

ภาคผนวก ข

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## เอกสารสอบเทียบเครื่องมือที่ใช้ในการวิเคราะห์

High Volume Air Sampler Calibration Worksheet

Project Site : คณะแพทยศาสตร์ โรงพยาบาล  
รามคำแหง มหาวิทยาลัยมหิดล

Location : พื้นที่โครงการ

Date of measurement : 17/9/2022

Worksheet No. : C-170922-WWL0101

Calibration Office

High Volume ID : WWL0101

Calibrator ID : WWL0103

High Volume Model : TE-6070 (PM10)

Calibrator Model : TE-5028A

High Volume S/N : 654

Calibrator S/N : 3271

Ambient Condition

Calibrate Date : 11/02/2022

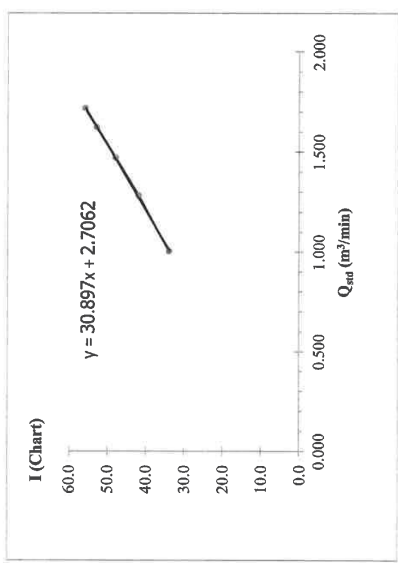
Temperature (°C) : 26

Quality Standard Slope : 1.00155

Barometric Pressure (mmHg) : 756

Quality Standard Inten : -0.01185

Test No.	delta H <sub>2</sub> O (inch)	Q <sub>ad</sub> (m <sup>3</sup> /min)	I (Chart)	IC (Corrected)	Linear Regression
1	7.40	1.720	56.0	35.21	Slope : 19.43 Intercept : 1.702 Correlation Coefficient : 0.9996
2	6.60	1.625	53.0	33.33	
3	5.40	1.471	48.0	30.18	
4	4.10	1.283	42.0	26.41	
5	2.50	1.005	34.0	21.38	



Calibrated by :

Approved by :

FO.LAB 5.5-1/25

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

High Volume Air Sampler Calibration Worksheet

Project Site : คณะแพทยศาสตร์ โรงพยาบาล  
รามคำแหง มหาวิทยาลัยมหิดล

Location : พื้นที่โครงการ

Date of measurement : 17/9/2022

Worksheet No. : C-170922-WWL0096

Calibration Office

High Volume ID : WWL0096

Calibrator ID : WWL0103

High Volume Model : TE-5170 (TSP)

Calibrator Model : TE-5028A

High Volume S/N : 2729

Calibrator S/N : 3271

Ambient Condition

Calibrate Date : 11/02/2022

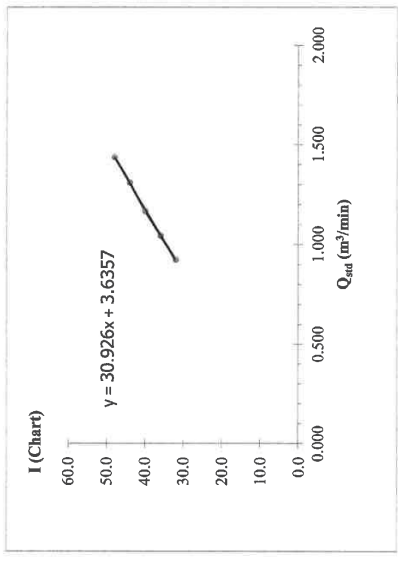
Temperature (°C) : 26

Quality Standard Slope : 1.61297

Barometric Pressure (mmHg) : 756

Quality Standard Inte : -0.04609

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



Calibrated by :

Approved by :

FO.LAB 5.5-1/25

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

### High Volume Air Sampler Calibration Worksheet

Project Site :

Location :

Date of measurement :

Worksheet No. :

High Volume ID :

High Volume Model :

High Volume S/N :

Ambient Condition

Temperature (°C) :

Barometric Pressure (mmHg) :

คณะแพทยศาสตร์ โรงพยาบาล  
รามธิบดี มหาวิทยาลัยมหิดล

บริเวณมหาวิทยาลัยรามคำแหง  
สมุทรปราการ

17/9/2022

C-170922-WWL0098

WWL0098

TE-6070 (PM10)

654

11/02/2022

26

756

Calibration Office

Calibrator ID :

Calibrator Model :

Calibrator S/N :

Calibrate Date :

Quality Standard Slope

Quality Standard Inter

WWL0103

TE-5028A

3271

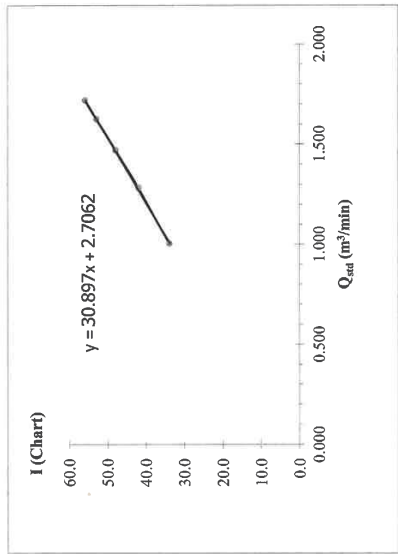
11/02/2022

1.00155

-0.01185

Page 1 of 1

Test No.	delta H <sub>2</sub> O (inch)	Q <sub>ad</sub> (m <sup>3</sup> /min)	I (Chart)	IC (Corrected)	Linear Regression
1	7.40	1.720	56.0	35.21	Slope : 19.43 Intercept : 1.702 Correlation Coefficient : 0.9996
2	6.60	1.625	53.0	33.33	
3	5.40	1.471	48.0	30.18	
4	4.10	1.283	42.0	26.41	
5	2.50	1.005	34.0	21.38	



Calibrated by :

Approved by :

### High Volume Air Sampler Calibration Worksheet

Project Site :

Location :

Date of measurement :

Worksheet No. :

High Volume ID :

High Volume Model :

High Volume S/N :

Ambient Condition

Temperature (°C) :

Barometric Pressure (mmHg) :

คณะแพทยศาสตร์ โรงพยาบาล  
รามธิบดี มหาวิทยาลัยมหิดล

บริเวณมหาวิทยาลัยรามคำแหง  
สมุทรปราการ

17/9/2022

C-170922-WWL0093

WWL0093

TE-5170 (TSP)

2729

11/02/2022

26

756

Calibration Office

Calibrator ID :

Calibrator Model :

Calibrator S/N :

Calibrate Date :

Quality Standard Slope

Quality Standard Inte

WWL0103

TE-5028A

3271

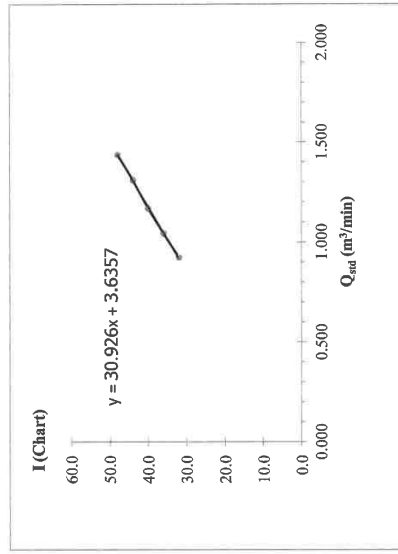
11/02/2022

1.61297

-0.04609

Page 1 of 1

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



Calibrated by :

Approved by :

High Volume Air Sampler Calibration Worksheet

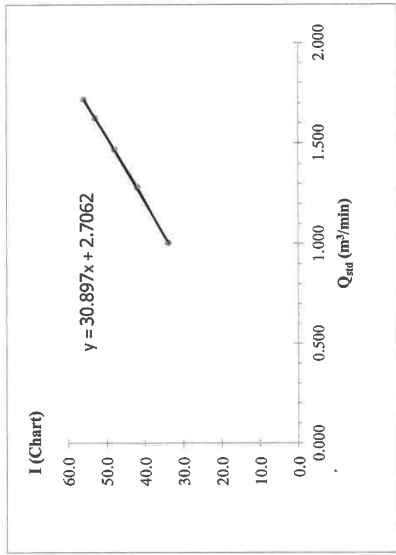
Project Site :  
Location :  
Date of measurement :  
Worksheet No. :  
High Volume ID :  
High Volume Model :  
High Volume S/N :  
Ambient Condition  
Temperature (°C) :  
Barometric Pressure (mmHg) :

คณะแพทยศาสตร์ โรงพยาบาล  
รามคำแหง มหาวชิราลงคมที่ดล  
บริเวณศูนย์การศึกษาพิเศษ  
ประจักษ์วงหัดสมพรปรการ  
17/9/2022  
C-170922-WWL0100  
WWL0100  
TE-6070 (PM10)  
654  
11/02/2022  
26  
756

Calibration Orifice  
Calibrator ID :  
Calibrator Model :  
Calibrator S/N :  
Calibrate Date :  
Quality Standard Slope  
Quality Standard Inter

WWL0103  
TE-5028A  
3271  
11/02/2022  
1.00155  
-0.01185

Test No.	delta H <sub>2</sub> O (inch)	Q <sub>ad</sub> (m <sup>3</sup> /min)	I (Chart)	IC (Corrected)	Linear Regression
1	7.40	1.720	56.0	35.21	Slope : 19.43 Intercept : 1.702 Correlation Coefficient : 0.9996
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5	2.50	1.005	34.0	21.38	



High Volume Air Sampler Calibration Worksheet

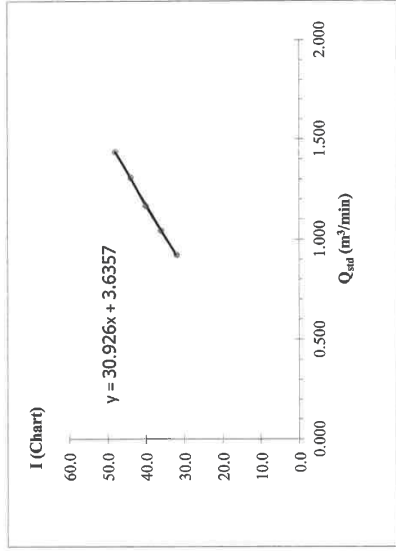
Project Site :  
Location :  
Date of measurement :  
Worksheet No. :  
High Volume ID :  
High Volume Model :  
High Volume S/N :  
Ambient Condition  
Temperature (°C) :  
Barometric Pressure (mmHg) :

คณะแพทยศาสตร์ โรงพยาบาล  
รามคำแหง มหาวชิราลงคมที่ดล  
บริเวณศูนย์การศึกษาพิเศษ  
ประจักษ์วงหัดสมพรปรการ  
17/9/2022  
C-170922-WWL0095  
WWL0095  
TE-5170 (TSP)  
2729  
11/02/2022  
26  
756

Calibration Orifice  
Calibrator ID :  
Calibrator Model :  
Calibrator S/N :  
Calibrate Date :  
Quality Standard Slope  
Quality Standard Inte

WWL0103  
TE-5028A  
3271  
11/02/2022  
1.61297  
-0.04609

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



Nitrogen Dioxide Analyzer Calibration Worksheet

Project Site :

คณะแพทยศาสตร์ โรงพยาบาลรามธิบดี

Location :

มหาวิทยาลัยมหิดล

Date of measurement :

30 November 2022

Worksheet No. :

C-301122-WWL 0114

Ambient NOx Analyzer ID :

WWL 0114

Manufacturer :

HORIBA

Ambient NOx Analyzer Model :

AFNA-370

Ambient NOx Analyzer S/N :

PIE199E5

Calibrator ID :

WWL0128

Calibrator Model :

Series 6100

Calibrator S/N :

S/N 7462

Calibrate Date :

18 December 2021

Cylinder Std. Gas

Std. Gas Concentration (PPM) : 50.90

Cylinder Pressure (psi)

2000

Certified Date :

07 December 2021

Expired Date :

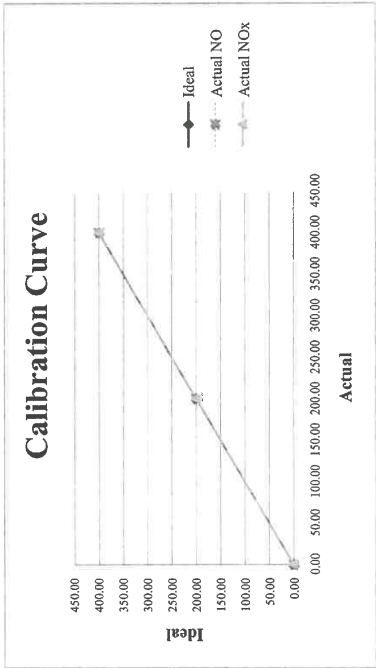
07 December 2025

Serial No. :

CC241587

Multi Gas Calibrator

Point	CALIBRATION RESULTS					
	Ideal	Actual NO	Error NO	%Error NO	Actual NO <sub>x</sub>	Error NO <sub>x</sub>
ZERO	0.00	0.10	0.10	-	0.10	0.10
SPAN 200 ppb	200.00	200.10	0.10	0.05	200.20	0.20
SPAN 400 ppb	400.00	400.10	0.10	0.03	400.20	0.20
AVERAGE (%)						0.04
						0.07



Approved by

Calibrated by

Sulfur Dioxide Analyzer Calibration Worksheet

Project Site :

คณะแพทยศาสตร์ โรงพยาบาลรามธิบดี

Location :

มหาวิทยาลัยมหิดล

Date of measurement :

30 November 2022

Worksheet No. :

C-301122-WWL 0109

Ambient SOx Analyzer ID :

WWL 0109

Manufacturer :

HORIBA

Ambient SOx Analyzer Model :

AFSA-370

Ambient SOx Analyzer S/N :

YDL839W0

Calibrator ID :

WWL0128

Calibrator Model :

Series 6100

Calibrator S/N :

S/N 7462

Calibrate Date :

18 December 2021

Cylinder Std. Gas

Std. Gas Concentration (PPM) : 49.68

Cylinder Pressure (psi)

2000

Certified Date :

07 December 2021

Expired Date :

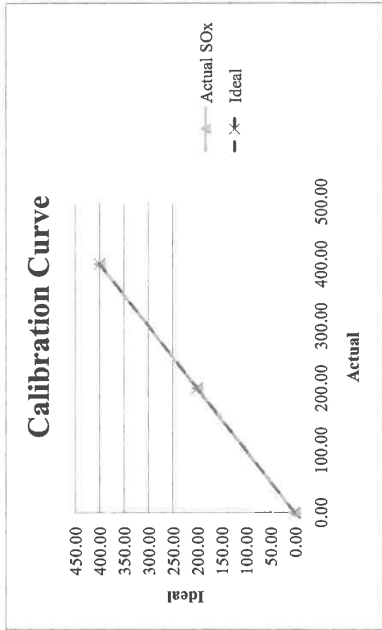
07 December 2025

Serial No. :

CC241587

Multi Gas Calibrator

Point	CALIBRATION RESULTS			
	Ideal	Actual SOx	Error Sox	%Error Sox
ZERO	0.00	0.10	0.10	-
SPAN 200 ppb	200.00	200.20	0.20	0.10
SPAN 400 ppb	400.00	400.20	0.20	0.05
AVERAGE (%)				0.07



Approved by

Calibrated by



## Sulfur Dioxide Analyzer Calibration Worksheet

Project Site : คณะแพทยศาสตร์ โรงพยาบาลรามาธิบดี

มหาวิทยาลัยมหิดล

Location : มหาวิทยาลัยราชภัฏธนบุรีสมุทรปราการ

Date of measurement : 30 November 2022

Worksheet No. : C-301122-WWL 0109

Ambient SOx Analyzer ID : WWL 0109

Manufacturer : HORIBA

Ambient SOx Analyzer Model : AFSA-370

Ambient SOx Analyzer S/N : YDL839W0

Calibrator ID : WWL0128

Calibrator Model : Series 6100

Calibrator S/N : S/N 7462

Calibrate Date : 18 December 2021

Cylinder Std. Gas

Std. Gas Concentration (PPM) : 49.68

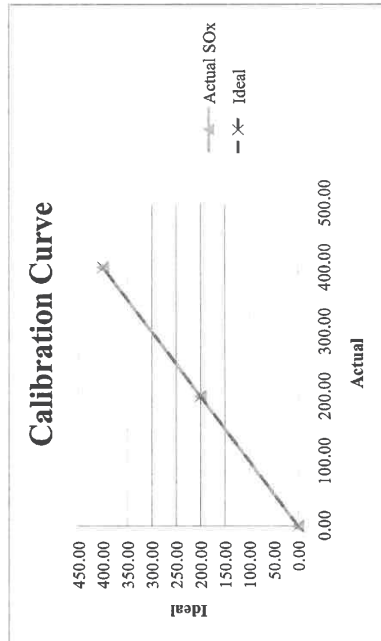
Cylinder Pressure (psi)

Certified Date : 07 December 2021

Expired Date : 07 December 2025

Serial No. : CC241587

Point	CALIBRATION RESULTS		
	Ideal	Actual SOx	Error Sox
ZERO	0.00	0.10	0.10
SPAN 200 ppb	200.00	200.10	0.10
SPAN 400 ppb	400.00	400.10	0.10
AVERAGE (%)			0.04



Calibrated by

Approved by

## Nitrogen Dioxide Analyzer Calibration Worksheet

Project Site : คณะแพทยศาสตร์ โรงพยาบาลรามาธิบดี

มหาวิทยาลัยมหิดล

Location : มหาวิทยาลัยราชภัฏธนบุรีสมุทรปราการ

Date of measurement : 30 November 2022

Worksheet No. : C-301122-WWL 0114

Ambient NOx Analyzer ID : WWL 0114

Manufacturer : HORIBA

Ambient NOx Analyzer Model : APNA-370

Ambient NOx Analyzer S/N : P1EJ99E5

Calibrator ID : WWL0128

Calibrator Model : Series 6100

Calibrator S/N : S/N 7462

Calibrate Date : 18 December 2021

Cylinder Std. Gas

Std. Gas Concentration (PPM) : 50.90

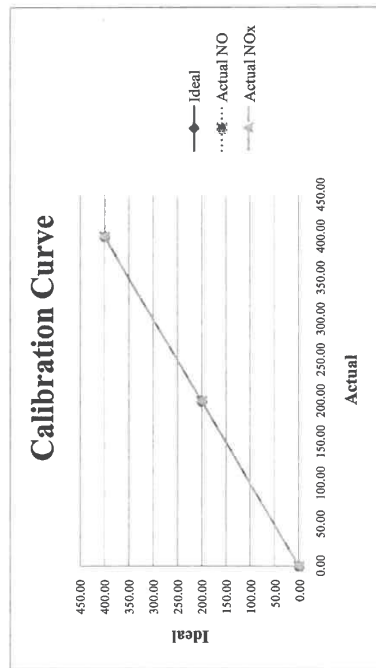
Cylinder Pressure (ps

Certified Date : 07 December 2021

Expired Date : 07 December 2025

Serial No. : CC241587

Point	CALIBRATION RESULTS				
	Ideal	Actual NO	Error NO	%Error NO	%Error NO <sub>x</sub>
ZERO	0.00	0.20	0.20	-	-
SPAN 200 ppb	200.00	200.10	0.10	0.05	0.10
SPAN 400 ppb	400.00	400.10	0.10	0.03	0.20
AVERAGE (%)					0.07



Calibrated by

Approved by

### Nitrogen Dioxide Analyzer Calibration Worksheet

Project Site :

คณะแพทยศาสตร์ โรงพยาบาลรามาธิบดี

Location :

มหาวิทยาลัยมหิดล

Date of measurement :

30 November 2022

Worksheet No. :

C-301122-WWL 0114

Ambient NOx Analyzer ID :

WWL 0114

Manufacturer :

HORIBA

Ambient NOx Analyzer Model :

APNA-370

Ambient NOx Analyzer S/N :

PIEJ99E5

Calibrator ID :

WWL0128

Calibrator Model :

Series 6100

Calibrator S/N :

S/N 7462

Calibrate Date :

18 December 2021

Cylinder Std. Gas

Std. Gas Concentration (PPM) : 50.90

Cylinder Pressure (psi)

2000

Certified Date :

07 December 2021

Expired Date :

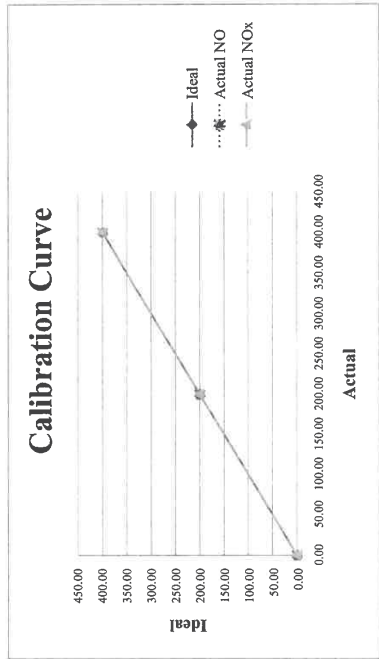
07 December 2025

Serial No. :

CC241587

Multi Gas Calibrator

CALIBRATION RESULTS						
Point	Ideal	Actual NO	Error NO	Actual NO <sub>x</sub>	Error NO <sub>x</sub>	%Error NO <sub>x</sub>
ZERO	0.00	0.10	0.10	0.10	0.10	-
SPAN 200 ppb	200.00	200.10	0.10	200.20	0.20	0.10
SPAN 400 ppb	400.00	400.10	0.10	400.20	0.20	0.05
AVERAGE (%)				0.04		0.07



Calibrated by

Approved by

### Sulfur Dioxide Analyzer Calibration Worksheet

Project Site :

คณะแพทยศาสตร์ โรงพยาบาลรามาธิบดี

Location :

มหาวิทยาลัยมหิดล

Date of measurement :

30 November 2022

Worksheet No. :

C-301122-WWL 0109

Ambient SOx Analyzer ID :

WWL 0109

Manufacturer :

HORIBA

Ambient SOx Analyzer Model :

APSA-370

Ambient SOx Analyzer S/N :

YDL839W0

Calibrator ID :

WWL0128

Calibrator Model :

Series 6100

Calibrator S/N :

S/N 7462

Calibrate Date :

18 December 2021

Cylinder Std. Gas

Std. Gas Concentration (PPM) : 49.68

Cylinder Pressure (psi)

2000

Certified Date :

07 December 2021

Expired Date :

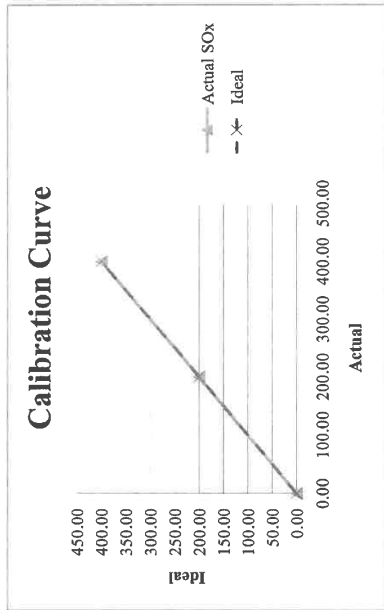
07 December 2025

Serial No. :

CC241587

Multi Gas Calibrator

CALIBRATION RESULTS				
Point	Ideal	Actual SOx	Error Sox	%Error Sox
ZERO	0.00	0.10	0.10	-
SPAN 200 ppb	200.00	200.10	0.10	0.05
SPAN 400 ppb	400.00	400.10	0.10	0.03
AVERAGE (%)				0.04



Calibrated by

Approved by





THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0137

MTC No. EEL. BP. 105/1164

## CALIBRATION CERTIFICATE

Submitted by : WATER ANALYSIS CENTER CO., LTD.

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

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

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

### Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00396803 (WWL 0160)

Microphone : Type UC-52 No.180449

Preamplifier : Type NH-24 No.87814

### Standards used :

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

Date of Receipt : 26 Nov. 2021

Date of Calibration : 13-16 Dec.2021

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.

### 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 : rumpai@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 2323 1672-80 ext. 115, 116  
Fax. (66) 0 2323 9165  
E-mail : mtc@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 : sumalee@tistr.or.th

FM.BLMTC.002 Rev.4



Certificate of Calibration

### Calibration Certification Information

Cal. Date: February 11, 2022 Ta: 294 °K  
Operator: Jim Tisch Rootsmeter S/N: 438320 Pa: 742.70 mm Hg  
Calibration Model #: TE-5028A Calibrator S/N: 3271

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.2550	4.3	1.50
2	3	4	1	0.9780	7.1	2.50
3	5	6	1	0.8910	8.4	3.00
4	7	8	1	0.8260	9.9	3.50
5	9	10	1	0.6280	16.8	6.00

### Data Tabulation

Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left( \frac{Pa}{Pa} \right)}$ (y-axis)
0.9848	0.7847	1.2189	0.9942	0.7922	0.7706
0.9811	1.0031	1.5736	0.9904	1.0127	0.9948
0.9793	1.0951	1.7238	0.9887	1.1096	1.0898
0.9773	1.1832	1.8619	0.9867	1.1945	1.1771
0.9681	1.5416	2.4379	0.9774	1.5563	1.5411
QSTD	m= 1.60965 b= -0.04335 r= 0.99999	QA	m= 1.60794 b= -0.02740 r= 0.99999		

### Calculations

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

### Standard Conditions

Tstd: 298.15 °K
Pstd: 760 mm Hg
Key
ΔH: calibrator manometer reading (in H2O)
ΔP: rootsmeter manometer reading (mm Hg)
Ta: actual absolute temperature (°K)
Pa: actual barometric pressure (mm Hg)
b: intercept
m: slope

### RECALIBRATION

US EPA recommends annual recalibration per 1998 40 Code of Federal Regulations Part 50 to S1, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere, 9.2.17, page 30.

Tisch Environmental, Inc.  
145 South Miami Avenue  
Village of Cleves, OH 45002

www.tisch-env.com  
TOLL FREE: (877)263-7610  
FAX: (513)467-9009



### 1. Absolute Sensitivity

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

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

### 2. Self-generated noise

#### 2.1 Normal test

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

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

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

Date of Calibration : 13-16 Dec.2021

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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 : rumpai@tistr.or.th Website:www.tistr.or.th

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

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

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

### Calibration Procedure :

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

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

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

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

Date of Calibration : 13-16 Dec.2021

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E-mail : mtc@tistr.or.th

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Thailand  
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Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th

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### 5. Frequency and time weightings at 1 kHz

#### 5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±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

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Fax. (66) 0 2323 9165  
E-mail : mtg@tistr.or.th

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E-mail : sumalee@tistr.or.th

### 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
1 000	-0.1	-0.1	-0.1	0.40	1.4
4 000	-0.8	-0.7	-0.7	0.40	3.6

### 4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (±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
1 000	0.0	0.0	0.0	0.20	1.4
2 000	-0.1	0.0	-0.1	0.20	2.6
4 000	0.0	0.0	0.0	0.20	3.6
8 000	0.1	0.1	0.0	0.20	5.6

Date of Calibration : 13-16 Dec.2021

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

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

7. Level linearity including the level range control

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

8. Tone burst response

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

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

## CALIBRATION CERTIFICATE

Submitted by : WATER ANALYSIS CENTER CO., LTD.

Address : 1/94 Moo.5, T. Kanham, A.U.-Thai, Ayuthaya 13120.

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

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

### Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Rion

Model : NL-42

Serial No. : 00396801

Microphone : Type UC-52 No.180447

Preamplifier : Type NH-24 No.87812

### Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2633526.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistophone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 20 May 2022

Date of Calibration : 13-14 Jun. 2022

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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 : rumpai@tistr.or.th Website:www.tistr.or.th

**Office/Laboratory**  
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang, Changwat Samutprakan 10280, Thailand  
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196 Phahonyothin Road, Chatuchak Bangkok 10900,  
Thailand  
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Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th

### 9. Peak C sound level

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

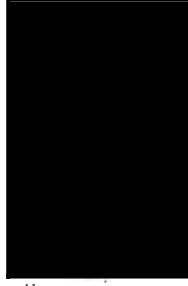
### 10. Overload indication

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

Calibrated by :



Approved by :



Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref : 2011264112604939002

End of Certificate

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

**Office/Laboratory**  
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### 1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test				Tolerance Limit Class 2 (±dB)
	Measured Value (dB)		Deviation (dB)	Uncertainty (±dB)	
	Before adjust	After adjust			
113.88	113.7	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 124.9 dB.

### 2. Self-generated noise

#### 2.1 Normal test

Measured value (dB)	Uncertainty (±dB)
18.6	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	13.1	0.10
C-Weighting	18.7	0.10
Flat	24.2	0.10

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

### Calibration Procedure :

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

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

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

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



### 5. Frequency and time weightings at 1 kHz

#### 5.1 Frequency weightings at 1 kHz

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

#### 5.2 Time weightings at 1 kHz

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

### 6. Level linearity on the reference level range

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

Date of Calibration : 13-14 Jun. 2022

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Fax. (66) 0 2323 9165  
E-mail : mt@tistr.or.th

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### 3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	-0.3	-0.2	-0.2	0.40	2.0
1 000	0.2	0.2	0.2	0.40	1.4
4 000	0.3	0.3	0.3	0.40	3.6

### 4. Electrical signal test of frequency weightings

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

Date of Calibration : 13-14 Jun. 2022

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

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
27	27.0	0.0	0.30	1.4
26	25.9	-0.1	0.30	1.4
25	24.9	-0.1	0.30	1.4

## 7. Level linearity including the level range control

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

## 8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 (dB)
Fast	200	126.0	0.0	0.20	$\pm 1.3$
	2	108.9	-0.1	0.20	+1.3; -2.8
	0.25	99.8	-0.2	0.20	+1.8; -5.3
Slow	200	119.5	-0.1	0.20	$\pm 1.3$
	2	99.9	-0.1	0.20	+1.3; -5.3
	200	120.0	0.0	0.20	$\pm 1.3$
SEL	2	99.9	-0.1	0.20	+1.3; -2.8
	0.25	90.8	-0.2	0.20	+1.8; -5.3

Date of Calibration : 13-14 Jun. 2022

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E-mail : sumalee@tistr.or.th

FMBL.MTC.002 Rev.4

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

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
130	130.0	0.0	0.30	1.4
129	129.0	0.0	0.30	1.4
124	124.0	0.0	0.30	1.4
119	119.0	0.0	0.30	1.4
114	114.0	0.0	0.30	1.4
109	109.0	0.0	0.30	1.4
104	104.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	84.1	0.1	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.0	0.0	0.30	1.4
69	69.0	0.0	0.30	1.4
64	64.0	0.0	0.30	1.4
59	59.0	0.0	0.30	1.4
54	53.9	-0.1	0.30	1.4
49	49.0	0.0	0.30	1.4
44	44.0	0.0	0.30	1.4
39	38.9	-0.1	0.30	1.4
34	34.0	0.0	0.30	1.4
29	29.0	0.0	0.30	1.4
28	28.0	0.0	0.30	1.4

Date of Calibration : 13-14 Jun. 2022

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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 : 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 2323 1672-80 ext. 115, 116  
Fax. (66) 0 2323 9165  
E-mail : mt@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 : sumalee@tistr.or.th

FMBL.MTC.002 Rev.4

Request No. 21-65/0137

MTC No. EEL. BP. 104/1164

## CALIBRATION CERTIFICATE

Submitted by : WATER ANALYSIS CENTER CO., LTD.

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

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

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

### Instrument Calibrated :

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

### Ambient Environment

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

### Standards used :

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

Date of Receipt : 26 Nov. 2021

Date of Calibration : 13-16 Dec 2021

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 Tel. (66) 0 2577 9000  
 Fax. (66) 0 2577 9009  
 E-mail : rumpa@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 2579 1121-30 ext. 115, 116  
 Fax. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
 E-mail : sumalee@tistr.or.th

FM.BL.MTC.002 Rev.4

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Request No. 21-65/0506

MTC No. EEL. BP. 59/0565

### 9. Peak C sound level

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

### 10. Overload indication

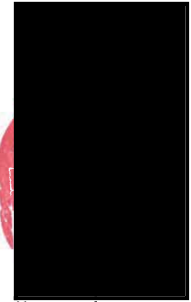
Measured value (dB)		Deviated value (dB)	Uncertainty ( $\pm$ dB)	Tolerance Limits Class 2 ( $\pm$ dB)
Positive one-half cycle	Negative one-half cycle	0.0	0.30	1.8
136.4	136.4			

Calibrated by :



(Mr. Pawikiat Iamsamran)

Approved by :



Electrical and Electronic Standards Laboratory  
 Industrial Metrology and Testing Service Centre

Date of Calibration : 13-14 Jun. 2022

Date of Issue : 15 Jun. 2022

Ref : 2011265052002210002

End of Certificate

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 Tel. (66) 0 2577 9000  
 Fax. (66) 0 2577 9009  
 E-mail : rumpa@tistr.or.th Website: www.tistr.or.th

Office/Laboratory : Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road, Amphoe Muang, Changwat Samutprakan 10280, Thailand  
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FM.BL.MTC.002 Rev.4

### 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 114.2	After adjust 113.9	0.0	0.30
			0.0	1.4

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

### 2. Self-generated noise

#### 2.1 Normal test

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

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

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

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

### Calibration Procedure :

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

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

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

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

### 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	136.0	0.0	0.30	1.4
135	135.0	0.0	0.30	1.4
134	134.0	0.0	0.30	1.4
133	133.0	0.0	0.30	1.4
132	132.0	0.0	0.30	1.4
131	131.0	0.0	0.30	1.4

Date of Calibration : 13-16 Dec.2021

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

Office/Laboratory

Sol 1C, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang, Changwat Samutprakan 10280, Thailand  
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196 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2579 8592  
E-mail : sumalee@tistr.or.th

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### 3. Acoustical signal test of frequency weightings

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

### 4. Electrical signal test of frequency weightings

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

Date of Calibration : 13-16 Dec.2021

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Tel. (66) 0 2577 9000  
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196 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
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### 6. Level linearity on the reference level range (cont.)

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

### 7. Level linearity including the level range control

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

### 8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (dB)
Fast	200	126.0	0.0	0.20	±1.3
	2	108.9	-0.1	0.20	+1.3; -2.8
	0.25	99.9	-0.1	0.20	+1.8; -5.3
Slow	200	119.5	-0.1	0.20	±1.3
	2	99.9	-0.1	0.20	+1.3; -5.3
SEL	200	120.0	0.0	0.20	±1.3
	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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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 : rumpai@tistr.or.th Website:www.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 : sunalee@tistr.or.th

### 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	49.0	0.0	0.30	1.4
44	44.0	0.0	0.30	1.4
39	39.0	0.0	0.30	1.4
34	34.0	0.0	0.30	1.4
29	28.9	-0.1	0.30	1.4
28	27.9	-0.1	0.30	1.4

Date of Calibration : 13-16 Dec.2021

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Fax. (66) 0 2579 8592  
E-mail : sunalee@tistr.or.th



# CALIBRATION CERTIFICATE

CALIBRATION CERTIFICATE No.: 01222462  
 CLIENT: Water Analysis Centre Co Ltd  
 INSTRUMENT TYPE / No.: V900012462  
 CALIBRATION DATE: 05/01/2022  
 CALIBRATION DUE: Jan 2023  
 CALIBRATED BY: PJA

CALIBRATION ACCURACY: 0.40Hz 5mm/s

	A	B	VDV
Peak Particle Velocity L	±5 %	channel	channel
Peak Particle Velocity V	±5 %	channel	channel
Peak Particle Velocity T	±5 %	channel	channel

AIR OVERPRESSURE CHANNEL - Peak Level Unweighted  $\Delta$  dB(Lin)

WE HEREBY CERTIFY THAT THIS SEISMOGRAPH FULLY  
 COMPLIES WITH THE MANUFACTURERS SPECIFICATION

CERTIFIED BY:

DATE:

THIS CERTIFICATE IS VALID FOR 12 MONTHS

The above calibration was carried out using equipment calibrated as follows:-  
 Pulsar Acoustic Calibrator 100B, serial number 60796, calibrated January 2022  
 ISO-TECH IFG 100 Oscillator, serial number 300351, calibrated July 2021  
 Monitran Vibration Meter, serial number 213608, calibrated August 2021  
 Precision Gold PG012 Multimeter, serial number 09000182, calibrated July 2021

THIS CALIBRATION IS TRACEABLE TO NATIONAL STANDARDS

VIBROCK LIMITED

Shanakiel  
 Ilkeston Road  
 Heanor  
 Derbyshire DE75 7DR  
 Tel: 01773 711211  
 Fax: 01773 711311  
 Email: vibrock@vibrocraft.com  
 Web: www.vibrocraft.com

INSTCALCERT/04/01/22



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0137

MTC No. EEL. BP. 104/1164

## 9. Peak C sound level

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

## 10. Overload indication

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

Calibrated by :

Approved by :

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 : 2011264112604939001

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 : rumpa@tistr.or.th Website: www.tistr.or.th

Office/Laboratory

Sol 1C, Bangpoo Industrial Estate, Sukhumvit Road,  
 Amphoe Muang, Changwat Samutprakarn 10280, Thailand  
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 Fax. (66) 0 2579 8592  
 E-mail : sumalee@tistr.or.th



## CERTIFICATE OF CALIBRATION

Certificate No.: C0-1908005/22

Page 1 of total 4 pages

Customer

WATER ANALYSIS CENTER CO., LTD.  
30/5 Soi Vipavadee 60, Vipavadee Rangsit Road,  
Kwaeng Taladbangkhen, 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: -

Calibration Location

Jayhawks Laboratory (CL&GL)

Received Date

19 August 2022

Calibration Date

19 August 2022

Date of Issue

22 August 2022

Checked by

Approved by

( ) (Krisyos K.) ( ) (Sakda Y.)  
( ) (Paiphan K.) ( ) (Omnapa P.)  
( ) (Pongsak H.) ( ) (Niti Phong 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	10-0804001/22	Apr. 7, 2023	THC
Digital Thermometer with Sensor	1523 / 5622	1709138 / 4605984-005	10-1006004/22	Jun. 9, 2023	

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

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

Measurement Results:

1. Function Simulated pH Meter

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

UUC : Unit Under Calibration

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

Certificate No.: C0-1908005/22

Page 3 of total 4 pages

Measurement Results (Cont.):

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

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

Note : Adjust Curve to Buffer Solution pH (4,7,10)  
Temperature stability of micro bath : 25 ± 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

Page 4 of total 4 pages

Reference Method:

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

Reference Standard Instruments:

Type	Model	Serial No.	Cert. No.	Due Date	Traceability
Thermometer Readout	1529-R	B7C853	10-1011001/21	Nov. 10, 2022	THC
Platinum Resistance Thermometer	5626	4854	COA30047	Oct. 22, 2023	FLUKE
Liquid Bath	XORTS-40A	XO111019	10-0306002/21	Jun. 3, 2023	THC

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

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

Measurement Results:

(X) Without Adjustment

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

Immersion Depth (mm.)	Standard Reading (°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 Viphavadee 60, Viphavadee Rangsit Road,  
Kwaeng Taladbangkhen, Khet Laksi, Bangkok 10210

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

**Environmental Conditions** Ambient Temperature:  $(20 \pm 2) ^\circ\text{C}$   
Relative Humidity:  $(50 \pm 10) \%$   
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**

**Approved by**

Act as Technical Manager

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

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

FE-169

REV.02 02/24/21

Certificate No.: 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 $\mu\text{S/cm}$ 1.421 $\text{mS/cm}$	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 ( $\pm$ )
151.1 $\mu\text{S/cm}$	150.9 $\mu\text{S/cm}$	0.2 $\mu\text{S/cm}$	1.5 $\mu\text{S/cm}$
1.421 $\text{mS/cm}$	1.423 $\text{mS/cm}$	-0.002 $\text{mS/cm}$	0.0052 $\text{mS/cm}$

**Note :** Adjustment points: 151.1  $\mu\text{S/cm}$  1.421  $\text{mS/cm}$

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

- End of Certificate -

Calibrated by

FE-169



SV 201003/2023

Cert. No. WAC-065  
Page 1 of 2

## CERTIFICATE OF CALIBRATION

Instrument : DO Meter  
Model : DO-31P  
Serial No. : 780065  
Manufacturer : TOA-DKK  
Measuring Range : 0.00 ~ 20.00 mg/l  
Customer : Water Analysis Center Co.,Ltd.  
1/94 Moo.5 T.Kanham, A.U.-Thai  
Ayutthaya 13210 Thailand  
Machine : -  
Location : -

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

Ambient Condition : Temperature 25 °C  
Humidity 50 % RH

Calibrated By : 

Approved By : 

Date Of Issue : 09 / 01 / 2023

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

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

Cert. No. WAC-065  
Page 2 of 2

### Calibrate Procedure

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

### Condition of this result of calibration

1). Reference Standard Solution

Standard	Lot No	Batch.	Cert.No.	Due Date
Sodium Sulfite Power	1.06657.0500	K54224057	-	30 Sep 2023

2). Traceability This certification is traceable to

- ☒ Merek KGaA 64271 Darmstadt
- ☐ DKK Corporation

### Result Of Calibration

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

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

Calibrated By : 

Certificate No.: MC 2207678

Page 2 of 3

**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.

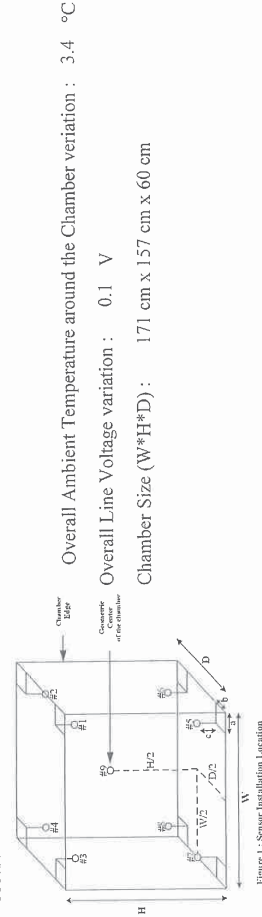


Figure 1 : Sensor Installation Location

Checked by : **Thanagorn**

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



Page 1 of 3

Certificate No.: MC 2207678

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

Reference Job No. : 22-1601 Received Date : 12 July 2022

Description : Refrigerator

Manufacturer : SANDENINTERCOOL Model : SEC-1500SBD

Serial No. : SEC1500201A-0708-00304 ID. No. : WWL0038

Marking : Additionally for the purpose of identification by this laboratory a label marked with this certificate number (MC 2207678) has been attached to the case.

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

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

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

Relative Humidity : ( 48.8 to 52.2 ) %

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

Checked by :

Approved by :

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

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

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

Certificate No.: MC 2207678

Page 3 of 3

## 2. Result of calibration :

### Temperature Measurement Accuracy Test

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

### Chamber Characterization Result

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

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

This report will certify of the calibrated equipment only.

End of Certificate

Checked by :

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

## Certificate of Calibration



Page 1 of 3



### TEMPERATURE CONTROLLER ENCLOSURES

Certificate No.: MC 2203933

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

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

Manufacturer : Memmert Model : UF260  
Serial No. : B620.0814 ID. No. : WWL0212

Marking : Additionally for the purpose of identification by this laboratory a label marked with this certificate number ( MC 2203933 ) has been attached to the case.

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

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

Environmental Conditions : Ambient Temperature : ( 30.5 to 32.6 ) °C  
Relative Humidity : ( 56.2 to 61.2 ) %

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

Checked by :

Approved by :

The uncertainties are for a ~~coverage~~ **probability of approximately 95%**

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

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



Certificate No.: MC 2203933

Page 2 of 3

## The Reference Standard :

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

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

- Master Calibration Co., Ltd.

## 1. Calibration Procedure:

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

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

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

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

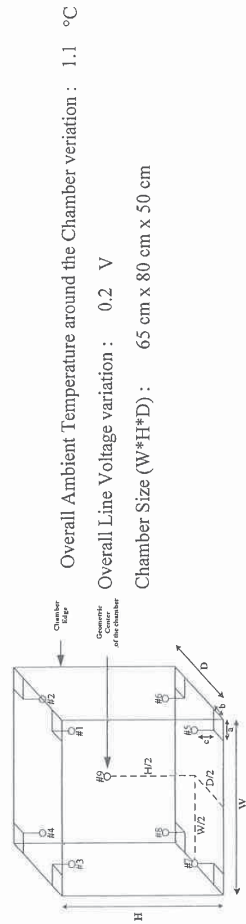


Figure 1 : Sensor Installation Location

Checked by :

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

Certificate No.: MC 2203933

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## 2. Result of calibration :

### Temperature Measurement Accuracy Test

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

### Chamber Characterization Result

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

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

This report will certify of the calibrated equipment only.

End of Certificate

Checked by :

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



## Certificate of Calibration

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

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

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

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

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

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



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

Certificate No.: C01221685

Page: 2 of 2

### Calibration Results: Without Adjustment

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

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

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

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

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

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
1	0.99998	1.0000	0.0000	0.000097	2.02
2	1.99999	2.0000	0.0000	0.000098	2.02
5	5.00000	5.0000	0.0000	0.000099	2.02
10	10.00002	10.0000	0.0000	0.00010	2.02
20	19.99995	20.0000	0.0000	0.00011	2.01
50	50.00002	50.0000	0.0000	0.00012	2.01
70	69.99997	70.0000	0.0000	0.00015	2.00
100	100.00007	100.0001	0.0000	0.00017	2.00
120	120.00002	120.0000	0.0000	0.00020	2.00
150	150.00009	150.0002	0.0001	0.00023	2.00
200	199.99993	200.0003	0.0004	0.00029	2.00

### The End of Certificate