

เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์



CERTIFICATE OF CALIBRATION

Certificate No.: CO-1808005/23 Page 1 of total 4 pages

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

Equipment: pH Meter
Manufacturer: METTLER TOLEDO Model: SevenCompact S220
Serial No.: B327527211 ID No.: WWL0068
Description: Range: 0 - 14 pH, Resolution: 0.01 pH

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

Calibration Location: Jayhawk Laboratory (CL&GL)

Received Date: 18 August 2023

Calibration Date: 18 August 2023

Date of Issue: 21 August 2023

Condition of Artifacts: Used conditions but can be calibrated

Checked by:

Act as Technical Manager

Approved by:

Representative of Managing Director

() (Krisyot K.) (Sakda Y.)

() (Patiphan K.) (Onnape P.)

() (Pongsak H.) (Niriphong K.)

() (Kamng C.) (Nonhachai K.)

() (Pramong P.) (Noppol P.)

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REV.02 02/24/21



Certificate No.: CO-1808005/23

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Reference Method:

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

Reference Standard:

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

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

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

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

Measurement Results:

1. Function Simulated pH Meter

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

UUC: Unit Under Calibration

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

Calibrated by: Kittipong

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Measurement Results (Cont.):

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

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

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

Temperature stability of micro bath: 25 ± 0.2 °C

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



Certificate No.: CO-1808005/23

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Reference Method:

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

Reference Standard Instruments:

Type	Model	Serial No.	Cert. No.	Due Date	Traceability
Thermometer Readout	1529-R	B7C853	10-0911001/22	Nov. 9, 2023	THC
Platinum Resistance Thermometer	5626	4854	C0A30047	Oct. 22, 2023	FLUKE
Liquid Bath	XORTS-40A	XO111019	10-2405001/23	May 25, 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 (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
120	22.00	22.2	-0.20	0.065
120	25.00	25.2	-0.20	0.065
120	28.00	28.2	-0.20	0.065

UUC: Unit Under Calibration

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

- End of Certificate -

Calibrated by: Kittipong

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ภาคผนวก ข-1

FB-169

Calibrated by: Pongsak

REV.02 02/24/21

Certificate of Calibration

TEMPERATURE CONTROLLER ENCLOSURES



Certificate No.: MC 2307702

Page 1 of 3

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

Reference Job No. : 23-1577 Received Date : 11 July 2023
Description : Refrigerator
Manufacturer : SANDEN INTERCOOL Model : SEC-1500SBD
Serial No. : SEC1500201A-0708-00304 ID. No. : WWL0038
Marking : Additionally for the purpose of identification by this laboratory a label marked with this certificate number (MC 2307702) has been attached to the case.
Method : In-House calibration procedure 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 : (25.3 to 25.9) °C
Relative Humidity : (65.2 to 67.9) %
Date of Calibration : 11 July 2023 Date of Issue : 12 July 2023

Checked by : Thanagorn
Thanagorn Linthacharoen
(Calibration Supervisor)

Approved by : Aittipong
Aittipong Kanjithavasi
(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 2307702

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The Reference Standard Instrument :

Description	Certificate No.	Serial No.	Due date	Traceable thru
Data Acquisition/Switch Unit	MC 2303173	MY41010916	9 Mar 2024	MCAL

With Thermocouple Type "T" ID. No. 1771 to 1779

Traceability :

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

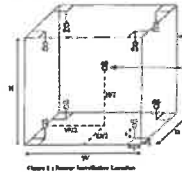
1. Calibration Procedure:

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

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

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

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



Overall Ambient Temperature around the Chamber variation : 3.2 °C

Overall Line Voltage variation : 0.1 V

Chamber Size (W*H*D) : 171 cm x 157 cm x 60 cm

Checked by : Thanagorn

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

Certificate No.: MC 2307702

Page 3 of 3

2. Result of calibration :

Temperature Measurement Accuracy Test

Indicating Temperature (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (±°C)
	#1	#2	#3	#4	#5	#6	#7	#8	Ref. #9	
2.5	4.4	4.2	4.2	4.2	4.0	3.9	4.1	4.0	3.8	0.36

Chamber Characterization Result

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

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

This certificate will certify of the calibrated equipment only.

End of Certificate

Checked by : Thanagorn

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

CERTIFICATE OF CALIBRATION

Certificate No.: CO-1907007/23

Page 1 of total 2 pages

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

Equipment	Conductivity Meter	Model	CON 2700
Manufacturer	EUTECH	ID No.	WW1.0136
Serial No.	2657889		
Description	-		

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

Calibration Location : Jayhawk Laboratory (CL&GL)

Received Date : 19 July 2023

Calibration Date : 19 July 2023

Date of Issue : 20 July 2023

Condition of Artifacts : Used conditions but can be calibrated

Checked by : [Signature]
Act as Technical Manager

Approved by : [Signature]
Representative of Managing Director

() (Krisyol K.)	() (Sakda Y.)	(Dr. Ekachai Puttiwong)
() (Paiphan K.)	() (Onnapa P.)	
() (Pongsak H.)	() (Nitiphong K.)	
() (Kanung C.)	() (Nonthachai K.)	
() (Pramong P.)	() (Noppol P.)	

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FE-169

REV.02 02/24/21



THC CALIBRATION CO., LTD.

254/1 Moo 5 T. Kanburi, A.U. Thai
Ayutthaya 13210 ThailandAUTOMATION SERVICE CO., LTD.
CALIBRATION LABORATORY

SV 201005/2024

Cert. No. WAC-065
Page 1 of 2

Certificate No.: C0-1907007/23

Page 2 of total 2 pages

Reference Method:

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

Reference Standard:

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

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

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

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

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

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

- End of Certificate -

FE-169

Calibrated by: Onnapa
REV.02 02/24/21AUTOMATION SERVICE CO., LTD.
CALIBRATION LABORATORYInstrument : DO Meter
Model : DO-31P
Serial No. : 789065Cert. 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	405K1405	-	-	-

2). Traceability This certification is traceable to

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

Result Of Calibration

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

DO Electrode No. OE270AA(3) S/N 111F0429

Calibrated By: P. Yooyen
(Ms. Phanee Yooyen)
Technician

CERTIFICATE OF CALIBRATION

Instrument : DO Meter
Model : DO-31P
Serial No. : 789065
Manufacturer : TOA-DKK
Measuring Range : 0.00 ~ 20.00 mg/l

Machine : -
Location : -

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

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

Ambient Condition : Temperature 26 °C
Humidity 58 % RH

Calibrated By: P. Yooyen
(Ms. Phanee Yooyen)
Technician

Approved By: N. Nipon
(Mr. Nipon Phungsonsak)
Technical Manager

Date Of Issue : 15/01/2024

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

Automation Service Co. Ltd. 828/828/1 Sri Pathanchan Rd. Pathanchan Rd. Bangkok, Bangkok 10220
Tel. 02-319-9944 ext. 131/223 / E-mail: info@automation.co.th, service@automation.co.th / www.automation.co.th



Intech Metrological Center Co., Ltd.
39/1 Soi 82, Sukhaphiban 5 Rd., O ngoon,
Sarnai, Bangkok 10220, Thailand
Tel. (662) 909-8820 (Auto 10 lines) www.imc-instrument.com



Certificate of Calibration

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

Customer : Water Analysis Center Co., Ltd.
Address : 1/94 M.5, Rojana Industrial Park, T. Kanburi, A.U. Thai, Ayutthaya 13210

Description : Hot Air Oven
Manufacturer : Memmert
Model : UF 280
Serial No. : B620.0814
Identification No. : WVVL 0212
Calibration Place : Customer Laboratory

Order No. : 1152/24
Received date : Mar 22, 2024
Calibration date : Mar 22, 2024
Environment Condition :
Temperature : (25±10) °C
Humidity : (50±30) %RH

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

Reference Standard Instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
LXI Data Acquisition Switch Unit with Sensor	34872A	MY49020096	MT23-7153	Nov 30, 2024

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

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

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

Calibrated by : Mr. Yutakorn Jannasari

Approved by : P. Panuwat Phukian
Issue date : Apr. 10, 2024

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

Rev.03 / Feb 2024

FM-MT-013

Certificate No. : MT24-3208

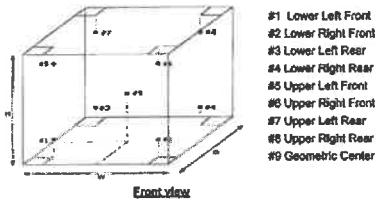
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Function : Temperature measurement
Calibration point : 104, 180 °C

Result : Without adjustment
Resolution : 0.1 °C

Calibration point (°C)	Temperature of UUC* at each position (°C)									Uncertainty of measurement (± °C)
	Ch.1	Ch.2	Ch.3	Ch.4	Ch.5	Ch.6	Ch.7	Ch.8	Ch.9	
104	103.494	103.933	103.871	103.888	103.990	104.081	103.843	104.217	104.022	0.45
180	179.985	179.953	180.047	179.985	179.908	180.088	180.005	180.273	180.105	0.54

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



UUC* = Unit under calibration

Uniformity = Maximum and Minimum difference of measured temperature at any probes and the measured temperature at the reference and same time.

Overall Variation = Difference of temperature value between the maximum and minimum any time.

Stability = One half of the maximum difference of measured temperatures at any one probe.

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Rev.03 / Feb 2024

FM-MT-013



Certificate of Calibration

Equipment: Balance
Model: BL 210S
Serial No. (or ID.): 15806131 (WVA, 0022)
Manufacturer: Sartorius
Condition: In condition

Certificate No.: C01241754
Issued Date: 05 June 2024
Job No.: WO-00030302
Page: 1 of 2

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

Environmental Condition: Temperature 28 °C ± 0.2 °C
Humidity 50 %RH ± 2.6 %RH

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

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

Polawad Ruamrup
(Mr. Polawad Ruamrup)
Person in charge

Rungrod Jenkitikulchai
(Mr. Rungrod Jenkitikulchai)
Authorized signatory

This certificate is issued on the basis 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 the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
These results may be affected by deviations from specified conditions. The results valid only for the same tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

บริษัท เทคโนโลยี จำกัด
DKSH Technology Limited
3633 Sukhumvit Road, Bangkok, Phrasangha, Bangkok 10260
Phone: +66-226-1787, Email: info@dksh.com, Website: www.dksh.com

Delivering Growth - In Asia and Beyond.

CAL-FM-C01-14: 12 Sep 2023



Certificate No.: C01241754

Page: 2 of 2

Calibration Results:

Without Adjustment

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

Nominal Test Value (g)	Reference Points (g)				
	A	B	C	D	E
100	0.0000	0.0001	0.0000	-0.0002	

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

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

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

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
1	1.00001	1.0000	0.0000	0.00011	2.04
2	2.00002	2.0000	0.0000	0.00011	2.04
5	5.00002	5.0000	0.0000	0.00011	2.04
10	10.00001	10.0000	0.0000	0.00011	2.04
20	20.00001	20.0000	0.0000	0.00012	2.03
50	50.00003	50.0000	0.0000	0.00013	2.02
70	70.00004	70.0000	0.0000	0.00018	2.01
100	99.99996	100.0001	0.0001	0.00017	2.01
120	119.99997	120.0002	0.0002	0.00021	2.00
150	149.99999	150.0002	0.0002	0.00024	2.00
200	199.99998	200.0004	0.0004	0.00030	2.00

The End of Certificate

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DKSH Technology Limited
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Delivering Growth - In Asia and Beyond.

CAL-FM-C01-14: 12 Sep 2022



บริษัท ไทยยูนิค จำกัด THAI UNIQUE CO., LTD.

80-82 ถนนวิภาวดีรังสิต แขวงจตุจักร กรุงเทพมหานคร 10200
80-82 Prachathipaisai Rd., Bangkokthani, Pranakorn, Bangkok 10200
Tel: 0-2629-0191-4, 0-2260-1787, Fax: 0-2360-1788, E-mail: showatt@thaiunique.com, Website: www.thaiunique.com

PREVENTATIVE MAINTENANCE (PM) CHECK LIST

FOR ATOMIC ABSORPTION SPECTROMETER

Model & Serial Number: 84013AA & M418250004

Customer: Water analysis center Co., Ltd.

Date: 25 Apr 2024

Safety

- ☒ Flame, Inspect/replace o-ring nebulizer, spray chamber and burner
- ☒ Flame, Clean nebulizer, spray chamber and burner
- ☒ Flame, Check liquid trap interlock, burner interlock, pressure relief buoy interlock and shield interlock
- ☐ Furnace, Clean work head, electrode and shroud N/A
- ☐ Furnace, Clean PSD and PSD tray N/A
- ☐ Furnace, Check water pressure N/A
- ☒ Check drain tube
- ☒ Check exhaust system
- ☒ Check gas pressure sensor interlock
- ☒ Check and all gas hoses for SpectraA
- ☒ Clean computer control

Optics

- ☒ Inspect/replace the external optics surfaces
- ☒ Check Wavelength Accuracy the copper line at 323.0-326.0 nm = 324.7 nm
- ☒ Check that PMT % Gain the copper at 324.8 nm, 4 mA, 0.5 nm slit width, Gain = 29% (should be ≤ 64% or ≤ 380V)
- ☒ Flame, Check D2 lamp is work



บริษัท ไทยยูนิค จำกัด THAI UNIQUE CO., LTD.

80-82 ถนนประชาวิทย์ แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200
80-82 Prachathipat Rd., Bangkokphrom, Pranakorn, Bangkok 10200

Tel: 0-2629-0191-6, 0-2280-1787, Fax: 0-2280-1788, E-mail: thau@thaiunique.com, Website: www.thaiunique.com

Electronics

- ☒ Check power supply voltage
- ☒ Check cables and connectors
- ☒ Check/Clean all boards in the instrument
- ☐ Furnace, Check camera and align** N/A

**Option for Graphite Zeeman only

Mechanisms

- ☒ Flame, Check the burner adjuster
- ☐ Furnace, Check PSD accessories N/A

Analytical performance

- ☒ Clear the sample compartment
- ☒ Flame, Check uptake rate form 7.2-10.6 mL per minute = 8.5 mL/min
- ☒ Test Photometric noise, STDV = 0.0001 Abs (should be ≤ 0.00050 Abs)
- ☒ Flame, Test high solids nebulizer setting use
- Al/acet Cu 5 ppm = 0.79 Abs, and Precision
- (%RSD) = 0.4 % (should be > 0.55 Abs and < 0.5 % RSD)
- or
- N2O/acet Cu 5 ppm = _____ Abs, and Precision
- (%RSD) = _____ % (should be > 0.3 Abs and < 0.5 % RSD)
- ☐ Furnace, Characteristic mass and sensitivity Cu 25 ppb = _____ Abs, and N/A
- Precision (%RSD) = _____ % (should be ≥ 0.15 Abs and ≤ 4.0 % RSD)

SIGN:

Engineer: Suriya Mecharoen

Customer: Water Analysis Center Co., Ltd.

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80-82 ถนนประชาวิทย์ แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200
80-82 Prachathipat Rd., Bangkokphrom, Pranakorn, Bangkok 10200

Tel: 0-2629-0191-6, 0-2280-1787, Fax: 0-2280-1788, E-mail: thau@thaiunique.com, Website: www.thaiunique.com

PREVENTATIVE MAINTENANCE (PM) CHECK LIST

FOR ATOMIC ABSORPTION SPECTROMETER

Model & Serial Number: 2402 AA & MP18230004

Customer: Water Analysis Center Co., Ltd.

Date: 26 Apr 2024

Safety

- ☐ Flame, Inspect/replace o-ring nebulizer, spray chamber and burner N/A
- ☐ Flame, Clean nebulizer, spray chamber and burner N/A
- ☐ Flame, Check liquid trap interlock, burner interlock, pressure relief bung interlock and shield interlock N/A
- ☒ Furnace, Clean work head, electrode and shroud
- ☒ Furnace, Clean PSD and PSD tray
- ☒ Furnace, Check water pressure
- ☒ Check drain tube
- ☒ Check exhaust system
- ☒ Check gas pressure sensor interlock
- ☒ Check and all gas hoses for SpectraAA
- ☒ Clean computer control

Optics

- ☒ Inspect/Replace the external optics surfaces
- ☒ Check Wavelength Accuracy the copper line at 323.0-326.0 nm = 324.8 nm
- ☒ Check that PMT % Gain the copper at 324.8 nm, 4 mA, 0.5 nm slit width, Gain = 90 % (should be ≤ 64 % or ≤ 380 V)
- ☐ Flame, Check D2 lamp is work N/A

12



บริษัท ไทยยูนิค จำกัด THAI UNIQUE CO., LTD.

80-82 ถนนประชาวิทย์ แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200
80-82 Prachathipat Rd., Bangkokphrom, Pranakorn, Bangkok 10200

Tel: 0-2629-0191-6, 0-2280-1787, Fax: 0-2280-1788, E-mail: thau@thaiunique.com, Website: www.thaiunique.com

Electronics

- ☒ Check power supply voltage
- ☒ Check cables and connectors
- ☒ Check/Clean all boards in the instrument
- ☒ Furnace, Check camera and align**

**Option for Graphite Zeeman only

Mechanisms

- ☐ Flame, Check the burner adjuster N/A
- ☒ Furnace, Check PSD accessories

Analytical performance

- ☒ Clear the sample compartment
- ☐ Flame, Check uptake rate form 7.2-10.6 mL per minute = _____ mL/min N/A
- ☒ Test Photometric noise, STDV = 0.0002 Abs (should be ≤ 0.00050 Abs)
- ☐ Flame, Test high solids nebulizer setting use N/A
- Al/acet Cu 5 ppm = _____ Abs, and Precision
- (%RSD) = _____ % (should be > 0.55 Abs and < 0.5 % RSD)
- or
- N2O/acet Cu 5 ppm = _____ Abs, and Precision
- (%RSD) = _____ % (should be > 0.3 Abs and < 0.5 % RSD)
- ☒ Furnace, Characteristic mass and sensitivity Cu 25 ppb = 0.16 Abs, and Precision (%RSD) = 3 % (should be ≥ 0.15 Abs and ≤ 4.0 % RSD)

SIGN:

Engineer: Suriya Napharoen

Customer: Water Analysis Center Co., Ltd.

23



บริษัท ไทยยูนิค จำกัด THAI UNIQUE CO., LTD.

80-82 ถนนประชาวิทย์ แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200
80-82 Prachathipat Rd., Bangkokphrom, Pranakorn, Bangkok 10200

Tel: 0-2629-0191-6, 0-2280-1787, Fax: 0-2280-1788, E-mail: thau@thaiunique.com, Website: www.thaiunique.com

PREVENTATIVE MAINTENANCE (PM) CHECK LIST

FOR ATOMIC ABSORPTION SPECTROMETER

Model & Serial Number: AA 240F3 & AA09111073

Customer: Water Analysis Center Co., Ltd.

Date: 12 Feb 2024

Safety

- ☒ Flame, Inspect/replace o-ring nebulizer, spray chamber and burner
- ☒ Flame, Clean nebulizer, spray chamber and burner
- ☒ Flame, Check liquid trap interlock, burner interlock, pressure relief bung interlock and shield interlock
- ☐ Furnace, Clean work head, electrode and shroud N/A
- ☐ Furnace, Clean PSD and PSD tray N/A
- ☐ Furnace, Check water pressure N/A
- ☒ Check drain tube
- ☒ Check exhaust system
- ☒ Check gas pressure sensor interlock
- ☒ Check and all gas hoses for SpectraAA
- ☒ Clean computer control

Optics

- ☒ Inspect/Replace the external optics surfaces
- ☒ Check Wavelength Accuracy the copper line at 323.0-326.0 nm = 324.8 nm
- ☒ Check that PMT % Gain the copper at 324.8 nm, 4 mA, 0.5 nm slit width, Gain = 90 % (should be ≤ 64 % or ≤ 380 V)
- ☒ Flame, Check D2 lamp is work

12

TS SV 421 Rev. 01



บริษัท ไทยยูนิค จำกัด THAI UNIQUE CO., LTD.

81-82 ถนนปิ่นเกล้าพิเศษ แขวงบางปิ่น เขตตลิ่งชัน กรุงเทพมหานคร 10200
80-82 Prachathipitai Rd., Bangkokthipitai, Pranakorn, Bangkok 10200

Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail: thairu@thaiunique.com, Website: www.thaiunique.com

Electronics

- ☒ Check power supply voltage
- ☒ Check cables and connectors
- ☒ Check/Clean all boards in the instrument
- ☐ Furnace, Check camera and align** N/A

**Option for Graphite Zeeman only

Mechanisms

- ☒ Flame, Check the burner adjuster
- ☐ Furnace, Check PSD accessories N/A

Analytical performance

- ☒ Clear the sample compartment
- ☒ Flame, Check uptake rate from 7.2-10.6 mL per minute = 9.5 mL/min
- ☒ Test Photometric noise, STDV = 0.0002 Abs (should be ≤ 0.00050 Abs)
- ☒ Flame, Test high solids nebulizer setting use
- Air/acetylene Cu 5 ppm = 0.75 Abs, and Precision (%RSD) = 0.3 % (should be > 0.55 Abs and $< 0.5\%$ RSD)
- or
- N₂O/acetylene Cu 5 ppm = _____ Abs, and Precision (%RSD) = _____ % (should be > 0.3 Abs and $< 0.5\%$ RSD)
- ☐ Furnace, Characteristic mass and sensitivity Cu 25 ppb = _____ Abs, and Precision (%RSD) = _____ % (should be ≥ 0.15 Abs and $\leq 4.0\%$ RSD)

SIGN :

Engineer : (Signature) Customer : (Signature)
(Sunja Natcharoon) (Sung Natcharoon)

2/2

PG-SV-013 Rev. 02



MEGAFIL CO., LTD.

99/183 Moo 3 Tambon Bang Rak Noi Amphur Muang Nonthaburi 11000
Tel. 0-2528-6081-2 Fax. 0-2528-6083, 0-2525-7034
www.megafil.co.th E-mail: megafil.group@gmail.com

BSC Certification Test Report

Page 1 of 6

Certificate No. : M1333/23

Customer Name : LABORATORY WATER ANALYSIS CENTER COMPANY LIMITED

Customer Address : 1/94 Moo 5 T.Kanbarn, 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. : WWL 0084

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

Test Date : 12/10/2023

Due Date : 11/10/2024 or after HEPA filters are replaced or unit is moved

Test by : Mr. Purwadee Krawila

Approved by :

(Mr. Kridsada Thinhmatooi)

Authorized Signatory

Issued Date : 16/10/2023

This calibration certificate documents the traceability to national standards, which realizes 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.

Megafil Co., Ltd.

MG-FM-7.8-001, R00 (01/07/19)



MEGAFIL CO., LTD.

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Page 2 of 6

Certificate No. : M1333/23

- 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 Above anah
2	8	1/4, 3/4	1/8, 3/8	100 mm

Measurement Data. (m/s.)

0.35	0.41	0.42	0.41
0.39	0.34	0.35	0.34

Average velocity 0.38 m/s (75 FPM.) Velocity range 0.35-0.50 m/s (69-96 FPM.)

Uniformity(EN: $\pm 20\%$ 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) 882 CFM.

Result Summary ☒ Pass ☐ Fail

Equipment used : Thermo Anemometer Model 425 S/N : 03004786 Calibration date : 16/02/2023



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Page 3 of 6

Certificate No. : M1333/23

2. Inflow velocity test.

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

MGF's Specifications method

0.56	0.56	0.57	0.56	0.54
0.59	0.54	0.55	0.56	0.57
0.57	0.56	0.57	0.54	0.58
0.56	0.58	0.57	0.58	0.59
0.57	0.54	0.54	0.55	0.57

(m/s.)

Average Inflow velocity 0.47 m/s (93 FPM.) Velocity range 0.40 m/s (79 FPM.)

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

Inflow volume(Q) 372 CFM

Result Summary ☒ Pass ☐ Fail

Adjustments Required ☐ Fan Speed ☐ Damper

Equipment used : Thermo Anemometer Model 425 S/N : 03004786 Calibration date : 16/02/2023

3. HEPA filter leak test.

Measurement Data

HEPA Filter	PAO Upstream Conc.(calculated)	Specification	Measured leak penetration
Supply HEPA Filter	17 $\mu\text{g/L}$	$<0.003\%$	$<0.003\%$
Exhaust HEPA Filter	17 $\mu\text{g/L}$	$<0.003\%$	$<0.003\%$

Megafil Co., Ltd.

MG-FM-7.8-001, R00 (01/07/19)

Megafil Co., Ltd.

MG-FM-7.8-001, R00 (01/07/19)

ภาคผนวก ข-6

Certificate No. : M1333/23

Leak location

Supply HEPA Filter
Back



Exhaust HEPA Filter
Back



Result Summary

☒ Pass ☐ Fail

Equipment used : Aerosol Photometer Model TDA-2H S/N : 21683 Calibration date : 16/02/2023

Equipment used : Smoke Generator Model TDA-6C S/N : 21623

4. Airflow smoke pattern test

Measurement Information

1. 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
2. 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.
3. 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.
4. 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. : M1333/23

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

231111 Site installation ไม่มีการพบข้อบกพร่องใดๆ

6. Illumination Test (Lighting) : Option

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

Lux

609	959	932	557
861	1439	1486	765

Remark :

Certificate No. : M1333/23

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/m² when measures at work floor surface.

mW/m²

690	1490	1520	720
440	960	970	430

Remark :

Certificate of Calibration

LIQUID BATH



Certificate No.: MC 2314268

Page 1 of 3

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

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

Checked by : Chalermkiet Rakphada
(Calibration Engineer)

Approved by : Aittipong Kanyana
(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.

Certificate No.: MC 2314268

Page 2 of 3

Reference Standard Instrument :

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

Traceability :

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

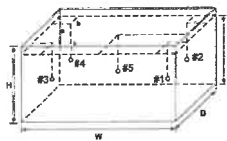
I. Calibration Procedure:

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

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

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

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



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

Checked by : Chalermkit

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

Certificate No.: MC 2314268

Page 3 of 3

2. Result of calibration :

Temperature Measurement Accuracy Test

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

Chamber Characterization Result

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

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

This certificate will certify of the calibrated equipment only.

End of Certificate

Checked by : Chalermkit

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

Certificate of Calibration

**TEMPERATURE
CONTROLLER ENCLOSURES**



Certificate No.: MC 2314270

Page 1 of 3

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

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

Checked by : Chalermkit
Chalermkit Rakphada
(Calibration Engineer)

Approved by : Aittipong
Aittipong Kachan Kasit
(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 2314270

Page 2 of 3

Reference Standard Instrument :

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

Traceability :

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

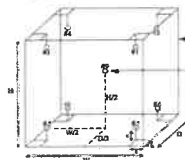
I. Calibration Procedure:

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.



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

Checked by : Chalermkit

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

Certificate No.: MC 2314270

Page 3 of 3

2. Result of calibration :

Temperature Measurement Accuracy Test

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

Chamber Characterization Result

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

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

This certificate will certify of the calibrated equipment only.

End of Certificate

Checked by : Chalermit

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

Certificate of Calibration

AUTOClave



Certificate No.: MC 2314269

Page 1 of 3



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

Reference Job No. : 23-2833 Received Date : 15 December 2023
Description : Autoclave
Manufacturer : TOMY Model : Autoclave ES-315
Serial No. : 51135128 ID. No. : WWL 0083
Marking : Additionally for the purpose of identification by this laboratory a label marked with this certificate number (MC 2314269) has been attached to the case.
Method : In-House calibration procedure MWI-T-036 this method is reference to based on BS 2646 : 1993 Part 5 "Autoclave".
Location of Calibration : Water Analysis Center Co., Ltd. ; Laboratory.
Environmental Condition : Ambient Temperature : (29.4 to 30.7) °C
Relative Humidity : (50.0 to 52.0) %
Date of Calibration : 15 December 2023 Date of Issue : 19 December 2023

Checked by : Chalermit
Chalermit Rakphada
(Calibration Engineer)

Approved by : Aittipong
Aittipong Kanjanasasi
(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 2314269

Page 2 of 3

Reference Standard Instrument :

Description	Certificate No.	Serial No.	Due date	Traceable thru
Temperature Recorder RTD 100 Ohm	MC 2300163	M79232	9 Jan 2024	MCAL
Temperature Recorder RTD 100 Ohm	MC 2300164	5978194	9 Jan 2024	MCAL
Temperature Recorder RTD 100 Ohm	MC 2300165	M79251	9 Jan 2024	MCAL

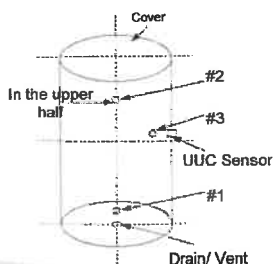
Traceability :

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

1. Calibration Procedure:

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

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



- Overall Line Voltage variation : 0.0 V

Checked by : Chalermit

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

Certificate No.: MC 2314269

Page 3 of 3

2. Result of calibration :

Temperature Measurement Accuracy Test

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

Characterization Result

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

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

This certificate will certify of the calibrated equipment only.

End of Certificate

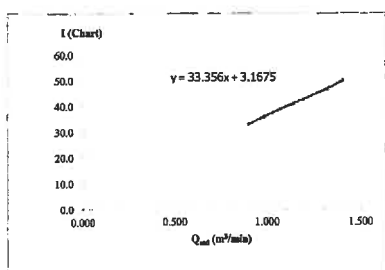
Checked by : Chalermit

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

High Volume Air Sampler Calibration Worksheet

Project Site : สถานอุตสาหกรรมโรจนะอุบลฯ (โครงการ 4) Page 1 of 1
Location : ทุ่งนา
Date of measurement : 7/5/2024
Worksheet No. : C-070524-WWL0093 Calibration Office :
High Volume ID : WWL0093 Calibrator ID : WWL0103
High Volume Model : TE-S170 (TSP) Calibrator Model : TE-S028A
High Volume S/N : 2729 Calibrator S/N : 3271
Ambient Condition : Calibrate Date : 27/03/2024
Temperature (°C) : 26 Quality Standard Slope : 1.59186
Barometric Pressure (mmHg) : 756 Quality Standard Intercept : -0.01922

Test No.	delta H ₂ O (inch)	Q _{std} (m³/min)	I (Chart)	IC (Corrected)	Linear Regression
1	4.90	1.397	50.0	49.80	Slope : 33.22 Intercept : 3.155 Correlation Coefficient : 0.9995
2	4.40	1.324	47.0	46.81	
3	3.20	1.131	41.0	40.83	
4	2.40	0.981	36.0	35.85	
5	2.00	0.897	33.0	32.87	



Calibrated by :
Mr. JITTAWEE WONGMAKHEE

Approved by :
Mr. RUNGSASIKORN KOSUM

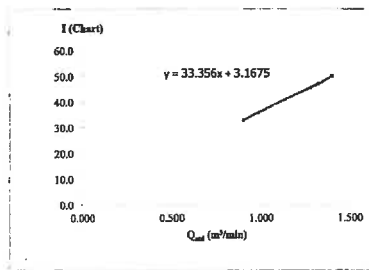
POLAB 5.5-105

แก้ไขครั้งที่ : วันที่บังคับใช้ : 1 ธ.ค. 2560 หน้า : 1 ของ 1

High Volume Air Sampler Calibration Worksheet

Project Site : สถานอุตสาหกรรมโรจนะอุบลฯ (โครงการ 4) Page 1 of 1
Location : หนองน้ำเขื่อน
Date of measurement : 7/5/2024
Worksheet No. : C-070524-WWL0095 Calibration Office :
High Volume ID : WWL0095 Calibrator ID : WWL0103
High Volume Model : TE-S170 (TSP) Calibrator Model : TE-S028A
High Volume S/N : 2727 Calibrator S/N : 3271
Ambient Condition : Calibrate Date : 27/03/2024
Temperature (°C) : 26 Quality Standard Slope : 1.59186
Barometric Pressure (mmHg) : 756 Quality Standard Intercept : -0.01922

Test No.	delta H ₂ O (inch)	Q _{std} (m³/min)	I (Chart)	IC (Corrected)	Linear Regression
1	4.90	1.397	50.0	49.80	Slope : 33.22 Intercept : 3.155 Correlation Coefficient : 0.9997
2	4.40	1.324	47.0	46.81	
3	3.20	1.131	41.0	40.83	
4	2.40	0.981	36.0	35.85	
5	2.00	0.897	33.0	32.87	



Calibrated by :
Mr. JITTAWEE WONGMAKHEE

Approved by :
Mr. RUNGSASIKORN KOSUM

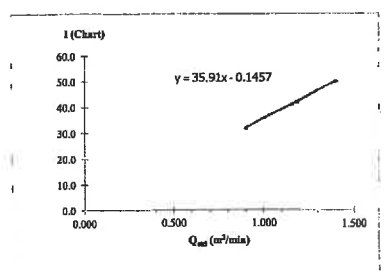
POLAB 5.5-105

แก้ไขครั้งที่ : วันที่บังคับใช้ : 1 ธ.ค. 2560 หน้า : 1 ของ 1

High Volume Air Sampler Calibration Worksheet

Project Site : สถานอุตสาหกรรมโรจนะอุบลฯ (โครงการ 4) Page 1 of 1
Location : ทุ่งนา
Date of measurement : 7/5/2024
Worksheet No. : C-070524-WWL0223 Calibration Office :
High Volume ID : WWL0223 Calibrator ID : WWL0103
High Volume Model : TE-S170 (TSP) Calibrator Model : TE-S028A
High Volume S/N : 2738 Calibrator S/N : 3271
Ambient Condition : Calibrate Date : 27/03/2024
Temperature (°C) : 26 Quality Standard Slope : 1.59186
Barometric Pressure (mmHg) : 756 Quality Standard Intercept : -0.01922

Test No.	delta H ₂ O (inch)	Q _{std} (m³/min)	I (Chart)	IC (Corrected)	Linear Regression
1	4.90	1.397	50.0	49.80	Slope : 35.77 Intercept : -0.145 Correlation Coefficient : 0.9996
2	4.10	1.279	46.0	45.81	
3	3.50	1.183	42.0	41.83	
4	2.50	1.001	36.0	35.85	
5	2.00	0.897	32.0	31.87	



Calibrated by :
Mr. JITTAWEE WONGMAKHEE

Approved by :
Mr. RUNGSASIKORN KOSUM

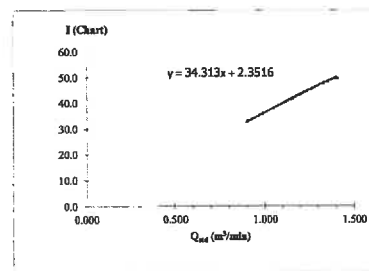
POLAB 5.5-125

แก้ไขครั้งที่ : วันที่บังคับใช้ : 1 ธ.ค. 2560 หน้า : 1 ของ 1

High Volume Air Sampler Calibration Worksheet

Project Site : สถานอุตสาหกรรมโรจนะอุบลฯ (โครงการ 4) Page 1 of 1
Location : ทุ่งนา
Date of measurement : 7/5/2024
Worksheet No. : C-070524-WWL0094 Calibration Office :
High Volume ID : WWL0094 Calibrator ID : WWL0103
High Volume Model : TE-S170 (TSP) Calibrator Model : TE-S028A
High Volume S/N : 2736 Calibrator S/N : 3271
Ambient Condition : Calibrate Date : 27/03/2024
Temperature (°C) : 26 Quality Standard Slope : 1.59186
Barometric Pressure (mmHg) : 756 Quality Standard Intercept : -0.01922

Test No.	delta H ₂ O (inch)	Q _{std} (m³/min)	I (Chart)	IC (Corrected)	Linear Regression
1	4.90	1.397	50.0	49.80	Slope : 34.17 Intercept : 2.342 Correlation Coefficient : 0.9995
2	4.40	1.324	48.0	47.81	
3	3.30	1.149	42.0	41.83	
4	2.40	0.981	36.0	35.85	
5	2.00	0.897	33.0	32.87	



Calibrated by :
Mr. JITTAWEE WONGMAKHEE

Approved by :
Mr. RUNGSASIKORN KOSUM

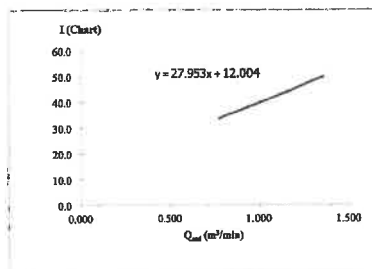
POLAB 5.5-125

แก้ไขครั้งที่ : วันที่บังคับใช้ : 1 ธ.ค. 2560 หน้า : 1 ของ 1

High Volume Air Sampler Calibration Worksheet

Project Site : ส่วนอุตสาหกรรมโรงงานสุรา (โครงการ 4) Page 1 of 1
Location : โรงงานสุรา
Date of measurement : 7/5/2024
Worksheet No. : C-070524-WWL0097 Calibration Office
High Volume ID : WWL0097 Calibrator ID : WWL0103
High Volume Model : TE-5170 (TSP) Calibrator Model : TE-5028A
High Volume S/N : 2726 Calibrator S/N : 3271
Ambient Condition : Calibrate Date : 27/03/2024
Temperature (°C) : 26 Quality Standard Slope : 1.59186
Barometric Pressure (mmHg) : 756 Quality Standard Intercept : -0.01922

Test No.	delta H ₂ O (inch)	Q _{as} (m³/min)	I (Chart)	IC (Corrected)	Linear Regression
1	4.60	1.354	50.0	49.80	Slope : 27.84 Intercept : 11.956 Correlation Coefficient : 0.9991
2	3.30	1.149	44.0	43.82	
3	2.50	1.001	40.0	39.84	
4	2.20	0.940	38.0	37.85	
5	1.50	0.778	34.0	33.86	



Calibrated by :
Mr. JITTAWEE WONGMAKHEEB

Approved by :
Mr. RUNGRASAKORN KOSUM

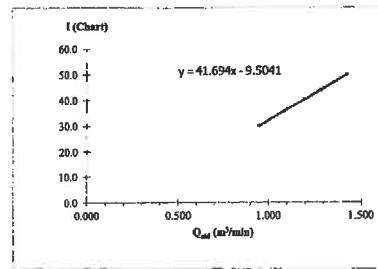
FO.LAB 5.5-1025

แก้ไขครั้งที่ : วันที่ยกเลิกใช้ : 1 ธ.ค. 2560 หน้า : 1 ของ 1

High Volume Air Sampler Calibration Worksheet

Project Site : ส่วนอุตสาหกรรมโรงงานสุรา (โครงการ 4) Page 1 of 1
Location : โรงงานสุรา
Date of measurement : 7/5/2024
Worksheet No. : C-070524-WWL0098 Calibration Office
High Volume ID : WWL0098 Calibrator ID : WWL0103
High Volume Model : TE-6070 (PM10) Calibrator Model : TE-5028A
High Volume S/N : 2734 Calibrator S/N : 3271
Ambient Condition : Calibrate Date : 27/03/2024
Temperature (°C) : 26 Quality Standard Slope : 0.99709
Barometric Pressure (mmHg) : 756 Quality Standard Intercept : -0.01199

Test No.	delta H ₂ O (inch)	Q _{as} (m³/min)	I (Chart)	IC (Corrected)	Linear Regression
1	5.00	1.422	50.0	31.44	Slope : 26.22 Intercept : -5.977 Correlation Coefficient : 0.9996
2	4.10	1.289	44.0	27.67	
3	3.50	1.192	40.0	25.15	
4	2.90	1.086	36.0	22.64	
5	2.20	0.947	30.0	18.87	



Calibrated by :
Mr. JITTAWEE WONGMAKHEEB

Approved by :
Mr. RUNGRASAKORN KOSUM

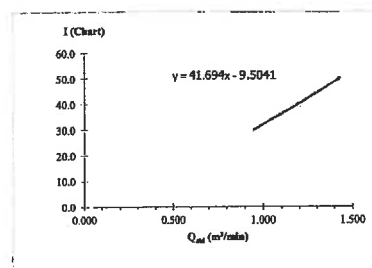
FO.LAB 5.5-1025

แก้ไขครั้งที่ : วันที่ยกเลิกใช้ : 1 ธ.ค. 2560 หน้า : 1 ของ 1

High Volume Air Sampler Calibration Worksheet

Project Site : ส่วนอุตสาหกรรมโรงงานสุรา (โครงการ 4) Page 1 of 1
Location : โรงงานสุรา
Date of measurement : 7/5/2024
Worksheet No. : C-070524-WWL0100 Calibration Office
High Volume ID : WWL0100 Calibrator ID : WWL0103
High Volume Model : TE-6070 (PM10) Calibrator Model : TE-5028A
High Volume S/N : 2735 Calibrator S/N : 3271
Ambient Condition : Calibrate Date : 27/03/2024
Temperature (°C) : 26 Quality Standard Slope : 0.99709
Barometric Pressure (mmHg) : 756 Quality Standard Intercept : -0.01199

Test No.	delta H ₂ O (inch)	Q _{as} (m³/min)	I (Chart)	IC (Corrected)	Linear Regression
1	5.00	1.422	50.0	31.44	Slope : 26.22 Intercept : -5.977 Correlation Coefficient : 0.9998
2	4.10	1.289	44.0	27.67	
3	3.50	1.192	40.0	25.15	
4	2.90	1.086	36.0	22.64	
5	2.20	0.947	30.0	18.87	



Calibrated by :
Mr. JITTAWEE WONGMAKHEEB

Approved by :
Mr. RUNGRASAKORN KOSUM

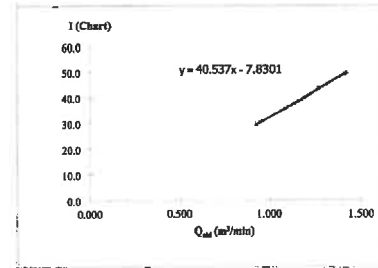
FO.LAB 5.5-1025

แก้ไขครั้งที่ : วันที่ยกเลิกใช้ : 1 ธ.ค. 2560 หน้า : 1 ของ 1

High Volume Air Sampler Calibration Worksheet

Project Site : ส่วนอุตสาหกรรมโรงงานสุรา (โครงการ 4) Page 1 of 1
Location : โรงงานสุรา
Date of measurement : 7/5/2024
Worksheet No. : C-070524-WWL0224 Calibration Office
High Volume ID : WWL0224 Calibrator ID : WWL0103
High Volume Model : TE-6070 (PM10) Calibrator Model : TE-5028A
High Volume S/N : 2739 Calibrator S/N : 3271
Ambient Condition : Calibrate Date : 27/03/2024
Temperature (°C) : 26 Quality Standard Slope : 0.99709
Barometric Pressure (mmHg) : 756 Quality Standard Intercept : -0.01199

Test No.	delta H ₂ O (inch)	Q _{as} (m³/min)	I (Chart)	IC (Corrected)	Linear Regression
1	5.00	1.422	50.0	31.44	Slope : 25.49 Intercept : -4.924 Correlation Coefficient : 0.9991
2	4.00	1.273	44.0	27.67	
3	3.50	1.192	40.0	25.15	
4	2.90	1.086	36.0	22.64	
5	2.10	0.926	30.0	18.87	



Calibrated by :
Mr. JITTAWEE WONGMAKHEEB

Approved by :
Mr. RUNGRASAKORN KOSUM

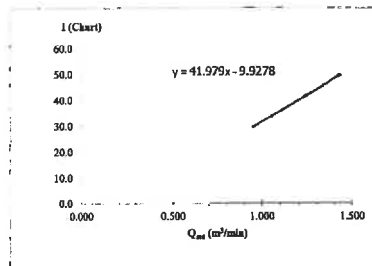
FO.LAB 5.5-1025

แก้ไขครั้งที่ : วันที่ยกเลิกใช้ : 1 ธ.ค. 2560 หน้า : 1 ของ 1

High Volume Air Sampler Calibration Worksheet

Project Site : **สวนอุตสาหกรรมโรจนะอุตสาหกรรม (โรงงาน 4)** Page 1 of 1
 Location : **พื้นที่ภาคกลางตอนบน**
 Date of measurement : **7/5/2024**
 Worksheet No. : **C-070524-WWL0099** Calibration Orifice :
 High Volume ID : **WWL0099** Calibrator ID : **WWL0103**
 High Volume Model : **TE-6070 (PM10)** Calibrator Model : **TE-5028A**
 High Volume S/N : **2732** Calibrator S/N : **3271**
 Ambient Condition : **27/03/2024**
 Temperature (°C) : **26** Quality Standard Slope : **0.99709**
 Barometric Pressure (mmHg) : **756** Quality Standard Intercept : **-0.01199**

Test No.	delta H ₂ O (inch)	Q _{std} (m³/min)	I (Chart)	IC (Corrected)	Linear Regression
1	5.00	1.422	50.0	31.44	Slope : 26.40 Intercept : -6.243 Correlation Coefficient : 0.9998
2	4.40	1.335	46.0	28.93	
3	3.80	1.241	42.0	26.41	
4	2.70	1.048	34.0	21.38	
5	2.20	0.947	30.0	18.87	



Calibrated by :
 Mr. JITTAWEE WONGMAKHEEB

Approved by :
 Mr. RUNGSASIKORN KOSUM

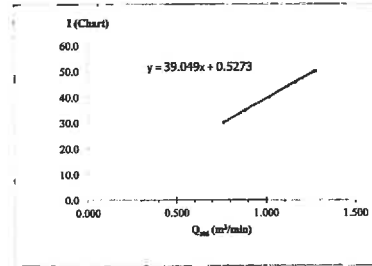
FOLAB 5.5-1/25

วันที่ทำ : 1 วันที่สอบ : 1 วันที่ : 1 วันที่ : 1

High Volume Air Sampler Calibration Worksheet

Project Site : **สวนอุตสาหกรรมโรจนะอุตสาหกรรม (โรงงาน 4)** Page 1 of 1
 Location : **พื้นที่ภาคกลางตอนบน**
 Date of measurement : **7/5/2024**
 Worksheet No. : **C-070524-WWL0102** Calibration Orifice :
 High Volume ID : **WWL0102** Calibrator ID : **WWL0103**
 High Volume Model : **TE-6070 (PM10)** Calibrator Model : **TE-5028A**
 High Volume S/N : **2731** Calibrator S/N : **3271**
 Ambient Condition : **27/03/2024**
 Temperature (°C) : **26** Quality Standard Slope : **0.99709**
 Barometric Pressure (mmHg) : **756** Quality Standard Intercept : **-0.01199**

Test No.	delta H ₂ O (inch)	Q _{std} (m³/min)	I (Chart)	IC (Corrected)	Linear Regression
1	4.00	1.273	50.0	31.44	Slope : 24.56 Intercept : 0.332 Correlation Coefficient : 0.9997
2	3.30	1.158	46.0	28.93	
3	2.50	1.009	40.0	25.15	
4	1.90	0.881	35.0	22.01	
5	1.40	0.758	30.0	18.87	



Calibrated by :
 Mr. JITTAWEE WONGMAKHEEB

Approved by :
 Mr. RUNGSASIKORN KOSUM

FOLAB 5.5-1/25

วันที่ทำ : 1 วันที่สอบ : 1 วันที่ : 1 วันที่ : 1



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 done

Client: **Envir Service Co., Ltd.**
 Serial: **2310DR0044**
 Calibration Date: **2024/3/29**
 Calibration Expiry Date: **2025/3/28**

The Result of Calibration

Measured Value (m/s)	Actual Value (m/s)	Deviation	Tolerance	Result
1.0	0.0	0.0	0.0-1.1	Pass
1.9	0.0	0.0	1.0-2.2	Pass
4.9	0.1	0.1	4.1-5.3	Pass
7.1	0.1	0.1	6.0-8.0	Pass
10.0	0.0	0.0	9.5-10.5	Pass
19.0	0.0	0.0	18.0-20.0	Pass

Measured Value (m/s)	Actual Value (m/s)	Wind Direction Deviation	Tolerance	Result
4.9	135°	0	42-48	Pass
135°	0	0	132-138	Pass
224°	0	0	222-228	Pass
314°	0	0	312-318	Pass
319°	0	0	317-3	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	1004	3	1001-1009	Pass

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

Performed by :
 Certified by Head of Engineer

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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 done

Client: **Envir Service Co., Ltd.**
 Serial: **2302DR0081**
 Calibration Date: **2024/3/29**
 Calibration Expiry Date: **2025/3/28**

The Result of Calibration

Measured Value (m/s)	Actual Value (m/s)	Deviation	Tolerance	Result
1.0	0.0	0.0	0.0-1.1	Pass
1.9	0.0	0.0	1.0-2.2	Pass
4.9	0.1	0.1	4.1-5.3	Pass
7.1	0.1	0.1	6.0-8.0	Pass
10.0	0.0	0.0	9.5-10.5	Pass
19.0	0.0	0.0	18.0-20.0	Pass

Measured Value (m/s)	Actual Value (m/s)	Wind Direction Deviation	Tolerance	Result
4.9	135°	0	42-48	Pass
135°	0	0	132-138	Pass
224°	0	0	222-228	Pass
314°	0	0	312-318	Pass
319°	0	0	317-3	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	1004	3	1001-1009	Pass

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

Performed by :
 Certified by Head of Engineer

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Certificate of Calibration

WL-21 Wireless Anemometer

Scarlet Tech Ltd. hereby certifies that the WL-21 wireless anemometer listed below was thoroughly calibrated, tested and inspected following the standard calibration procedure (at-wl-20) and is within manufacturer's specification at the time when the calibration is done

Client: Envir Service Co., Ltd.
Serial: 23020R0083
Calibration Date: 2024/3/29
Calibration Expiry Date: 2025/3/28

The Result of Calibration

Measured Value (m/s)	Actual Value (m/s)	Velocity Deviation	Tolerance	Result
1.0	1.0	0.0	0.5-1.1	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	7.1	0.1	6.8-7.4	Pass
10.0	10.0	0.0	9.5-10.5	Pass
19.6	20.0	0.4	19.5-20.5	Pass

Measured Value (m/s)	Actual Value (m/s)	Wind Direction Deviation	Tolerance	Result
49°	49°	1	42-48	Pass
135°	135°	0	132-138	Pass
225°	225°	0	222-228	Pass
315°	315°	1	310-318	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	1000-1009	Pass

Environment Conditions:
Air temperature: 22.2 °C
Relative humidity: 55.2 %
Static pressure: 102.2 kPa

Performed by: 
Certified by Head of Engineering Department

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Certificate of Calibration

WL-21 Wireless Anemometer

Scarlet Tech Ltd. hereby certifies that the WL-21 wireless anemometer listed below was thoroughly calibrated, tested and inspected following the standard calibration procedure (at-wl-20) and is within manufacturer's specification at the time when the calibration is done

Client: Envir Service Co., Ltd.
Serial: 23020R0090
Calibration Date: 2024/3/29
Calibration Expiry Date: 2025/3/29

The Result of Calibration

Measured Value (m/s)	Actual Value (m/s)	Velocity Deviation	Tolerance	Result
1.0	1.0	0.0	0.5-1.1	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	7.1	0.1	6.8-7.4	Pass
10.0	10.0	0.0	9.5-10.5	Pass
19.6	20.0	0.4	19.5-20.5	Pass

Measured Value (m/s)	Actual Value (m/s)	Wind Direction Deviation	Tolerance	Result
49°	49°	1	42-48	Pass
135°	135°	0	132-138	Pass
225°	225°	0	222-228	Pass
315°	315°	1	310-318	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	1004	3	1000-1009	Pass

Environment Conditions:
Air temperature: 22.2 °C
Relative humidity: 55.2 %
Static pressure: 102.2 kPa

Performed by: 
Certified by Head of Engineering Department

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Web site: www.jirante.com

Accredited calibration laboratory
ISO/IEC 17025:2017
MSC-150-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: Wind Direction Sensor
MANUFACTURER: Honeywell
MODEL/TYPE: SCA-105-02P
SIGNAL NUMBER: Data Logger: 208-W5-235
Data Logger: RS-040
Data Logger: AS040
ID NUMBER: -
CONDITION AS-RECEIVED: -
CUSTOMER: -
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 ± 5.0 %RH
Atmospheric Pressure: 1012.6 ± 0.5 kPa

PLACE OF CALIBRATION: E884-type wind tunnel of Jirante Associates Co., Ltd.


CALIBRATION CONDITION:
Wind tunnel cross-section area¹: 900 cm²
Wind direction frontal area²: 129 cm²
Diameter of measuring pipe³: mm
Blockage ratio by test object⁴: 0.5-49 %

Preconditioning: 24 hours in ambient conditions.
Measurement Condition: The average sphere during measurement are (23.8)°C, (41.1) %RH and (1012.5) kPa.

TABULATION OF RESULTS:
The table on next page give the measured values.

Calibrated by:
[Signature]
[Signature]



Approved signature: 
Air Purveyor
Calibration Department Manager

Remarks:
¹ Inside cross-section area of the wind tunnel
² Projected cross-section area of the tested object include measuring pipe
³ Diameter of measuring pipe
⁴ Ratio: $\frac{A}{B}$

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-026-66

Page 2 of 2 Pages

MEASUREMENT RESULTS⁵

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 counter-clockwise 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 ⁶ ₉₀ Degrees (°)	D ⁶ ₄₅ Degrees (°)	Error Degrees (°)	D (R=2) Degrees (°)
5.05	45.000	41	-4	1.0
	90.000	87	-3	1.0
	135.000	133	-2	1.0
	180.000	180	0	1.0
	225.001	227	2	1.0
	270.001	273	3	1.0
10.10	315.000	319	4	1.0
	360.000	359	-1	1.0

Remarks:

⁵ Calibration results only count for the tested circumstances and environmental conditions during which calibration has been made.
⁶ Direction of standard
⁷ Direction of Unit Under Calibration



End of Calibration

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Honeywell
MODEL/TYPE : Sensor: WS-42F
Data logger: 200-WS-254B
SERIAL NUMBER : Sensor: WS-040
Data logger: AS040
LO NUMBER :
CONDITION AS RECEIVED : Used item
CUSTOMER : Water Analysis Center Co., Ltd.
54/1 Moo 5, T.Jarathin, A.U.District, Ayutthaya 13220

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

ENVIRONMENTAL CONDITIONS
Ambient condition in the laboratory are as follows:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1000 ± 10 hPa

PLACE OF CALIBRATION : Effort-type wind tunnel of Jirante Associates Co., Ltd.

CALIBRATION CONDITIONS
Wind tunnel cross-section (mm) : 900 mm
Wind direction (frontal area) : 100 mm²
Diameter of mounting pipe : 100 mm
Blockage ratio of test object : 0.113 %

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.5) °C, (42.5) %RH and (1000.5) hPa.

TABULATION OF RESULTS
The table on next page give the tabulated results.



Approved signature:
Mr. Parinya Booncharoen
Calibration Department Manager

Remarks:
1. Results cross-section is 100 mm of the wind tunnel.
2. Projected cross-section area of the tested object include mounting pipe.
3. Diameter of mounting pipe.
4. Ratio 100 %

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Certificate Number

CL-028-66

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MEASUREMENT RESULTS

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

UUC (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V _{ref} (m/s)	Error (m/s)	U _{ref} (m/s)
1.057	24.24	24.45	0.9	-0.1	0.91
2.052	24.70	24.45	1.9	-0.1	1.94
3.054	24.46	24.45	3.0	-0.1	2.91
4.237	24.70	24.46	4.0	-0.2	3.81
5.82	24.40	24.45	4.9	-0.2	4.61
5.59	24.70	24.45	5.9	-0.2	5.61
7.04	24.60	24.45	6.9	-0.2	6.61
8.27	24.62	24.45	8.1	-0.2	7.91
9.07	24.54	24.45	9.0	-0.2	8.81
10.07	24.40	24.45	10.0	-0.2	9.81
11.13	24.50	24.45	11.0	-0.2	10.81
12.13	24.36	24.45	12.0	-0.1	11.81
13.18	24.50	24.45	13.0	-0.1	12.81
14.24	24.40	24.45	14.0	-0.1	13.81
15.22	24.40	24.45	15.0	-0.1	14.81
16.27	24.40	24.45	16.0	-0.2	15.81

Remarks:

1. Calibration results only valid for the tested circumstances and environmental conditions during which calibration took place

2. Velocity of master

3. Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



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



W	PO.LAB 6-4-1/28	เมทริกซ์ที่ : 0	วันที่บังคับใช้ : 1 มี.ค. 2562	หน้า : 1 ของ 1
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แบบบันทึกการทวนสอบเครื่อง Sound Level Meter

เครื่อง CA111 Sound Calibrator S/N 520272	รหัสเครื่อง : SR004	เกณฑ์การยอมรับ 93.77 ± 0.3, 113.84 ± 0.3
วันที่สอบเทียบ 15/05/66	วันที่สอบเทียบครั้งต่อไป 14/05/67	
เครื่อง Digital Thermohygrometer S/N 105091609	รหัสเครื่อง : WWL 0055	
วันที่สอบเทียบ 29/11/66	วันที่สอบเทียบครั้งต่อไป 28/11/67	
เครื่อง Sound Level Meter S/N 00396923	รหัสเครื่อง : WWL 0161	
วันที่สอบเทียบ 31/05/66	วันที่สอบเทียบครั้งต่อไป 30/05/68	

การทวนสอบห้องสอบเทียบ

อุณหภูมิ (°C) 25 เกณฑ์การยอมรับ 23.0 ± 3.0
ความชื้นสัมพัทธ์ (%) 51 เกณฑ์การยอมรับ 50.0 ± 15.0
วันที่ทวนสอบ 07/05/67

การทวนสอบห้องสอบเทียบ

อุณหภูมิ (°C) 25 เกณฑ์การยอมรับ 23.0 ± 3.0
ความชื้นสัมพัทธ์ (%) 51 เกณฑ์การยอมรับ 50.0 ± 15.0
วันที่ทวนสอบ 16/05/67

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

ผู้บันทึก
ผู้ตรวจสอบ

ผู้บันทึก
ผู้ตรวจสอบ

W	PO.LAB 6-4-1/28	เมทริกซ์ที่ : 0	วันที่บังคับใช้ : 1 มี.ค. 2562	หน้า : 1 ของ 1
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แบบบันทึกการทวนสอบเครื่อง Sound Level Meter

เครื่อง CA111 Sound Calibrator S/N 520272	รหัสเครื่อง : SR004	เกณฑ์การยอมรับ 93.77 ± 0.3, 113.88 ± 0.3
วันที่สอบเทียบ 09/05/67	วันที่สอบเทียบครั้งต่อไป 08/05/68	
เครื่อง Digital Thermohygrometer S/N 105091609	รหัสเครื่อง : WWL 0055	
วันที่สอบเทียบ 29/11/66	วันที่สอบเทียบครั้งต่อไป 28/11/67	
เครื่อง Sound Level Meter S/N 00396923	รหัสเครื่อง : WWL 0160	
วันที่สอบเทียบ 31/05/66	วันที่สอบเทียบครั้งต่อไป 30/05/68	

การทวนสอบห้องสอบเทียบ

อุณหภูมิ (°C) 25 เกณฑ์การยอมรับ 23.0 ± 3.0
ความชื้นสัมพัทธ์ (%) 51 เกณฑ์การยอมรับ 50.0 ± 15.0
วันที่ทวนสอบ 14/05/67

การทวนสอบห้องสอบเทียบ

อุณหภูมิ (°C) 25 เกณฑ์การยอมรับ 23.0 ± 3.0
ความชื้นสัมพัทธ์ (%) 51 เกณฑ์การยอมรับ 50.0 ± 15.0
วันที่ทวนสอบ 15/05/67

Item	ระดับเสียงที่วัดได้ (dB) (ความดังที่ 94.0dB)	ระดับเสียงที่วัดได้ (dB) (ความดังที่ 114.0dB)	Item	ระดับเสียงที่วัดได้ (dB) (ความดังที่ 94.0dB)	ระดับเสียงที่วัดได้ (dB) (ความดังที่ 114.0dB)
1	93.8	113.9	1	93.8	113.9
2	93.8	113.9	2	93.8	113.9
3	93.8	113.9	3	93.8	113.9
4	93.8	113.9	4	93.8	113.9
5	93.8	113.9	5	93.8	113.9
6	93.8	113.9	6	93.8	113.9
7	93.8	113.9	7	93.8	113.9
8	93.8	113.9	8	93.8	113.9
9	93.8	113.9	9	93.8	113.9
10	93.8	113.9	10	93.8	113.9
X	93.80	113.90	X	93.80	113.90
SD	0.00	0.00	SD	0.00	0.00
%RSD (≤ 10)	0.00	0.00	%RSD (≤ 10)	0.00	0.00
ผลการ ทวนสอบ	ผ่าน	ผ่าน	ผลการ ทวนสอบ	ผ่าน	ผ่าน

ผู้บันทึก
ผู้ตรวจสอบ

ผู้บันทึก
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