS/cm]	
	1 M	0.196	< 0.4	<input type="checkbox"/>
	20 k 5	2.437	< 10.0	<input type="checkbox"/>

No.	Title	Comments	Yes	No	N/A
104	Conductivity dry test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



Document Type	Calibration Certificate (CC)
Description	CC for 850 9010 Conductivity Detector
Document ID	CC.850 Version 1.3 / 8.850.3022EN

No.	Title	Pass	
		Yes	No
105	Conductivity cell (optional)		
	System installation and preparation	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	105.1 Write a method	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	105.3 Measurement		
	Nominal value [µS/cm]	Measured value [µS/cm]	Tolerance [%]
	91.32	92.13	± 10
		<input checked="" type="checkbox"/>	<input type="checkbox"/>

## CC.850 Document history

Date	Article No.	Author	Description/Changes
26.04.2012	8.850.3022EN	Philipp Ruegg	Layout adapted to Metrohm Compliance Service
End of CC Document			



Document Type	Calibration Certificate (CC)
Description	CC for 863 Compact Autosampler
Document ID	CC.863 Version 1.0 / 8.863.3003EN

# Metrohm Compliance Service

## Calibration Certificate (CC) for 863 Compact Autosampler

Instrument details	
Type:	18630010
Serial No.:	221567/ME (1863001038117)
Manufacturer:	Metrohm AG Ionenstrasse CH-9100 Herisau Switzerland
Firmware:	5.863.0022
Customer instrument ID:	N/A
System Designation Number:	CAL220486/ME
Customer details	
Name of company:	ECO CONSULTANT COMPANY LIMITED
Address:	32/3-4 m/4 อาคารพาณิชย์ 12160
Department:	Laboratory
Responsible person:	K. Thilima
Calibration place:	Laboratory ECO CONSULTANT COMPANY LIMITED
Date and time of calibration:	
05/07/2022 - 11:40	





Document Type	Calibration Certificate (CC)
Description	CC for 863 Compact Autosampler
Document ID	CC.863 Version 1.0 / 8.863.3003EN

## Conclusion of food results

### Calibration status

**Operational status**  
We certify that the instrument stated above  
executes the instrument's specific functions tested  
except where detailed overleaf.

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Metrohm representative confirms correct execution of instrument calibration		<input checked="" type="checkbox"/>	<input type="checkbox"/>
Date	Name	Signature	
05/07/2022	Mr. Prutchaya Kumpailee		

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Date	Name	Signature
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Document Type	Calibration Certificate (CC)
Description	CC for 863 Compact Autosampler
Document ID	CC.863 Version 1.0 / 8.863.3003EN

### Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Visual check		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101	Safety check		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
102	Getting started (system self test)		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
103	Serial number, date and time check		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
104	Prepare the instrument for diagnosis		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
105	Display test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
106	Keyboard test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
107	Prepare the instrument for service		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
108	Contrast test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
109	Remote test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title	Comments	Pass		
			Yes	No	N/A
110	RS bridge test (USB-RS232-bridge)				
	RS-232/1		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	RS-232/2		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



Document Type	Calibration Certificate (CC)
Description	CC for 863 Compact Autosampler
Document ID	CC.863 Version 1.0 / 8.863.3003EN

### Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
111	Table test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
112	Lift test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
113	Peristaltic pump test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
115	Test end		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

### CC.863 Document history

Date	Article No.	Author	Description/Changes
03.08.2011	8.863.3003EN	Giuseppe Conte	Layout adapted to Metrohm Compliance Service
End of CC document			

RECALIBRATION  
DUE DATE:  
**February 24, 2022**

# Certificate of Calibration

Calibration Certification Information			
Cal. Date:	February 24, 2021	Rootsmeier S/N: 438320	Ta: 294 °K
Operator:	Jim Tisch		Pa: 745.2 mm Hg
Calibration Model #:	TE-5025A	Calibrator S/N: 3650	

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3890	3.2	2.00
2	3	4	1	0.9870	6.4	4.00
3	5	6	1	0.8810	8.0	5.00
4	7	8	1	0.8440	8.8	5.50
5	9	10	1	0.6960	12.9	8.00

Data Tabulation			
Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left( \frac{P_a}{P_{std}} \right) \left( \frac{T_{std}}{T_a} \right)}$ (y-axis)	Qa (x-axis)
0.9896	0.7125	1.4099	0.9957
0.9854	0.9984	1.9939	0.9914
0.9832	1.1161	2.2293	0.9893
0.9822	1.1637	2.3381	0.9882
0.9767	1.4033	2.8198	0.9827
<b>QSTD</b>	<b>m= 2.04249</b> <b>b= -0.04523</b> <b>r= 0.99997</b>	<b>QA</b>	<b>m= 1.27897</b> <b>b= -0.02850</b> <b>r= 0.99997</b>

Calculations	
Vstd= $\Delta \text{Vol}((P_a - \Delta P)/P_{std})(T_{std}/T_a)$	Va= $\Delta \text{Vol}((P_a - \Delta P)/P_a)$
Qstd= Vstd/ΔTime	Qa= Va/ΔTime
For subsequent flow rate calculations:	
Qstd= $1/m \left( \sqrt{\Delta H \left( \frac{P_a}{P_{std}} \right) \left( \frac{T_{std}}{T_a} \right)} - b \right)$	Qa= $1/m \left( \sqrt{\Delta H \left( \frac{T_a}{P_a} \right)} - b \right)$

Standard Conditions	
Tstd:	298.15 °K
Pstd:	760 mm Hg
Key	
ΔH:	calibrator manometer reading (in H2O)
ΔP:	rootsmeier 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, § 2.17, page 30