



Certificate of Calibration



Certificate No.:	PTC/04/21151	Page:	1 of 3
Equipment:	Cooled Incubator	Condition:	Normal
Manufacturer:	Lovibond	Serial No. :	1014/0000026
Model:	I255s	ID No. :	07.57.02.0001/49
Ventilation Valve:	None	Shelves(pc.):	2

Customer: Faculty of Science and Technologys,
Suansunandha Rajabhat University
1 U-Thong nok Road, Dusit, Bangkok 10300 Thailand

Environment Condition:	Temperature:	31.4	°C	±	0.4	°C
	Humidity:	65.7	%RH	±	3.2	%RH
	Voltage:	230.1	VAC	±	5.1	VAC

Calibration Place: Faculty of Science and Technologys,
Suansunandha Rajabhat University
(Storage room for tools and equipment)
1 U-Thong nok Road, Dusit, Bangkok 10300 Thailand

The Method used: In house method, PTC-WI-04, base on TLAS-G20

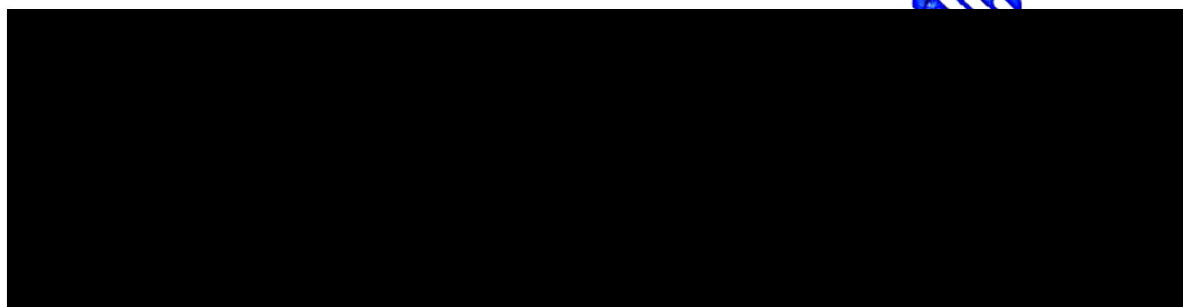
Traceability: This certificate is traceable to the SI Units through Quality Reborn Co.,Ltd ,
NSC-ONSC Accreditation No.: Calibration 0292

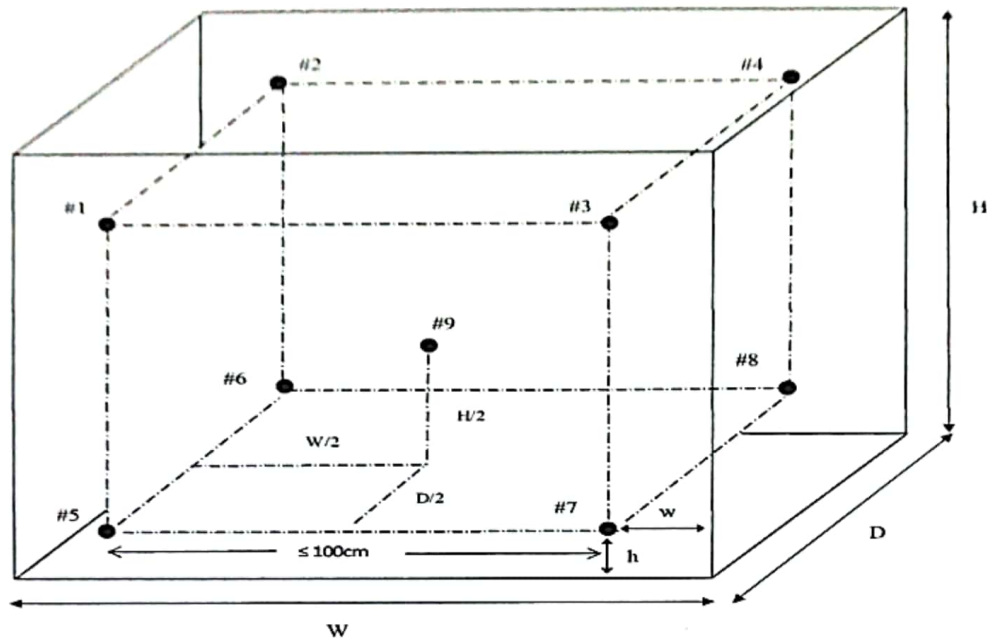
Date Received: August 4, 2021

Date Calibrated: August 4, 2021

Date Issued: August 10, 2021

Calibrated By: Mr. Rungroje Metakul





Standard Installation Position:

Volume (Working Area)= 95 (Liters)

Inside chamber: W = 50 (cm) D = 47 (cm) H = 145 (cm)

Standard Positions (#1, #2, #3, #4): w = 5 (cm) d = 5 (cm) h = 48 (cm)

Standard Positions (#5, #6, #7, #8): w = 5 (cm) d = 5 (cm) h = 33 (cm)

Standard Positions (#9): Geometric center of the chamber (Referent point)

Module	2								
Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Probe No.	1	2	3	4	5	6	7	8	9

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.

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Certificate No.: PTC/04/21151

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Without adjustment

Temperature Distribution: Calibration point 20.0 (°C)

Measurement Temperature (°C) @ Probe No.					
UUC Setting (°C)	UUC Reading (°C)	Probe No.	Standard Reading (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
20.0	-	#1	19.98	-0.02	2.3
		#2	19.92	-0.08	2.5
		#3	19.80	-0.20	2.3
		#4	19.75	-0.25	2.7
		#5	20.05	0.05	2.0
		#6	19.87	-0.13	2.2
		#7	20.15	0.15	1.7
		#8	20.01	0.01	1.9
		#9	20.00	0.00	1.8

Chamber Characterization

Calibration point (°C)	UUC Setting (°C)	UUC Reading (°C)	Measured Stability (± °C)	Measured Uniformity (°C)	Overall Variation (°C)
20.0	20.0	-	2.28	1.57	4.61

Note: UUC = Unit Under Calibration

Definitions

UUC Reading : The average reading of indicating device which forms the integral part of the enclosure.

Standard Reading : The average reading of standards at any positions or location.

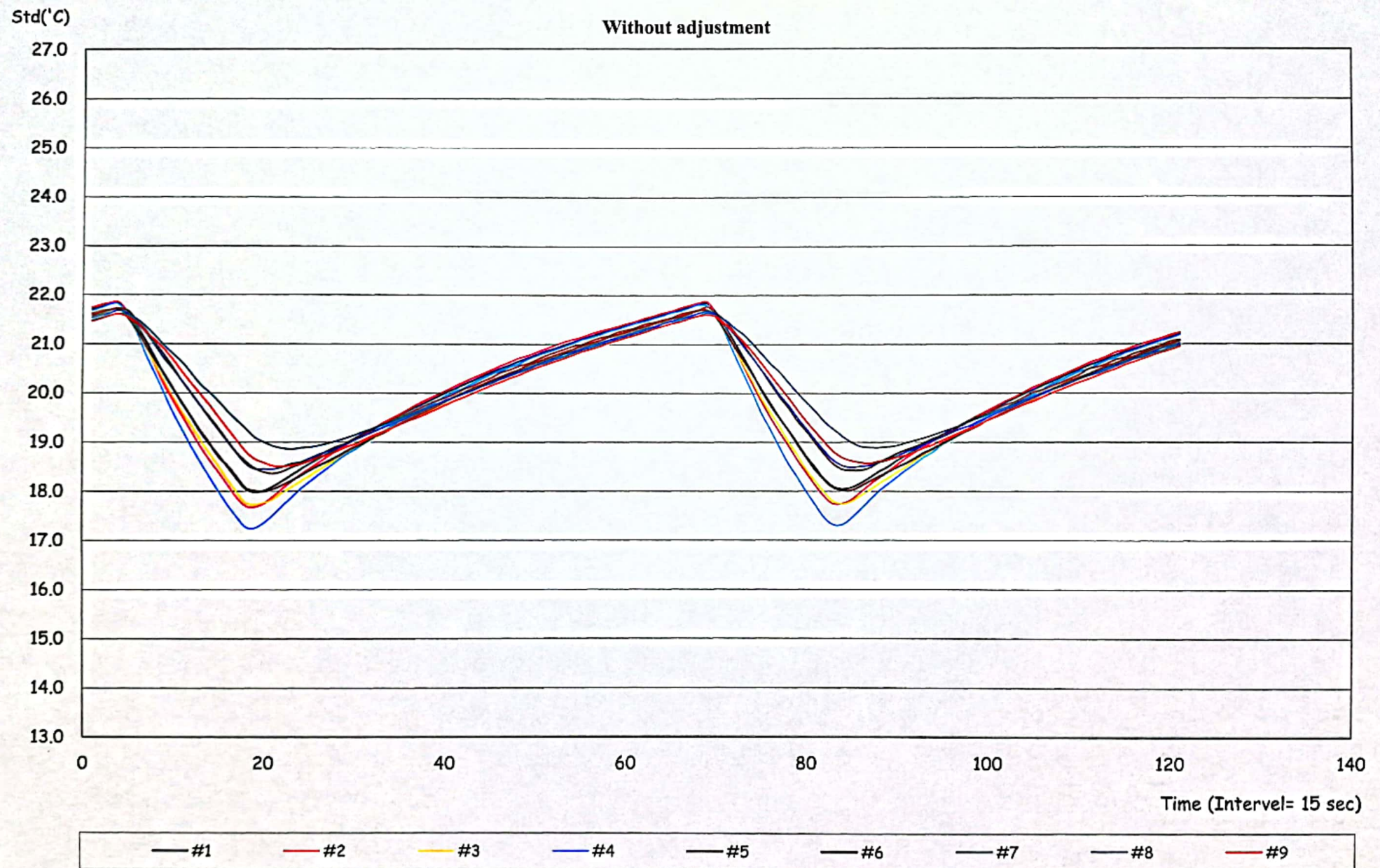
Measured Uniformity : The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the chamber at steady-state. The reference probe is preferably located in the geometric center of the chamber.

Measured Stability : The one-half of greatest maximum difference of measured temperatures at any one probe.

Overall Variation : The difference of maximum and minimum measured temperatures throughout observation time.

The End of Certificate

Temperature Distribution
Certificate No. PTC/04/21151
Without adjustment





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CERTIFICATE OF CALIBRATION

Certificate No. : 22-118-002

Work Order No. : 22/118

Issue Date : 28 January 2022

Customer Name : Faculty of Science and Technology
Suan Sunandha Rajabhat University
1 U-Thong nok Road, Dusit, Bangkok 10300.Thailand

Date of Received : 28 January 2022

Date of Calibration : 28 January 2022

Instrument Details : Description : Electronic Balance
Manufacturer : OHAUS
Model : PX5202
Serial No. : C146971338
ID No. : N/A
Resolution : 0.01 g
Capacity : 5200 g
Location : Science Center Laboratory

Calibration Method : This calibration was conducted by using in-house method according to calibration procedure no. CWI-B-01 based on UKAS LAB14 edition 6, October 2019

Environmental Condition

Temperature : Maximum 26.8°C / Minimum 26.7°C
Humidity : Maximum 59%R.H. / Minimum 57%R.H.
Air Pressure : Maximum 1013hPa / Minimum 1013hPa

Traceability of Measurement

: This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of

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CERTIFICATE OF CALIBRATION

Certificate No. : 22-118-002

Issue Date : 28 January 2022

Work Order No. : 22/118

Details of Calibration

1. Reference Standards Instrument

Instrument	Capacity of Weight	Serial No. / ID No.	Certificate No.	Due date
Weight Class F1	1mg to 5kg	30402687	21-828-001 / 21-075774	12 September 2022

2. Certificate traceable : This certificate traceable to The International System of Unit (SI Unit)

3. Condition of item : New

4. Calibration site : On-site

Result of Calibration

1. Calibration result : Check performance before calibration

Applied Weight g	Balance Reading g	Correction Value g	Uncertainty (±) g	Coverage Factor (k)
2500.00	2499.98	0.02	0.014	2.00
5000.00	4999.94	0.06	0.019	2.00

2. The result of check performance in first step has to Reset span

3. Calibration result : After set span by Internal Calibration

3.1 Repeatability number of repeatability is 10 times

Norminal Value (g)	Standard Deviation of Reading (g)
2500	0.00000
5000	0.00000

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

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



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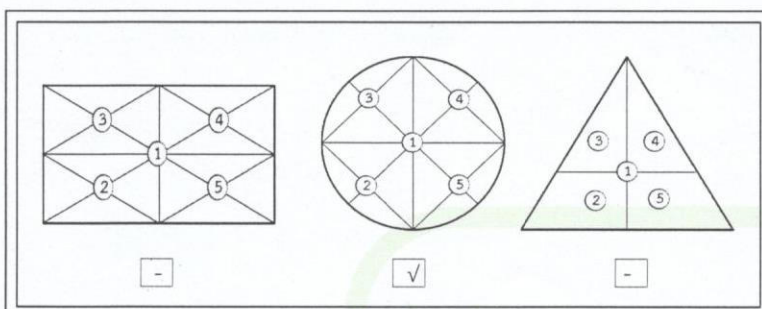
Certificate No. : 22-118-002

Issue Date : 28 January 2022

Work Order No. : 22/118

3. Calibration result : After set span by Internal Calibration (continued)

3.2 Eccentric or Off-center Error A mass of 2000 g was placed and moved to various position on pan.



Result of Eccentric Error		
Position 1	2000.00	g
Position 2	2000.01	g
Position 3	2000.00	g
Position 4	2000.00	g
Position 5	2000.00	g
(Maximum Difference)	0.01	g

3.3 Departure of indication from nominal value

Applied Weight g	Balance Reading g	Correction Value g	Uncertainty (\pm) g	Coverage Factor (k)
Unload	0.00	0.00	0.0082	2.00
1.00	1.00	0.00	0.0082	2.00
100.00	100.00	0.00	0.0082	2.00
500.00	500.00	0.00	0.0083	2.00
1000.00	1000.00	0.00	0.0087	2.00
1500.00	1500.00	0.00	0.0087	2.00
2000.00	2000.00	0.00	0.0087	2.00
2500.00	2500.00	0.00	0.014	2.00
3000.00	3000.00	0.00	0.014	2.00
3500.00	3500.00	0.00	0.014	2.00
4000.00	4000.00	0.00	0.014	2.00
4500.00	4500.01	-0.01	0.019	2.00
5000.00	5000.01	-0.01	0.019	2.00

Note

Calibrate items it good condition and this report customer request and accepted in certificate

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

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



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CERTIFICATE OF CALIBRATION

Certificate No. : 22-765-001

Issue Date : 10 June 2022

Work Order No. : 22/765

Customer Name : คณะวิทยาศาสตร์และเทคโนโลยี มหาวิทยาลัยราชภัฏสวนสุนันทา
เลขที่ 1 ถนนอุททองนอก แขวงวรชัยยบาล
เขตดุสิต กรุงเทพมหานคร 10300

Date of Received : 10 June 2022

Date of Calibration : 10 June 2022

Instrument Details : Description : Electronic Balance
Manufacturer : METTLER TOLEDO
Model : ME204
Serial No. : B534348442
ID No. : สส.07.14.02.0003/59
Resolution : 0.0001 g
Capacity : 220 g
Location : ห้อง 26311 อาคาร 26 คณะวิทยาศาสตร์และเทคโนโลยี

Calibration Method : This calibration was conducted by using in-house method according to calibration procedure no. CWI-B-01 based on UKAS LAB14 edition 6, October 2019

Environmental Condition

Temperature : Maximum 25.6°C / Minimum 24.7°C

Humidity : Maximum 62%R.H. / Minimum 60%R.H.

Air Pressure : Maximum 1002.9hPa / Minimum 1002.8hPa

Traceability of Measurement

: This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI)

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CERTIFICATE OF CALIBRATION

Certificate No. : 22-765-001

Issue Date : 10 June 2022

Work Order No. : 22/765

Details of Calibration

1. Reference Standards Instrument

Instrument	Capacity of Weight	Serial No. / ID No.	Certificate No.	Due date
Weight Set E2	1mg to 200g	B744909236	19-095084	10 November 2022

2. Certificate traceable : This certificate traceable to The International System of Unit refer to
Asia Medical and Agricultural Laboratory and Research center Co., Ltd. , NAC Calibration No.
0152

3. Condition of item : Used

4. Calibration site : On-site

Result of Calibration

1. Calibration result : Check performance before calibration

Applied Weight g	Balance Reading g	Correction Value g	Uncertainty (\pm) g	Coverage Factor (k)
100.0000	100.0000	0.0000	0.00017	2.00
200.0001	200.0000	0.0000	0.00030	2.00

2. The result of check performance in first step has to Reset span

3. Calibration result : After set span by Internal Calibration

3.1 Repeatability number of repeatability is 10 times

Norminal Value (g)	Standard Deviation of Reading (g)
100	0.0000422
200	0.0000422

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

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



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CERTIFICATE OF CALIBRATION

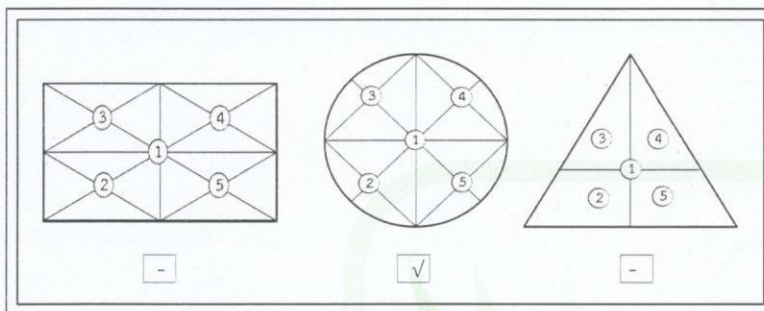
Certificate No. : 22-765-001

Issue Date : 10 June 2022

Work Order No. : 22/765

3. Calibration result : After set span by Internal Calibration (continued)

3.2 Eccentric or Off-center Error A mass of 100 g was placed and moved to various position on pan.



Result of Eccentric Error		
Position 1	100.0000	g
Position 2	100.0000	g
Position 3	100.0000	g
Position 4	100.0000	g
Position 5	100.0001	g
(Maximum Difference)	0.0001	g

3.3 Departure of indication from nominal value

Applied Weight g	Balance Reading g	Correction Value g	Uncertainty (±) g	Coverage Factor (k)
Unload	0.0000	0.0000	0.00010	2.00
0.1000	0.1000	0.0000	0.00010	2.00
0.5000	0.5000	0.0000	0.00010	2.00
1.0000	1.0000	0.0000	0.00010	2.00
2.0000	2.0000	0.0000	0.00010	2.00
3.0000	3.0000	0.0000	0.00010	2.00
4.0000	4.0000	0.0000	0.00010	2.00
5.0000	5.0000	0.0000	0.00010	2.00
10.0000	10.0000	0.0000	0.00010	2.00
50.0001	50.0000	0.0001	0.00012	2.00
100.0000	100.0000	0.0000	0.00017	2.00
150.0001	150.0000	0.0001	0.00025	2.00
200.0001	200.0000	0.0001	0.00030	2.00

Note

Calibrate items in good condition and this report customer request and accepted in certificate

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

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%.

--END--

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CERTIFICATE OF CALIBRATION

Certificate No. : 22-765-002

Issue Date : 10 June 2022

Work Order No. : 22/765

Customer Name : คณะวิทยาศาสตร์และเทคโนโลยี มหาวิทยาลัยราชภัฏสวนสุนันทา
เลขที่ 1 ถนนอุททองนอก แขวงวชิรพยาบาล
เขตดุสิต กรุงเทพมหานคร 10300

Date of Received : 10 June 2022

Date of Calibration : 10 June 2022

Instrument Details : Description : Temperature Controlled Enclosures [Hot Air Oven]
Manufacturer : memmert
Model : UN 55
Serial No. : B216.3645
ID No. : สส.07.99.05.0012/60
Resolution : 0.1 °C
Location : ห้อง 2424 อาคาร 24 คณะวิทยาศาสตร์และเทคโนโลยี

Calibration Method : This instrument was calibrated by insert standard thermometer into the chamber according to calibration procedure no. CWI-T-10 follow up to TLAS G-20-1/02-08 (E) : Guidelines for Calibration and Checks of Temperature Controlled Enclosures.

Environmental Conditions :

Temperature : Area Monitoring between 15°C to 40°C
Humidity : Area Monitoring between 30%RH to 85%RH
Line Voltage : Area Monitoring 220 VAC \pm 10%

Traceability of Measurement :

This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI) and The temperature scale in use at this laboratory is The International

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CERTIFICATE OF CALIBRATION

Certificate No. : 22-765-002

Issue Date : 10 June 2022

Work Order No. : 22/765

Details of Calibration

1. Reference Standards Instrument

Instrument	Model	Serial No./Ins No.	Certificate No.	Due Date
Data Acquisition unit	34972A	MY49018270	21-1304-001	02 January 2023
Sensor type	RTD	RTD# 101-109	21-1304-001	02 January 2023

2. Certificate traceble

: This certificate traceable to The International System of Unit refer to
Crystal Calibration Sales and Service Co., Ltd. , NAC Calibration No. 0260

3. Condition of item

: Used

4. Calibration site

: On - Site

5. Result of Calibration

: Without adjustment

6. Evaluate Condition

: Time Constant : - Hour 33 Minute At cal. point 105 °C
Air vent : Off
Fan speed status : None Fan Speed

7. Calibration note

: The results reported in this certificate refer to the condition of instrument on
the process into the steady state of chamber

8. Sensors Installation Diagram

: When ; Sensor installation location in Chamber @ Working Space
A = Distance between sensor and wall of chamber is 5 cm

9. Dimensions of chamber

: W = 0.4 m ; D = 0.336 m ; H = 0.4 m

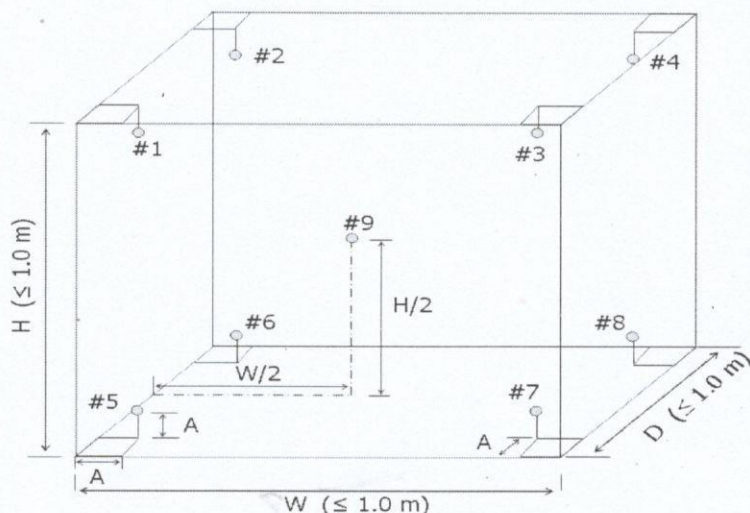


Diagram of Chamber



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CERTIFICATE OF CALIBRATION

Certificate No. : 22-765-002

Work Order No. : 22/765

Issue Date : 10 June 2022

Result of Temperature Distribution and Performance Check

Table1 : Reporting of Temperature Distribution

Calibration point (°C)	Average Measured Temperature (°C) @ Sensor No. (Sensor No.9 is REF)									Uncertainty ± (°C)
	#1	#2	#3	#4	#5	#6	#7	#8	#9	
105.0	106.87	106.25	106.83	106.02	103.65	105.81	103.94	105.05	105.40	0.65
150.0	151.38	150.67	151.29	150.31	147.53	149.98	147.90	149.08	149.47	0.66

Table 2 : Reporting of Performance check

Indicator Set Point (°C)	Indicator Reading (°C)			Stability ± (°C)	Uniformity (°C)	Overall variation (°C)
	MAX	MIN	Average			
105.0	105.0	104.9	105.0	0.32	1.94	3.67
150.0	150.1	149.9	150.0	0.23	2.32	4.26

Note

Calibrate items it good condition and this report customer request and accepted in certificate

The reference sensor is preferably located of the geometric center of chamber

The measured temperature data readout by software "Benchlink Datalogger 3"

The quoted uncertainty include " Stability " and " Loading effect (20% of Temp Uniformity) "

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

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

Overall Variation - The difference of the maximum and minimum measured temperatures throughout observation time.

Indicating Temperature - the average reading of indicating device that forms the integral part of the enclosure.

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

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



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CERTIFICATE OF CALIBRATION

Certificate No. : 22-1337-001

Issue Date : 6 October 2022

Work Order No. : 22/1337

Customer Name : Faculty of Science and Technology Suan Sunandha Rajabhat University
1 U-Thong nok Road, Dusit,
Bangkok 10300 Thailand

Date of Received : 29 September 2022

Date of Calibration : 4 to 5 October 2022

Instrument Details : Description : Digital Thermo hygrometer
Manufacturer : testo
Model : 608-H1
Serial No. : 83241348
ID No. : N/A
Location : Humidity and Temperature Laboratory

Calibration Method : This instrument was calibrated by comparison of indication with Standard Chilled Mirror Hygrometer and Standard Thermometer into Temperature and Humidity Chamber controller according to calibration procedure no. CWI-H-01

Environmental Condition

Temperature : Laboratory Control at $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$
Humidity : Laboratory Control at $55\%\text{RH} \pm 20\%\text{RH}$

Traceability of Measurement

: This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI) and The temperature scale in use at this laboratory is The International Temperature scale of 1990.

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CERTIFICATE OF CALIBRATION

Certificate No. : 22-1337-001

Issue Date : 6 October 2022

Work Order No. : 22/1337

Details of Calibration

1. Reference Standards Instrument

Instrument	Serial No.	Certification	Due Date
1.1 Chilled Mirror Hygrometer	157966 / 157152	TH-0078-22	02 August 2023
1.2 Digital Thermometer with RTD	15000016 / RTD-11	21-970-005	22 October 2022

2. Certificate traceable : This certificate traceable to The International System of Unit refer to
No. 1.1 National Institute of Metrology (Thailand), NAC Calibration No. 0144
No. 1.2 Crystal Calibration Sales and Service Co., Ltd. , NAC Calibration No. 0260

3. Condition of item : Used

4. Calibration location : Permanent

Result of Calibration

1. Temperature Measurement : Without Adjustment

Resolution of UUC : 0.1 °C

Calibration Point (°C)	Average Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty ± (°C)
20	20.036	19.9	+ 0.136	0.30
25	25.018	25.1	- 0.082	0.30
30	30.065	30.1	- 0.035	0.30

2. Humidity Measurement : Without Adjustment

Resolution of UUC : 0.1 %RH

Calibration Point (%RH)	Calculated Standard Reading (%RH)	UUC Reading (%RH)	Correction (%RH)	Uncertainty ± (%RH)
40	40.13	44.0	- 3.87	1.2
60	60.01	63.8	- 3.79	1.4
80	79.92	83.0	- 3.08	1.8

- Note : 1. Process calibration humidity measurement Reference temperature control at 25°C
2. Calculated STD humidity refer to dew-point temperature and convert to humidity by magnus's Equation
3. Calibrate items it good condition and this report customer request and accepted in certificate

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

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%.



CRYSTAL CALIBRATION SALES AND SERVICE CO., LTD.

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Tel : 0-2408-8474-5 Fax : 0-2408-8477 Email : info@crystalcal.com www.crystalcal.com



CERTIFICATE OF CALIBRATION

Certificate No. : 22-1337-002

Issue Date : 3 October 2022

Work Order No. : 22/1337

Customer Name : Faculty of Science and Technology Suan Sunandha Rajabhat University
1 U-Thong nok Road, Dusit,
Bangkok 10300 Thailand

Date of Received : 29 September 2022

Date of Calibration : 30 September 2022

Instrument Details : Description : pH meter
Manufacturer : OHAUS
Model : ST5000
Serial No. : 17460012
ID No. : N/A
Resolution : 0.01 pH
Location : Temperature and Chemical Calibration Laboratory

Calibration Method : This instrument was calibrated by in-house calibration procedure no. CWI-C-02 based on direct measurement by using standard voltage calibrator and certified reference material (CRM)

Environmental Condition

Temperature : Laboratory Control at $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$

Humidity : Laboratory Control at $55\%\text{RH} \pm 20\%\text{RH}$

Traceability of Measurement

: This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI)

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CERTIFICATE OF CALIBRATION

Certificate No. : 22-1337-002

Issue Date : 3 October 2022

Work Order No. : 22/1337

Details of Calibration

1. Certified Reference Material / Certified of Instrument

Certified Reference Material	CRM Code	Lot no.	Expire Date
1.1 Buffer Solution pH 4.00	TRM-S-2027	081020	28 August 2024
1.2 Buffer Solution pH 7.00	TRM-S-2034	300522	28 August 2024
1.3 Buffer Solution pH 10.00	TRM-S-2031	091020	28 August 2024

Instrument	Certificate no.	Serial No. / ID No.	Due Date
1.4 DC Source Calibrator	22E1250	20109000330	19 April 2023
1.5 Digital Thermometer with sensor	22-546-001	51159946/811	26 April 2023

2. This certificate traceable to the international unit (SI)

Buffer solution no. 1.1 traceable to : Nation Institute of Metrology (Thailand)
Buffer solution no. 1.2 traceable to : Nation Institute of Metrology (Thailand)
Buffer solution no. 1.3 traceable to : Nation Institute of Metrology (Thailand)
Instrument no. 1.4 traceable to : Technology Promotion Association (Thailand-Japan) NAC Calibration No. 0008
Instrument no. 1.5 traceable to : Crystal Calibration slaes and service Co., Ltd., NAC Calibration No. 0260

3. Condition of item : Used

4. Calibration location : Permanent

Result of Calibration

Measurement Function : mV Measurement

Performing : Standard curve by Voltage calibrator at pH (4, 7, 10)

Norminal value pH	Applied DC voltage mV	Average indicator reading		Uncertainty (±) mV	Coverage Factor k
		mV	pH		
0	414.1	413.87	0.02	0.065	2.00
2	295.9	295.47	2.02	0.065	2.00
4	177.6	177.24	4.01	0.065	2.00
7	0.0	-0.12	7.00	0.065	2.00
9	-118.3	-118.34	9.01	0.065	2.00
10	-177.6	-177.47	10.01	0.065	2.00
12	-295.9	-295.69	12.02	0.065	2.00
14	-414.1	-414.08	14.03	0.065	2.00

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CERTIFICATE OF CALIBRATION

Certificate No. : 22-1337-002

Issue Date : 3 October 2022

Work Order No. : 22/1337

Result of calibration

Measurement Function : pH Measurement with electrode

Performing : Three buffer standard curve using buffer nominal pH (4, 7, 10)

STD buffer solution pH @ 25 °C	Average indicator reading			Uncertainty (±) pH	Coverage factor k
	pH	mV	pH correction		
4.01	4.04	170.37	-0.03	0.012	2.00
7.01	7.03	-9.91	-0.02	0.012	2.00
10.00	10.03	-178.67	-0.03	0.013	2.00

Descriptions of electrode :

Electrode Type : Combination Electrode

Manufacturer : OHAUS

Model : ST310

Serial no. : 2936028

ID No. : N/A

Detail of % slope form calculation

pH range	% Slope value	% Slope recommend
4 pH to 7 pH	101.6	
7 pH to 10 pH	95.4	

Note : Calibrate items it good condition and this report customer request and accepted in certificate

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

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



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CERTIFICATE OF CALIBRATION

Certificate No. : 22-1337-003

Issue Date : 5 October 2022

Work Order No. : 22/1337

Customer Name : Faculty of Science and Technology Suan Sunandha Rajabhat University
1 U-Thong nok Road, Dusit,
Bangkok 10300 Thailand

Date of Received : 29 September 2022

Date of Calibration : 30 September 2022

Instrument Details : Description : Digital Thermometer with probe
Manufacturer : OHAUS
Model : ST5000
Serial No. : 17460012
ID No. : N/A
Resolution : 0.1 °C
Location : Temperature and Humidity Calibration Laboratory

Calibration Method : This instrument was calibrated by comparison of indication with Standard Thermometer into calibration bath temperature controller according to calibration procedure no. CWI-T-09

Environmental Condition

Temperature : Laboratory Control at $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$

Humidity : Laboratory Control at $55\%\text{RH} \pm 20\%\text{RH}$

Traceability of Measurement

: This certificate of calibration documents the traceability to national standard, which realize the unit of measurement according to the International system of Units (SI) and The temperature scale in use at this laboratory is The International Temperature scale of 1990.

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CERTIFICATE OF CALIBRATION

Certificate No. : 22-1337-003

Issue Date : 5 October 2022

Work Order No. : 22/1337

Details of Calibration

1. Reference Standards Instrument

Instrument	Model	Serial No. / ID No.	Certification	Due Date
Thermometer Readout	1586A	2827002	21-1304-009	5-Jan-2023
Platinum Resistance Thermometers (PRT)	5618B	885515	21-1304-009	5-Jan-2023

2. Certificate traceable : This certificate traceable to The International System of Unit (SI unit)

3. Condition of equipment : Used

4. Calibration site : Permanent

Result of Calibration

Calibration result : Without Adjustment

Calibration point (°C)	STD. Value (°C)	UUC Reading (°C)	Correction value (°C)	Uncertainty ± (°C)
20	20.02	19.8	+ 0.22	0.074
25	25.06	24.8	+ 0.26	0.074
30	30.15	29.8	+ 0.35	0.074

Note : Calibrate items it good condition and this report customer request and accepted in certificate

Electrode Type : Combination Electrode

Manufacturer : OHAUS

Model : ST310

Serial no. : 2936028

ID No. : N/A

UUC : Unit Under Calibration.

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

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%.



Certificate of Calibration

Calibration Certification Information

Cal. Date: August 3, 2022 Rootsmeter S/N: 438320 Ta: 296 °K
Operator: Jim Tisch Pa: 748.3 mm Hg
Calibration Model #: TE-5025A Calibrator S/N: 710725

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3740	3.2	2.00
2	3	4	1	0.9780	6.4	4.00
3	5	6	1	0.8730	7.9	5.00
4	7	8	1	0.8300	8.8	5.50
5	9	10	1	0.6870	12.8	8.00

Data Tabulation

Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left(Ta/Pa \right)}$ (y-axis)
0.9870	0.7183	1.4080	0.9957	0.7247	0.8895
0.9828	1.0049	1.9912	0.9914	1.0137	1.2579
0.9808	1.1234	2.2262	0.9894	1.1334	1.4064
0.9796	1.1802	2.3349	0.9882	1.1907	1.4750
0.9743	1.4182	2.8160	0.9829	1.4307	1.7789
QSTD	m=	2.00936	QA	m=	1.25823
	b=	-0.03294		b=	-0.02081
	r=	0.99998		r=	0.99998

Calculations

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

Standard Conditions

Tstd: 298.15 °K

Pstd: 760 mm Hg

Key

ΔH: calibrator manometer reading (in H2O)
ΔP: rootsmeter manometer reading (mm Hg)
Ta: actual absolute temperature (°K)
Pa: actual barometric pressure (mm Hg)
b: intercept
m: slope

RECALIBRATION

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



THAI METEOROLOGICAL DEPARTMENT

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

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 27 January, 2023

Certification No. 045/23

Page : 1 of 3

Object : Wind speed and wind direction

Manufacturer : Davis Instruments Inc.

Type : Weather Wizard III Product No. 7425

Serial No. : WC90601A48

Customer : Evergreen Consulting Co.,Ltd.
17/106 Moo 3, Sattahip, Sattahip,
Chonburi 20180 Thailand.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1012.2 hPa

NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91563

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

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

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

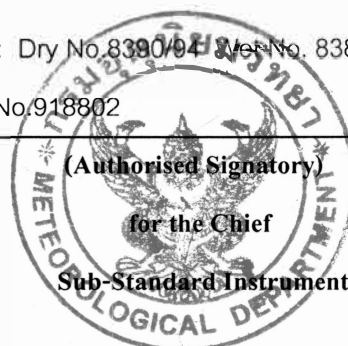
Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

STANDARD THERMOMETER

: Theodor Friedrich : Dry No. 8389/94 Wet No. 8389/94

Thermometer No. 918802



(Authorised Signatory)

for the Chief

Sub-Standard Instrument



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 045/23

27 January, 2023

Page : 2 of 3

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches	Vacumm inches	Pressure hPa	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.9	0.10
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.9	0.10
7.00	-	-	-	6.7	0.30
9.02	-	-	-	8.1	0.92
11.01	-	-	-	10.3	0.71
13.01	-	-	-	12.1	0.91
15.01	-	-	-	14.3	0.71
17.02	-	-	-	16.1	0.92
20.02	-	-	-	19.3	0.72

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



THAI METEOROLOGICAL DEPARTMENT

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

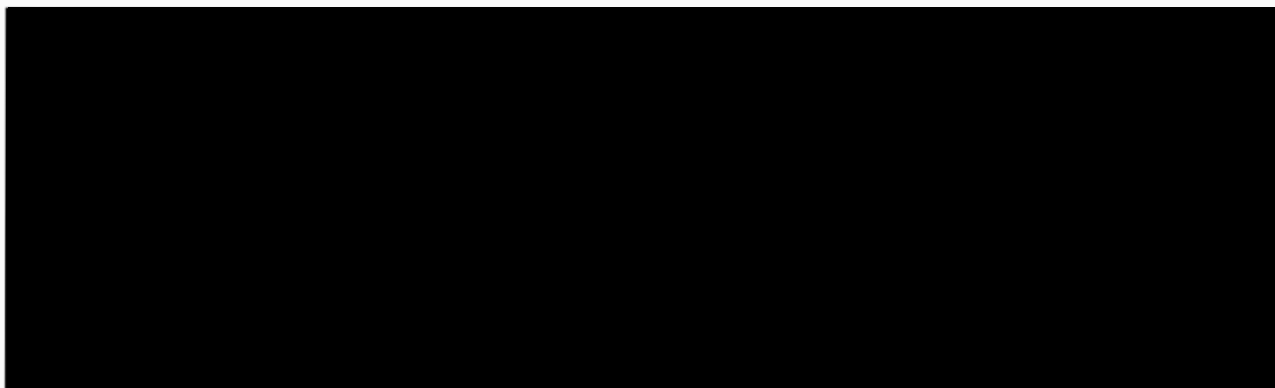
The Result of Calibration

Certification No. 045/23

27 January, 2023

Page : 3 of 3

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.1	44.8	0.3
30.4	30.2	0.2
15.6	15.4	0.2



Calibration Test

Calibrated Date: 19 July 2023

Certificate No. 020/23

Instruments Information

Manufacturer : YOUNG Instrument Type : four blade helicoid propeller
Model : 40C Serial Number : Logger 428007859

Environment : Temperature 25.5 °C Humidity: 51 %RH

NATIONAL STANDARD WIND TUNNEL

: Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425

: Wind Aloft Plotting Board

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

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

Serial Number 110730029 (sensor 120629586) JAPAN QUALITY ASSURANCE ORGANIZATION

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO 1425			TESTED ANEMOMETER			
	Pressure inches	Vacuum inches	Pressure hPa	Pressure hPa	Correction hPa	Velocity m/sec	Correction m/sec
1.00	-	-	-	-	-	0.9	0.1
3.02	-	-	-	-	-	2.9	0.12
5.04	-	-	-	-	-	4.8	0.24
7.03	-	-	-	-	-	6.8	0.23
9.01	-	-	-	-	-	8.7	0.31
11.03	-	-	-	-	-	10.7	0.33
13.01	-	-	-	-	-	12.5	0.51
15.03	-	-	-	-	-	14.4	0.63
17.05	-	-	-	-	-	16.5	0.55
20.02	-	-	-	-	-	19.3	0.72

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



SCARLET | TECH

Certificate of Calibration

WL-21 Wireless Anemometer

Scarlet Tech Ltd. hereby certifies that the WL-21 wireless anemometer listed below was thoroughly calibrated, test and inspected following the standard calibration procedure (st-wl-21) and is within manufacture's specification at the time when the calibration is don

Client: Envir Service Co., Ltd.
Serial: 2112DR0071
Calibration Date: 2023/5/5
Calibration Expiry Date: 2024/5/4

The Result of Calibration

Velocity				
Measured Value (m/s)	Actual Value (m/s)	Deviation	Tolerance	Result
1.0	1.0	0.0	0.9-1.1	Pass
1.9	2.0	0.1	1.8-2.2	Pass
4.9	5.0	0.1	4.7-5.3	Pass
7.0	7.0	0.0	6.0-8.0	Pass
10.0	10.0	0.0	9.5-10.5	Pass
19.6	20.0	0.4	19.0-21.0	Pass

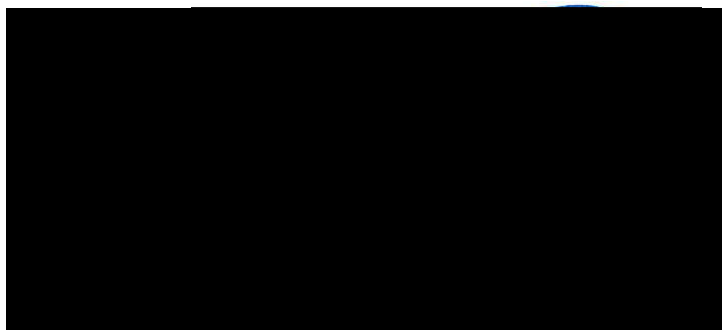
Wind Direction				
Measured Value (m/s)	Actual Value (m/s)	Deviation	Tolerance	Result
48°	47°	1	42-48	Pass
135°	135°	0	132-138	Pass
226°	225°	1	222-228	Pass
316°	315°	1	312-318	Pass
359°	0°	1	357-3	Pass

Inspection Room Temp	Actual Value	Deviation	Tolerance	Result
22.2°C	22.5	0.3	21.5-23.5	Pass

Atmospheric Pressure Inspection	Actual Value	Deviation	Tolerance	Result
1007	1005	2	1001-1019	Pass

Environment Conditions :

Air temperature: 22 °C
Relative humidity: 55 %
Static pressure: 102.2 kPa



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SCARLET | TECH

Certificate of Calibration

WL-21 Wireless Anemometer

Scarlet Tech Ltd. hereby certifies that the WL-21 wireless anemometer listed below was thoroughly calibrated, test and inspected following the standard calibration procedure (st-wl-21) and is within manufacture's specification at the time when the calibration is don

Client: Envir Service Co., Ltd.
Serial: 2122DR0059
Calibration Date: 2023/5/5
Calibration Expiry Date: 2024/5/4

The Result of Calibration

Velocity				
Measured Value (m/s)	Actual Value (m/s)	Deviation	Tolerance	Result
1.0	1.0	0.0	0.9-1.1	Pass
1.9	2.0	0.1	1.8-2.2	Pass
4.9	5.0	0.1	4.7-5.3	Pass
7.0	7.0	0.0	6.0-8.0	Pass
10.0	10.0	0.0	9.5-10.5	Pass
19.6	20.0	0.4	19.0-21.0	Pass

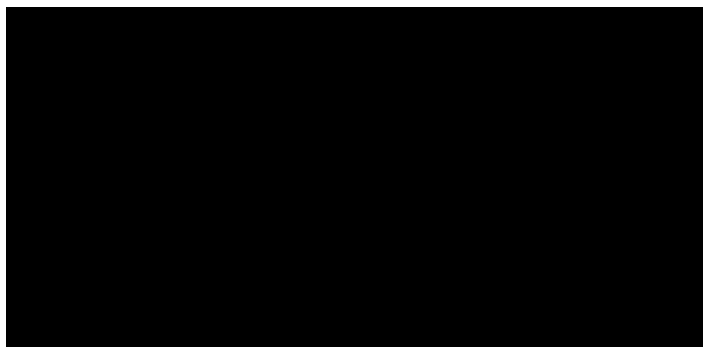
Wind Direction				
Measured Value (m/s)	Actual Value (m/s)	Deviation	Tolerance	Result
48°	47°	1	42-48	Pass
135°	135°	0	132-138	Pass
226°	225°	1	222-228	Pass
316°	315°	1	312-318	Pass
359°	0°	1	357-3	Pass

Inspection Room Temp	Actual Value	Deviation	Tolerance	Result
22.2°C	22.5	0.3	21.5-23.5	Pass

Atmospheric Pressure Inspection	Actual Value	Deviation	Tolerance	Result
1007	1005	2	1001-1019	Pass

Environment Conditions :

Air temperature: 22 °C
Relative humidity: 55 %
Static pressure: 102.2 kPa



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