

ภาคผนวก ข

เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์

CERTIFICATE OF CALIBRATION



Certificate No.: C0-1908005/22 Page 1 of total 4 pages

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

Equipment
pH Meter
Manufacturer
METTLER TOLEDO
Model
SevenCompact S220
Serial No.
B327527211
ID No.
WWL 0068
Description
Range : 0 - 14 pH, Resolution : 0.01 pH

Environmental Conditions
Ambient Temperature: (20 ± 2) °C
Relative Humidity: (50 ± 10) %
Atmospheric Pressure:
Jayhawks Laboratory (CL&GL)
Calibration Location
19 August 2022
Received Date
19 August 2022
Calibration Date

Date of Issue
22 August 2022

Checked by  **Approved by** 
Act as Technical Manager Representative of Managing Director
(Dr. Ekachai Puttitwong)
() (Krisyosl K.) () (Sakda Y.)
() (Patiphan K.) () (Onnapa P.)
() (Pongsak H.) () (Nitiphong K.)
() (Kanung C.) () (Nonthachai K.)
() (Pramong P.) () (Noppol P.)

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

Certificate No.: C0-1908005/22 Page 2 of total 4 pages

Reference Method:

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

Reference Standard:

Type	pH Value	Lot No.	Due Date	Traceability
pH Standard Solution	4.01	081020	Jan. 22, 2023	NIMT
	7.01	020221	Jan. 18, 2023	
	10.00	091020	Feb. 7, 2023	

Type	Model	Serial No.	Certificate No.	Due Date	Traceability
Documenting Process Calibrator	753	3101007	I0-0804001/22	Apr. 7, 2023	THC
Digital Thermometer with Sensor	1523 / 5622	1709138 / 4605984-005	I0-1006004/22	Jun. 9, 2023	

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

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

Measurement Results:

1. Function Simulated pH Meter

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

UUC : Unit Under Calibration

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

Certificate No.: C0-1908005/22

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Measurement Results (Cont.):

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

pH Standard Solution (pH)	Measured Value		Uncertainty (± pH)
	(pH)	(mV)	
4.01	4.01	185.9	0.013
7.01	7.01	9.3	0.013
10.00	10.01	-164.9	0.013

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

Temperature stability of micro bath : 25 ± 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.: C0-1908005/22

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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	I0-1011001/21	Nov. 10, 2022	THC
Platinum Resistance Thermometer	5626	4854	C0A30047	Oct. 22, 2023	FLUKE
Liquid Bath	XORTS-40A	XO111019	I0-0306002/21	Jun. 3, 2023	THC

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

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

Measurement Results:

(X) Without Adjustment

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

Immersion Depth (mm.)	Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
120	22.00	22.0	0.00	0.060
120	25.00	25.0	0.00	0.060
120	28.00	28.0	0.00	0.060

UUC : Unit Under Calibration

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

- End of Certificate -

CERTIFICATE OF CALIBRATION

Certificate No.: C0-2007006/22

Page 1 of total 2 pages

Customer
WATER ANALYSIS CENTER CO., LTD.
30/5 Soi Vipavadee 60, Vipavadee Rangsit Road,
Kwaeng Taladbangkhien, Khet Laksi, Bangkok 10210

Equipment
Conductivity Meter
Manufacturer
EUTECH
Serial No.
2657889
Description
-

Model
CON 2700
ID No.
WWL 0136

Environmental Conditions
Ambient Temperature: (20 ± 2) °C
Relative Humidity: (50 ± 10) %
Atmospheric Pressure: -
Calibration Location
Jayhawks Laboratory (CL&GL)
Received Date
20 July 2022
Calibration Date
20 July 2022

Date of Issue
21 July 2022

Checked by

Act as Technical Manager

() (Krisyol K.) () (Sakda Y.)
() (Patiphan K.) () (Onnape P.)
() (Pongsak H.) () (Nitiphong K.)
() (Kanung C.) () (Nonthachai K.)
() (Pramong P.) () (Noppol P.)

Approved by

Representative of Managing Director

(Dr. Ekachai Puttiwong)

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FE-169

REV.02 02/24/21

Certificate No.: C0-2007006/22

Page 2 of total 2 pages

Reference Method:

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

Reference Standard :

Material	Batch Value	Lot Number	Due Date	Traceability
Conductivity Standard Solution	151.1 µS/cm 1.421 mS/cm	S211008031 S220112015	Jan. 18, 2023 May 16, 2023	SCP Science

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

Measurement Results:

Conductivity Standard Solution	Measured Value	Correction	Uncertainty (±)
151.1 µS/cm	150.9 µS/cm	0.2 µS/cm	1.5 µS/cm
1.421 mS/cm	1.423 mS/cm	-0.002 mS/cm	0.0032 mS/cm

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

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

- End of Certificate -

Calibrated by Kitipong

REV.02 02/24/21

Certificate No.: MC 2207678

The Reference Standard :

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

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

- Master Calibration Co., Ltd.

1. Calibration Procedure:

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

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

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

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

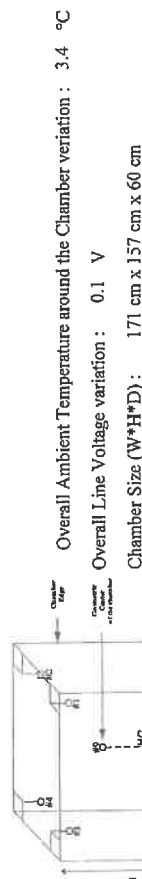


Figure 1 : Sensor Installation Location

Checked by : **Thanagorn**

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

Master Calibration Co.,Ltd.

547 Soi Ratchadapit, Kwang Samsenok, Khet Huaykwang, Bangkok 10310
Tel. : (02) 274 2978-9, (02) 2742987-8 Fax : (02) 274 2518, (02) 274 2989
Website : www.mastercalibration.com E-mail : calibrate@mastercalibration.com

MASTER CALIBRATION CO.,LTD.



TEMPERATURE
CONTROLLER ENCLOSURES

Certificate No.: MC 2207678

Page 1 of 3

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

Reference Job No. : 22-1601 Received Date : 12 July 2022
Description : Refrigerator
Manufacturer : SANDENINTERCOOL Model : SEC-1500SBD
Serial No. : SEC1500201A-0708-00304 ID. No. : WWL0038
Marking : Additionally for the purpose of identification by this laboratory a label marked with this certificate number (MC 2207678) has been attached to the case.
Method : In-House calibration procedure MWI-T-033 this method is reference to

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

Environmental Conditions : Ambient Temperature : (25.8 to 27.5) °C

Relative Humidity : (48.8 to 52.2) %

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

Checked by : **Thanagorn** Approved by : **Aitipong**
Thanagorn Limchaitcharoen Aitipong Kanjanawasit
(Calibration Supervisor) (Technical Manager)

The uncertainties are for a confidence probability of approximately 95%

This certificate is issued in accordance with the conditions of accreditation granted by the National Standardization Council of Thailand-Office of the National Standardization Council that has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of Master Calibration Co.,Ltd.

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

Certificate No.: MC 2207678

Page 3 of 3

2. Result of calibration :

Temperature Measurement Accuracy Test

Indicating Temperature (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (±°C)
	#1	#2	#3	#4	#5	#6	#7	#8	Ref. #9	
2.5	3.5	3.6	3.7	3.5	3.6	3.4	3.4	3.3	3.4	1.1

Chamber Characterization Result

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

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

This report will certify of the calibrated equipment only.

End of Certificate

Checked by :

Thanyom

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

Certificate of Calibration

TEMPERATURE CONTROLLER ENCLOSURES

Certificate No.: MC 2203933

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

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

Description : Oven

Manufacturer : Memmert Model : UF260

Serial No. : B620.0814 ID. No. : WWL0212

Marking : Additionally for the purpose of identification by this laboratory a label marked

with this certificate number (MC 2203933) has been attached to the case.

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

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

Environmental Conditions : Ambient Temperature : (30.5 to 32.6) °C

Relative Humidity : (56.2 to 61.2) %

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

Checked by :

Thanyom

Thanyom Linchaichareon
(Calibration Supervisor)

Approved by :

Aitipong

Aitipong Ka'janawasit
(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 ; Rev6 ; Date : 22/04/2021]

Certificate No.: MC 2203933

Page 2 of 3

The Reference Standard :

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

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

- Master Calibration Co., Ltd.

1. Calibration Procedure:

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

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

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

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

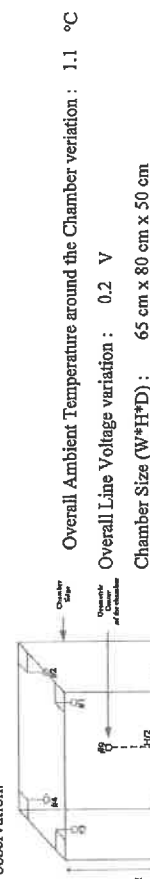


Figure 1 : Sensor Installation Location

Checked by : *Thanyam*

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

Certificate No.: MC 2203933

Page 3 of 3

2. Result of calibration :

Temperature Measurement Accuracy Test

Indicating Temperature (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (±°C)
	#1	#2	#3	#4	#5	#6	#7	#8	Ref. #9	
104.0	103.9	103.9	103.9	104.1	104.3	104.2	104.2	104.1	104.0	0.67
180.0	179.3	179.3	179.3	179.5	180.1	180.3	180.5	180.4	180.1	0.99

Chamber Characterization Result

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

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

This report will certify of the calibrated equipment only.

End of Certificate

Checked by : *Thanyam*

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



Certificate of Calibration

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


Certificate No.: C01221685
Issued Date: 08 June 2022
Job No.: KSPR2206908
Page: 1 of 2

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

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

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

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


(Mr. Preecha Phooasai)


SERT
SPC RT Co., Ltd.
(Mr. Rungrod Jenkitrakulchai)

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

Calibration Results:

Without Adjustment

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

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

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

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

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

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
1	0.99998	1.0000	0.0000	0.000097	2.02
2	1.99999	2.0000	0.0000	0.000098	2.02
5	5.00000	5.0000	0.0000	0.000099	2.02
10	10.00002	10.0000	0.0000	0.00010	2.02
20	19.99995	20.0000	0.0000	0.00011	2.01
50	50.00002	50.0000	0.0000	0.00012	2.01
70	69.99987	70.0000	0.0000	0.00015	2.00
100	100.00007	100.0001	0.0000	0.00017	2.00
120	120.00002	120.0000	0.0000	0.00020	2.00
150	150.00009	150.0002	0.0001	0.00023	2.00
200	199.99993	200.0003	0.0004	0.00029	2.00

The End of Certificate

CERTIFICATE OF CALIBRATION

Certificate No. WS-01022022
Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.
Manufacturer : Data logger: Novalyx
Model/Type : Cup anemometer: Novalyx
Serial Number : Data logger: 200-WS-251B
ID No : Cup anemometer: WS-02P
Customer : Data logger: ASD40
Test Conditions : Cup anemometer: K-040
Test Conditions : Data logger: -
Customer : Water Analysis Center Co., Ltd.
Test Conditions : 94/1 Moo 6, Thanin, A-U-thai, Ayutthaya 13210
Test Conditions : Wind tunnel cross test section area 900 cm²
Test Conditions : Anemometer frontal area 100 cm²
Test Conditions : Diameter of mounting pipe - mm
Test Conditions : Buckeye ratio of test object 0.111 [-]
Test Conditions : Air temperature 25.3 ±0.8 °C
Test Conditions : Air pressure 1011.1 ±0.4 hPa
Test Conditions : Relative air humidity 55.5 ±3.5 %RH

Calibration Procedure : Calibration was carried out base on:
IEC 61400-12-1 ED1: 2005-Power Measurements of Electricity Producing Wind Turbines;
Traceability : MEASNET Anemometer Calibration Procedure - Version 2: 2009;

This calibration documents the traceable to national standard, which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).

Measurement Date : FEB 18, 2022.
Issued Date : FEB 21, 2022.

Calibrated by
☒ Mr. Sorwit Thacheld
☐ Miss Orathai Wivattwittaya



Approved Signatory:
Mr. Panyha Boontharoen
Calibration Department Manager

THIS CERTIFICATE MAY NOT BE REPRODUCED EXCEPT IN FULL LESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY.

Continuation of Certificate of Calibration Number

Certificate No. WS-01022022
Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment
Calibration in the range of 1 - 16 m/s at a calibration interval of 1 m/s.

The results of calibration and associated measurement uncertainties are reported in the table below.

V _{ref} Reading m/s	V _{user} Reading m/s	Error (m/s)	Uncertainty (%)
2.097	2.0	-0.1	2.4
4.135	4.1	0.0	1.7
6.04	6.0	0.0	1.1
8.03	8.1	0.1	0.71
10.00	10.0	0.0	1.1
11.97	12.1	0.1	0.91
13.97	13.9	-0.1	0.53
16.04	16.1	0.1	0.60
14.97	16.1	0.1	1.2
12.97	13.0	0.0	0.87
11.01	11.0	0.0	1.5
8.99	9.0	0.0	1.4
6.98	7.0	0.0	0.85
5.171	5.2	0.0	0.97
3.033	3.0	0.0	2.3
1.034	0.9	-0.1	4.6

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pilot static	TESTO INC.	04332145	Aug 07, 2021	MW-0034-21	5 - 30 m/s
2	Predation Differential Pressure Meter	Zoglab	DPH2500	Aug 07, 2021	MW-0034-21	5 - 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8445-12	Aug 08, 2021	MW-0035-21	0 - 5 m/s
4	Temperature	Zoglab	DSR-THP	March 30, 2021	CL-027-24	-30 - 70 °C
5	Relative humidity	Zoglab	DSR-THP	March 30, 2021	RH-03032021	0 - 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 30, 2021	BP-01032021	500 - 1100 hPa
7	Wind tunnel	SSOM	MP3300	-	-	0 - 50 Hz

End of certificate of calibration



CERTIFICATE OF CALIBRATION

Certificate No: WD-01022022
Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Novallnyc
: Wind direction sensor: Novallnyc.

Model/Type : Data logger: 20CWS-25LB
: Wind direction sensor: WS-02P

Serial Number : Data logger: A5040
: Wind direction sensor: K6-040

ID No : Data logger: -
: Wind direction sensor: -

Customer : Water Analysis Center Co.Ltd
: 94/1 Moo 5, Thanham, A-U-thai, Ayutthaya 13210

Environmental Condition:

The measurement was carried out in an ambient temperature of (23±3) °C, and relative humidity of (40±10) %.

Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and line laser is used for axis control. The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

Note: The UUC was warmed up for 1 hour prior to the calibration being performed

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No: Q21066014, Certificate No: KWS64/0026.

Measurement Date : FEB 18, 2022.
Issued Date : FEB 21, 2022.

Performed by
☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wivethwilaeye



Approved Signatory:

[Signature]
Mr. Parnya Booncharoen,
Calibration Department Manager

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

Continuation of Certificate of Calibration Number

Certificate No: WD-01022022
Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment
Calibration in the range of 0 - 360 ° at a calibration interval of 45°.
The results of calibration and associated measurement uncertainties are reported in table below.

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	41	-4	3.0
3		90	90	87	-3	3.0
4		135	135	135	0	3.0
5	Counter Clockwise	180	180	182	2	3.0
6		225	225	227	2	3.0
7		270	270	273	3	3.0
8		315	315	319	4	3.0
9		0/360	360	359	-1	3.0
10		45	45	41	-4	3.0
11		90	90	87	-3	3.0
12		135	135	135	0	3.0
13		180	180	182	2	3.0
14		225	225	227	2	3.0
15		270	270	273	3	3.0
16		315	315	319	4	3.0

UUC*: Unit Under Calibration The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%

End of Certificate of Calibration





High Volume Air Sampler Calibration Worksheet

Project Site : สวนอุตสาหกรรมโรจนะอุตสาหกรรม (โครงการ 4) Page 1 of 1

Location : วังน้อย

Date of measurement : 22/11/2022

Worksheet No. : C-221122-WWL0093 Calibration Office : WWL0103

High Volume ID : WWL0093 Calibrator ID : TE-5028A

High Volume Model : TE-5170 (TSP) Calibrator Model : 3271

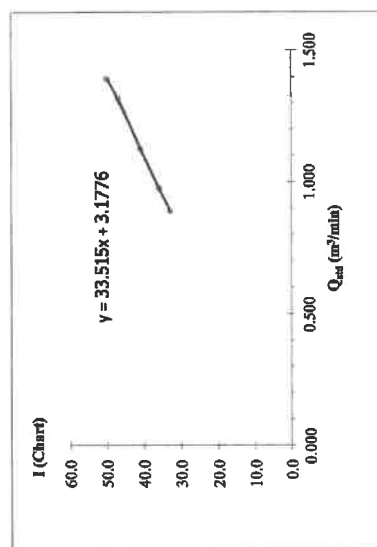
High Volume S/N : 2729 Calibrator S/N : 11/02/2022

Ambient Condition : 26 Quality Standard Slope : 1.59945

Temperature (°C) : 756 Quality Standard Intercept : -0.01874

Barometric Pressure (mmHg) :

Test No.	delta H ₂ O (inch)	Q _{std} (m ³ /min)	I (Chart)	IC (Corrected)	Linear Regression
1	4.90	1.390	50.0	49.80	Slope : 33.38 Intercept : 3.165 Correlation Coefficient : 0.9995
2	4.40	1.318	47.0	46.81	
3	3.20	1.126	41.0	40.83	
4	2.40	0.976	36.0	35.85	
5	2.00	0.892	33.0	32.87	



Calibrated by :

Mr. RATTAPOL BAIKAI

Approved by :

Mr. RUNGSASIKORN KOSUM

FOLAB 5.5-125

แก้ไขครั้งสุดท้าย : 1 พ.ค. 2560 หน้า : 1 ของ 1



High Volume Air Sampler Calibration Worksheet

Project Site : สวนอุตสาหกรรมโรจนะอุตสาหกรรม (โครงการ 4) Page 1 of 1

Location : วังน้อย

Date of measurement : 22/11/2022

Worksheet No. : C-221122-WWL0094 Calibration Office : WWL0103

High Volume ID : WWL0094 Calibrator ID : TE-5028A

High Volume Model : TE-5170 (TSP) Calibrator Model : 3271

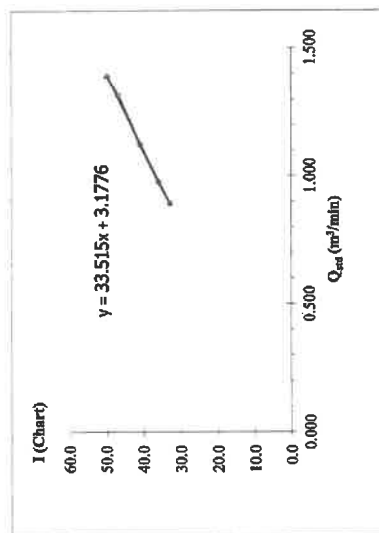
High Volume S/N : 2729 Calibrator S/N : 11/02/2022

Ambient Condition : 26 Quality Standard Slope : 1.59945

Temperature (°C) : 756 Quality Standard Intercept : -0.01874

Barometric Pressure (mmHg) :

Test No.	delta H ₂ O (inch)	Q _{std} (m ³ /min)	I (Chart)	IC (Corrected)	Linear Regression
1	4.90	1.390	50.0	49.80	Slope : 33.38 Intercept : 3.165 Correlation Coefficient : 0.9995
2	4.40	1.318	47.0	46.81	
3	3.20	1.126	41.0	40.83	
4	2.40	0.976	36.0	35.85	
5	2.00	0.892	33.0	32.87	



Calibrated by :

Mr. RATTAPOL BAIKAI

Approved by :

Mr. RUNGSASIKORN KOSUM

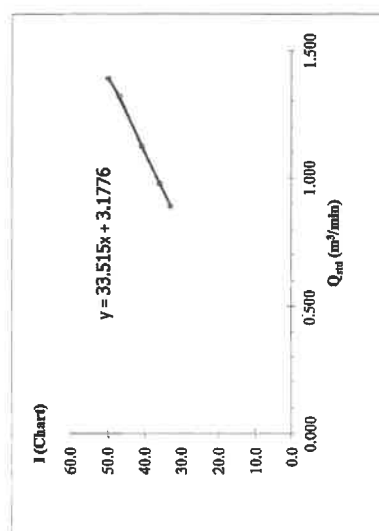
FOLAB 5.5-125

แก้ไขครั้งสุดท้าย : 1 พ.ค. 2560 หน้า : 1 ของ 1

High Volume Air Sampler Calibration Worksheet

Project Site :	स्थानांतरित/समाप्त (अवधि 4)		
Location :	जोशीपुरा		
Date of measurement :	22/1/2022		
Worksheet No. :	C-2211132-WWL0095		
High Volume ID :	WWL0095		
High Volume Model :	TE-S170 (TSP)		
High Volume S/N :	2729		
Ambient Condition			
Temperature (°C)	26		
Barometric Pressure (mmHg) :	756		
	Calibration Office	Calibrator ID :	WWL0103
		Calibrator Model :	TE-5028A
		Calibrator SN :	3271
		Calibrate Date :	11/02/2022
		Quality Standard Slope :	1.59945
		Quality Standard Intercept :	-0.01874

Test No.	delta H ₂ O (inch)	Q _{ad} (m ³ /min)	I (Chart)	IC (Corrected)	Linear Regression
1	4.90	1.390	50.0	49.80	Slope : 33.38
2	4.40	1.318	47.0	46.81	Intercept : 3.165
3	3.20	1.126	41.0	40.83	Correlation Coefficient : 0.9995
4	2.40	0.976	36.0	35.85	
5	2.00	0.892	33.0	32.87	



Calibrated by : _____
Approved by : _____

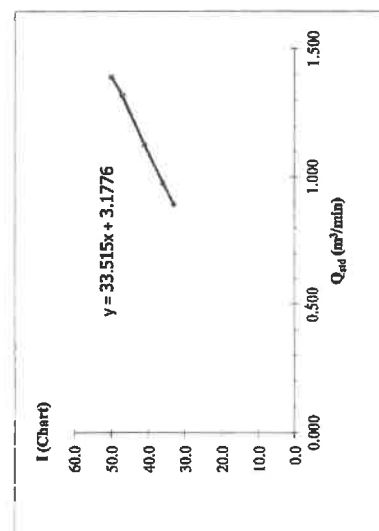
Mt. RATTAPOL BAIKAI
Mt. RUNGSASIKORN KOSUM

CO.LAB 5.5-1/25

High Volume Air Sampler Calibration Worksheet

Project Site :	สถานพนาพร ไร่เขาหลวง (โครงการ 4)		
Location :	บ้านทุ่งหลวง		
Date of measurement :	22/11/2022		
Worksheet No. :	C-221122-WWL0096	Calibration Office	
High Volume ID :	WWL0096	Calibrator ID :	
High Volume Model :	TE-5170 (TSP)	Calibrator Model :	
High Volume S/N :	2729	Calibrator S/N :	
Ambient Condition	Calibrate Date :		
Temperature (°C) :	26	Quality Standard Slope :	
Barometric Pressure (mmHg) :	756	Quality Standard Intercept :	
		-0.01874	

Test No.	delta H ₂ O (inch)	Q _{ad} (m ² /min)	I (Chart)	IC (Corrected)	Linear Regression
1	4.90	1.390	50.0	49.80	Slope : 33.38
2	4.40	1.318	47.0	46.81	Intercept : 3.165
3	3.20	1.126	41.0	40.83	Correlation Coefficient : 0.9995
4	2.40	0.976	36.0	35.85	
5	2.00	0.892	33.0	32.87	



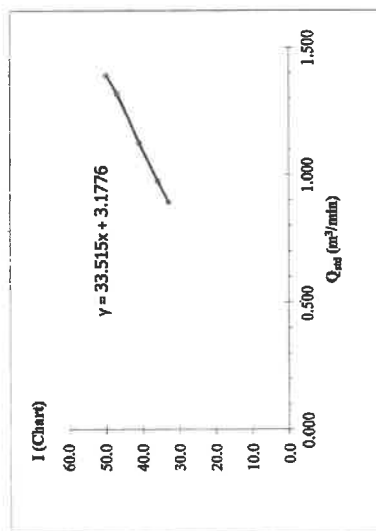
Calibrated by :  _____
Approved by :  _____
Mr. RATTAPOL BAIKAI
Mr. RUNGSASIKORN KOSIUM

TO LAB 55-125

High Volume Air Sampler Calibration Worksheet

Project Site : สวนอุตสาหกรรมโรจนาอยุธยา (โครงการ 4)
Location : ที่กาศวัดทางใต้บริเวณถนนโครงการ (A5)
Date of measurement : 22/11/2022
Worksheet No. : C-221122-WVL0095 Calibration Office : WWL0103
High Volume ID : WVL0095 Calibrator ID : TE-5028A
High Volume Model : TE-5170 (TSP) Calibrator Model : 3271
High Volume S/N : 2729 Calibrator S/N : 11/02/2022
Ambient Condition : Calibrate Date : 1.59945
Temperature (°C) : 26 Quality Standard Slope : -0.01874
Barometric Pressure (mmHg) : 756 Quality Standard Intercept :

Test No.	delta H ₂ O (inch)	Q _{as} (m ³ /min)	I (Chart)	IC (Corrected)	Linear Regression
1	4.90	1.390	50.0	49.80	Slope : 33.38
2	4.40	1.318	47.0	46.81	Intercept : 3.165
3	3.20	1.126	41.0	40.83	Correlation Coefficient : 0.9995
4	2.40	0.976	36.0	35.85	
5	2.00	0.892	33.0	32.87	



Calibrated by :

TOT

Mr. RATTAPOL BAIKAI

Approved by :

Ba

Mr. RUNGSASIKORN KOSUM

FOLAB 5.5-1/25

แก้ไขครั้งที่: 1 วันที่ใช้ฉบับนี้: 1 พ.ค. 2560 หน้า: 1 ของ 1

จัดทำโดย บริษัท ศูนย์วิเคราะห์น้ำ จำกัด

28 พฤศจิกายน 2565

5.2 ระดับเสียงในบรรยากาศ

1) ผลการตรวจวัด

จากการตรวจวัดระดับเสียง ในระหว่างวันที่ 23 - 30 พฤศจิกายน พ.ศ. 2565 จำนวน 1 สถานี ได้แก่ ที่พักอาศัยบริเวณด้านทิศตะวันออกห่างจากพื้นที่โครงการ 100 เมตร (N1) แสดงจุดตรวจวัดระดับเสียงดังภาพที่ 2 และผลการตรวจวัดแสดงดังตารางที่ 4

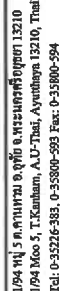
2) สรุปผลการตรวจวัด

จากการตรวจวัดระดับเสียง จำนวน 1 สถานี ได้แก่ ที่พักอาศัยบริเวณด้านทิศตะวันออกห่างจากพื้นที่โครงการ 100 เมตร (N1) พบว่ามีการตรวจวัดระดับเสียงเฉลี่ย 24 ชั่วโมง อยู่ระหว่าง 60.6 - 62.5 เดซิเบล(เอ) และค่าการตรวจวัดระดับเสียงสูงสุดอยู่ระหว่าง 88.1 - 97.1 เดซิเบล(เอ) ตามลำดับ ซึ่งมีค่าอยู่ในเกณฑ์มาตรฐาน ตามประกาศกระทรวงอุตสาหกรรม พ.ศ. 2548 เรื่อง กำหนดค่าระดับเสียงการรบกวนและระดับเสียงที่เกิดจากการประกอบกิจการโรงงาน และประกาศคณะกรรมการสิ่งแวดล้อมแห่งชาติ ฉบับที่ 15 พ.ศ. 2540 เรื่อง กำหนดมาตรฐานระดับเสียงโดยทั่วไป ซึ่งกำหนดให้มีระดับเสียงเฉลี่ย 24 ชั่วโมง ไม่เกิน 70 เดซิเบล(เอ) และกำหนดให้มีระดับเสียงสูงสุดไม่เกิน 115 เดซิเบล(เอ)

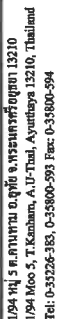
ตารางที่ 4 แสดงผลการตรวจวัดระดับเสียง

สถานี	วันที่เก็บตัวอย่าง	ผลการตรวจวัด (dB(A))		
		Leq 24 hrs	Lmax	L90
1. ที่พักอาศัยบริเวณด้านทิศตะวันออกห่างจากพื้นที่โครงการ 100 เมตร (N1) (47P 685302, 1582739)	23 - 24 พ.ย. 65	62.5	95.3	49.3
	24 - 25 พ.ย. 65	61.5	93.6	43.8
	25 - 26 พ.ย. 65	60.6	95.8	38.0
	26 - 27 พ.ย. 65	61.7	97.1	53.3
	27 - 28 พ.ย. 65	62.2	88.1	52.3
	28 - 29 พ.ย. 65	61.6	88.7	50.9
มาตรฐาน		70 ^{U, V}	115 ^{U, V}	-

หมายเหตุ : U มาตรฐานตามประกาศคณะกรรมการสิ่งแวดล้อมแห่งชาติ ฉบับที่ 15 (พ.ศ. 2540) เรื่อง กำหนดมาตรฐานระดับเสียงโดยทั่วไป
V มาตรฐานตามประกาศกระทรวงอุตสาหกรรม พ.ศ. 2548 เรื่อง กำหนดค่าระดับเสียงการรบกวนและระดับเสียงที่เกิดจากการประกอบกิจการโรงงาน



NO. LAB 55-175



Calibrated by:  Approved by: 

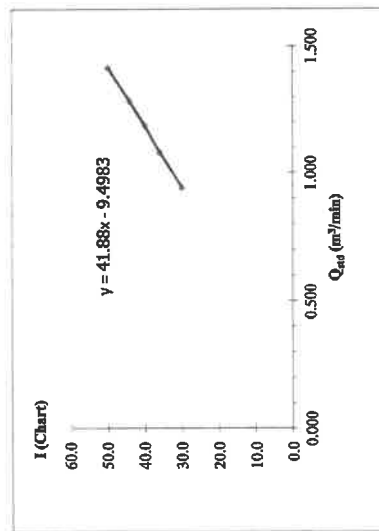
Mr. RATTAPOL BAKAJ
Mr. RUNGSASIKORN KOSIM



High Volume Air Sampler Calibration Worksheet

Project Site : สถานอุตสาหกรรมโรงงานอุตสาหกรรม (โครงการ 4) Page 1 of 1
Location : จังหวัดสุพรรณบุรี
Date of measurement : 22/11/2022
Worksheet No. : C-221122-WVL0100 Calibration Office : WWL0103
High Volume ID : WWL0100 Calibrator ID : TE-5028A
High Volume Model : TE-6070 (PM10) Calibrator Model : 654
High Volume S/N : 3271 Calibrator S/N : 11/02/2022
Ambient Condition : 26 Quality Standard Slope : 1.00155
Temperature (°C) : 756 Quality Standard Intercept : -0.01185
Barometric Pressure (mmHg) :

Test No.	delta H ₂ O (inch)	Q _{ad} (m ³ /min)	I (Chart)	IC (Corrected)	Linear Regression
1	5.00	1.416	50.0	31.44	Slope : 26.34
2	4.10	1.283	44.0	27.67	Intercept : -5.973
3	3.50	1.186	40.0	25.15	Correlation Coefficient : 0.9996
4	2.90	1.081	36.0	22.64	
5	2.20	0.943	30.0	18.87	

Calibrated by : Y. BAIKAI

Mr. RATTAPOL BAIKAI

Approved by :

Mr. RUNGSASIKORN KOSUM

POLAB 5.5-1/25

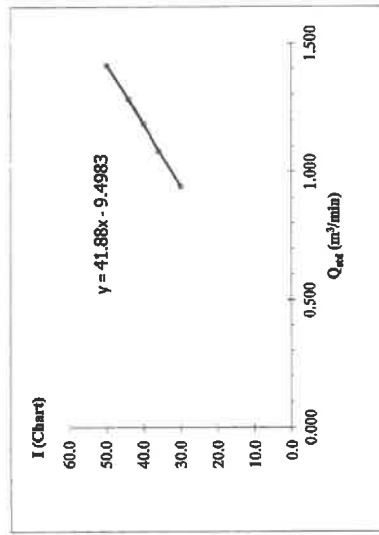
แก้ไขครั้งที่: 1 วันที่แก้ไข: 1 พ.ค. 2560 หน้า: 1 ของ 1



High Volume Air Sampler Calibration Worksheet

Project Site : สถานอุตสาหกรรมโรงงานอุตสาหกรรม (โครงการ 4) Page 1 of 1
Location : จังหวัดสุพรรณบุรี
Date of measurement : 22/11/2022
Worksheet No. : C-221122-WVL0101 Calibration Office : WWL0103
High Volume ID : WWL0101 Calibrator ID : TE-5028A
High Volume Model : TE-6070 (PM10) Calibrator Model : 654
High Volume S/N : 3271 Calibrator S/N : 11/02/2022
Ambient Condition : 26 Quality Standard Slope : 1.00155
Temperature (°C) : 756 Quality Standard Intercept : -0.01185
Barometric Pressure (mmHg) :

Test No.	delta H ₂ O (inch)	Q _{ad} (m ³ /min)	I (Chart)	IC (Corrected)	Linear Regression
1	5.00	1.416	50.0	31.44	Slope : 26.34
2	4.10	1.283	44.0	27.67	Intercept : -5.973
3	3.50	1.186	40.0	25.15	Correlation Coefficient : 0.9996
4	2.90	1.081	36.0	22.64	
5	2.20	0.943	30.0	18.87	

Calibrated by : Y. BAIKAI

Mr. RATTAPOL BAIKAI

Approved by :

Mr. RUNGSASIKORN KOSUM

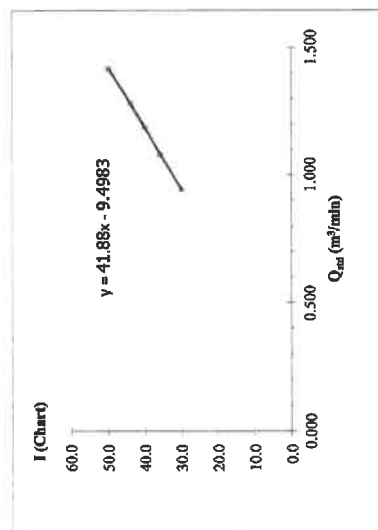
POLAB 5.5-1/25

แก้ไขครั้งที่: 1 วันที่แก้ไข: 1 พ.ค. 2560 หน้า: 1 ของ 1

High Volume Air Sampler Calibration Worksheet

Project Site : **ศูนย์อุตสาหกรรมโรงงานอุตสาหกรรม (โครงการ 4)** Page 1 of 1
 Location : **พื้นที่ภาคใต้ของจังหวัดภูเก็ต (A5)**
 Date of measurement : **22/11/2022**
 Worksheet No. : **C-221122-WWL0100** Calibration Office : **WWL0103**
 High Volume ID : **WWL0100** Calibrator ID : **TE-5028A**
 High Volume Model : **TE-4070 (PM10)** Calibrator Model : **3271**
 High Volume S/N : **654** Calibrator S/N : **11/02/2022**
 Ambient Condition : **26** Quality Standard Slope : **1.00155**
 Temperature (°C) : **756** Quality Standard Intercept : **-0.01185**
 Barometric Pressure (mmHg) :

Test No.	delta H ₂ O (inch)	Q _{ad} (m³/min)	I (Chart)	IC (Corrected)	Linear Regression
1	5.00	1.416	50.0	31.44	Slope : 26.34
2	4.10	1.283	44.0	27.67	Intercept : -5.973
3	3.50	1.186	40.0	25.15	Correlation Coefficient : 0.9996
4	2.90	1.081	36.0	22.64	
5	2.20	0.943	30.0	18.87	



Calibrated by :

Mr. RATTAPOL BAIKAI

Approved by :

Mr. RUNGASAKORN KOSUM

POLAB 5.5-1/25

แก้ไขครั้งที่ : 1 วันที่แก้ไข : 1 ต.ค. 2560 หน้า : 1 ของ 1



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0506

MTC No. EEL BP. 58/0565

CALIBRATION CERTIFICATE

Submitted by : WATER ANALYSIS CENTER CO.,LTD.

Address : 1/94 Moo 5, T.Kanburi, A.U.-Thai, Ayutthaya 13120.

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

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

Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : BSWA TECH

Model : CA111

Serial No. : 520272

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) kPa

Standards used : 1. Digital Function Synthesizer NF Electronic DE-193A S/N 122037.

2. Measuring Amplifier Buelac/Kjær 2636 S/N 1537484.

3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.

4. Digital Multimeter Agilent 34401A S/N MY44005560.

5. Pressure Transmitter Visala PTB202AD S/N T0650001.

6. Audio Analyzer Keithley 2015-P S/N 4106495.

7. Condenser Microphone Buelac/Kjær 4180 S/N 2889871.

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

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

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

Date of Receipt : 20 May 2022

Date of Calibration : 24 May 2022

1 / 3

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

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

PUBLICATION Rev-4

Head Office

30 Ma 5 Tambon Khlong Ha, Amphoe Khlong Luang,

Changwat Pathumthani 12120, Thailand

Tel. (66) 0 2577 9000

Fax. (66) 0 2577 9009

Email : rumpal@tistr.or.th Website: www.tistr.or.th

Office/Laboratory

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,

Amphoe Muang, Changwat Samutprakan 10280, Thailand

Tel. (66) 0 2523 1672-30 ext. 115, 116

Fax. (66) 0 2523 9165

E-mail : mcg@tistr.or.th

Office

194 Phaiyongthit Road, Chatuchak, Bangkok 10900,

Thailand

Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217

Fax. (66) 0 2579 8592

E-mail : samlee@tistr.or.th



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0506

MTC No. EEL. BP. 58/0565

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

Nominal Output of Unit Under Test = 94 dB re 20 μ Pa at 1000 Hz

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjær 4180	93.77	-0.23	± 0.10	± 0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjær 4180	1001.0	1.0	± 1.5	± 1.0 %

3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjær 4180	1.98	± 0.50	± 3.0 %

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Date of Calibration : 24 May 2022

2/3

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

Head Office
35 Mu.3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpak@tistr.or.th Website: www.tistr.or.th

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

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : suneles@tistr.or.th

FMJL.MTC.002 Rev.4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0506

MTC No. EEL. BP. 58/0565

Nominal Output of Unit Under Test = 114 dB re 20 μ Pa at 1000 Hz

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjær 4180	113.84	-0.16	± 0.10	± 0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjær 4180	1001.1	1.1	± 1.5	± 1.0 %

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjær 4180	0.62	± 0.50	± 3.0 %

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

Approved by :

(Mr. Nuttapong Niljiravut)

(Mr. Tawakiat Iamsanum)

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 24 May 2022

Date of Issue : 24 May 2022

Ref : 2011265052002210001

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End of Certificate

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Head Office
35 Mu.3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpak@tistr.or.th Website: www.tistr.or.th

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

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : suneles@tistr.or.th

FMJL.MTC.002 Rev.4

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

เครื่อง CA111 Sound Calibrator S/N 520272 รหัสเครื่องมือ SR004 เกณฑ์การยอมรับ 93.77 ± 0.3, 113.84 ± 0.3
วันที่สอบเทียบ 24/05/65

เครื่อง Digital Thermohygro Meter S/N 105091609 รหัสเครื่องมือ WWL 0055
วันที่สอบเทียบ 02/12/64 (30/11/65)

เครื่อง Sound Level Meter S/N 00396803 รหัสเครื่องมือ WWL 0160
วันที่สอบเทียบ 13-16/12/64

วันที่สอบเทียบเครื่องต่อไป 23/05/66

วันที่สอบเทียบเครื่องต่อไป 01/12/65 (29/11/66)

วันที่สอบเทียบเครื่องต่อไป 12/12/66

การทวนสอบก่อนออกจำหน่าย

อุณหภูมิ (°C) 24.0 เกณฑ์การยอมรับ 23.0±3.0
ความชื้นสัมพัทธ์ (%) 56 เกณฑ์การยอมรับ 50.0±15.0
วันที่ทวนสอบ 22/11/65

การทวนสอบหลังจากออกจำหน่าย

อุณหภูมิ (°C) 24.5 เกณฑ์การยอมรับ 23.0±3.0
ความชื้นสัมพัทธ์ (%) 59 เกณฑ์การยอมรับ 50.0±15.0
วันที่ทวนสอบ 02/12/65

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

ผู้บันทึก  ผู้ตรวจสอบ 

ผู้บันทึก  ผู้ตรวจสอบ 



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-650137

MTC No. EEL. BP. 106/164

CALIBRATION CERTIFICATE

Submitted by : WATER ANALYSIS CENTER CO., LTD.
Address : 1/94 MOO 5, TUKANHAM, A.U.-THAI, AYUTTHAYA 13210.
Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,
Sol 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter
Manufacturer : Rion
Model : NL-42
Serial No. : 00396803 (WWL 0160)
Microphone : Type UC-52 No.180449
Pre-amplifier : Type NR-24 No.87814
Standards used :

Ambient Environment
Temperature : (23 ± 3) °C
Relative Humidity : (50 ± 15) %
Ambient Pressure : (101.325 ± 1.5) kPa

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Audio AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY440-2668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Photophone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1557484.

Date of Receipt : 26 Nov. 2021

Date of Calibration : 13-16 Dec. 2021

The results relate only to the items tested/checked as value assigned.

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Head Office
35 Mu 3 Tambon Mueang Ha, Amphoe Mueang Luang,
Changwat Phetchaburi 12120, Thailand
Tel. (66) 0 2571 9000
Fax. (66) 0 2571 9009
E-mail : rump@tistr.or.th Website: www.tistr.or.th

Office/Laboratory
Sol 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2279 1121-30 ext. 5215, 5223, 5217
Fax. (66) 0 2279 8592
E-mail : sum@tistr.or.th



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (NISTR)

Request No. 21-650137

MTC No. REL. BP. 105/1164

9. Power Amplifier Bafed&Kjser 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215500.
11. Digital Multimeter Agilent 34401A S/N MY4005560.
12. Programmable Attenuator Tnangwa TPA-303A S/N 2212.

Calibration Procedure :

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

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

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

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

Date of Calibration : 13-16 Dec.2021

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Head Office
35 Mu.3 Tambon Mione Ha, Amphoe Mueang Luang
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : nistr@nistr.or.th Website:www.nistr.or.th

Office
196 Phahonyothin Road, Chauchak, Bangkok 10900,
Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@nistr.or.th

FMEL/MTC/002 Rev.4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (NISTR)

Request No. 21-650137

MTC No. REL. BP. 105/1164

1. Absolute Sensitivity

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

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

2. Self-generated noise

2.1 Normal test

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

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

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

Date of Calibration : 13-16 Dec.2021

3/8

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Head Office
35 Mu.3 Tambon Mione Ha, Amphoe Mueang Luang
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : nistr@nistr.or.th Website:www.nistr.or.th

Office
196 Phahonyothin Road, Chauchak, Bangkok 10900,
Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@nistr.or.th

FMEL/MTC/002 Rev.4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0137

MTC No. EEL, BP. 105/1164

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	-0.2	-0.1	-0.1	0.40	2.0
1000	-0.1	-0.1	-0.1	0.40	1.4
4000	-0.8	-0.7	-0.7	0.40	3.6

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	0.0	-0.1	-0.1	0.20	2.5
125	-0.1	0.0	-0.1	0.20	2.0
250	0.0	0.0	0.0	0.20	1.9
500	0.0	0.0	0.0	0.20	1.9
1000	0.0	0.0	0.0	0.20	1.4
2000	-0.1	0.0	-0.1	0.20	2.6
4000	0.0	0.0	0.0	0.20	3.6
8000	0.1	0.1	0.0	0.20	5.6

Date of Calibration : 13-16 Dec.2021

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Head Office
35 Mu 3 Tambon Klong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rump@tistr.or.th Website: www.tistr.or.th

Office/Laboratory
501/1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang Chonburi Samutprakan 10200, Thailand
Tel. (66) 0 2253 1672-80 ext. 115, 116
Fax. (66) 0 2253 9165
E-mail : mt@tistr.or.th

FAIR LMT-002 Rev A



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0137

MTC No. EEL, BP. 105/1164

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weightings at 1 kHz

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

6. Level Linearity on the reference level range

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

Date of Calibration : 13-16 Dec.2021

5/8

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Head Office
35 Mu 3 Tambon Klong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rump@tistr.or.th Website: www.tistr.or.th

Office/Laboratory
501/1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang Chonburi Samutprakan 10200, Thailand
Tel. (66) 0 2253 1672-80 ext. 115, 116
Fax. (66) 0 2253 9165
E-mail : mt@tistr.or.th

FAIR LMT-002 Rev A

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

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

Date of Calibration : 13-16 Dec. 2021

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Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpat@tistr.or.th Website: www.tistr.or.th

Office/Laboratory
Sri J.C. Bangoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2923 1672-80 ext. 115, 116
Fax. (66) 0 2579 1121-30 ext. 3219, 3225, 3217
E-mail : sumalee@tistr.or.th

FM.BJ.MTC.002 Rev.4

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

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

7. Level linearity including the level range control

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

8. Tone burst response

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

Date of Calibration : 13-16 Dec. 2021

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Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpat@tistr.or.th Website: www.tistr.or.th

Office/Laboratory
Sri J.C. Bangoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2923 1672-80 ext. 115, 116
Fax. (66) 0 2579 1121-30 ext. 3219, 3225, 3217
E-mail : sumalee@tistr.or.th

FM.BJ.MTC.002 Rev.4



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0137

MTC No. EHL BP. 105/1164

9. Peak C sound level

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

10. Overhead indication

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

Calibrated by :

P. P. Pongpang
Mr. Panya Pongpang
T. P. Pongpang

Approved by :

P. P. Pongpang
Mr. Panya Pongpang
T. P. Pongpang

Mr. Tawakint Jamsanan

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 13-16 Dec. 2021

Date of Issue : 17 Dec. 2021

Ref : 2011264112604939002

End of Certificate

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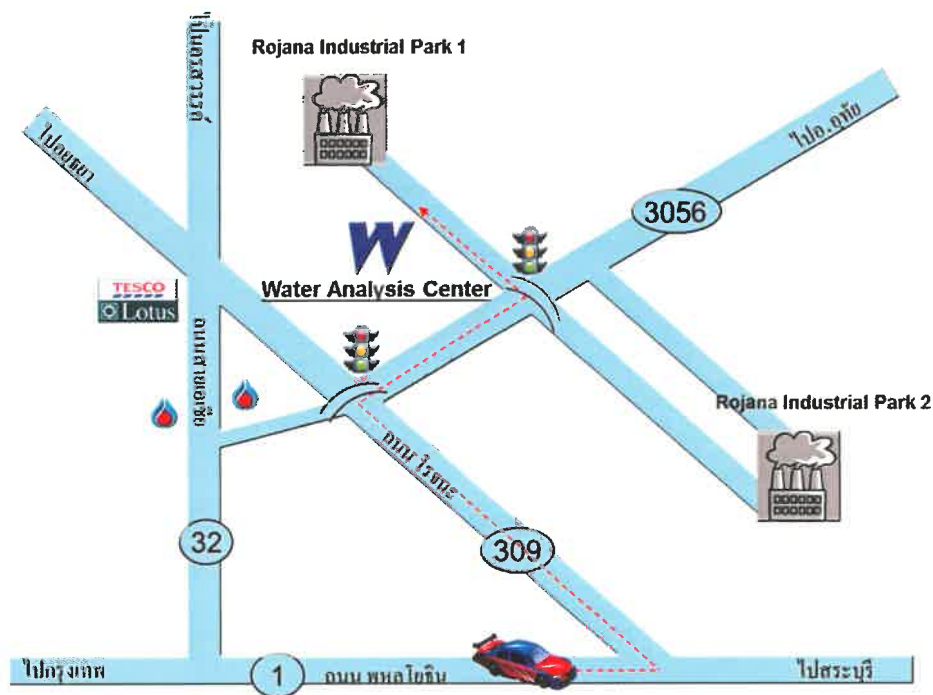
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Head Office
38 Mu. 3 Tambon Muang Ue, Amphoe Muang Luang,
Changwat: Ratchaburi 12121, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : tump@tistr.or.th Website: www.tistr.or.th

Office/Laboratory
501 UC Bangoo Industrial Estate, Sukhumvit Road,
Arachue Muang, Cheryue Samutprakan 10280, Thailand
Tel. (66) 0 2523 1672-80 ext. 115, 116
Fax. (66) 0 2523 9145
E-mail : mta@tistr.or.th

Office
198 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 3219, 3225, 3217
Fax. (66) 0 2579 1592
E-mail : sumalee@tistr.or.th

TAJL.MTC.002 Rev. A



บริษัท ศูนย์วิเคราะห์น้ำ จำกัด
 1/94 หมู่ที่ 5 ต.คานหาม อ.อุทัย จ.พระนครศรีอยุธยา 13210
 โทรศัพท์ 035-800593, 081-9917119 โทรสาร 035-800594
 Email : wac@wacthai.com Website : www.wacthai.com