

ภาคผนวกที่ 6-1
เอกสารสอบเทียบคุณภาพอากาศในบรรยากาศ



JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
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Bangkok 10600 (Thailand)
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Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Flow measurement laboratory
Calibration services department.



NSC – TISI – TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CO-006-66

Page 1 of 2 Pages

MEASUREMENT ITEM : Top Load Orifice
MANUFACTURER : TISCH
MODEL/TYPE : TE-5025A
SERIAL NUMBER : 710725
ID NUMBER : -
CONDITION AS-RECEIVED : Used item
CUSTOMER : Pacific Laboratory Co., Ltd.
14/5358 Moo14, T.Bang Bua Thong, A.Bang Bua Thong,
Nonthaburi 11110, Thailand.

RECEIVED DATE : 08 Jun 2023
MEASUREMENT DATE : 13 Jun 2023
ISSUE DATE : 13 Jun 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature	: 23.0 ± 3.0	°C
Relative Humidity	: 55.0 ± 15.0	%RH
Atmospheric Pressure	: 1010 ± 10	hPa

CALIBRATION CONDITION:

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are 24.3 °C and 57.1%RH.

NOTED: The certificate is valid only to the item calibrated on date and place of calibration.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:

The Orifice gas flow device was calibrated against Standard Rotary Displacement Meter (Roots Meter) Model G65/IMC/W2-dp. The WI-CL-004 was used as a calibration guideline.

Traceability:

This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the VSL (National Metrology Institute of Netherlands) via Certificate number: G2211901

Uncertainty of Measurement:

The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor $k=2$, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'

Calibrated by:

- ☐ Mr. Sorawit Thachalad
☒ Miss Jittraporn Lertsomphol



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

MEASUREMENT RESULTS:

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

Table 1: The results of Q Standard calibration data

Plate	Flow rate m^3/min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Δp_{meter} mmHg	$\Delta p_{Orifice}$ inH ₂ O	γ	Standard Flow [Q_s] m^3/min
1	0.706	755.735	24.45	23.61	50.097	1.703	1.302	0.659
2	0.998	755.793	24.22	23.66	63.145	3.306	1.816	0.914
3	1.119	755.870	24.25	23.69	43.259	4.386	2.091	1.054
4	1.167	755.926	24.11	23.44	32.309	4.937	2.219	1.117
5	1.409	755.921	24.03	23.51	29.079	7.321	2.703	1.354

Slope (m): 2.01034
 Intercept (b): -0.02337
 Correlation coefficient (r): 0.99984
 Uncertainty ($k=2$): 0.015 m^3/min

Table 2: The results of Q actual calibration data

Plate	Flow rate m^3/min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Δp_{meter} mmHg	$\Delta p_{Orifice}$ inH ₂ O	γ	Standard Flow [Q_a] m^3/min
1	0.706	755.735	24.45	23.61	50.097	1.703	0.819	0.661
2	0.998	755.793	24.22	23.66	63.145	3.306	1.141	0.916
3	1.119	755.870	24.25	23.69	43.259	4.386	1.314	1.057
4	1.167	755.926	24.11	23.44	32.309	4.937	1.393	1.120
5	1.409	755.921	24.03	23.51	29.079	7.321	1.697	1.357

Slope (m): 1.25919
 Intercept (b): -0.01471
 Correlation coefficient (r): 0.99983
 Uncertainty ($k = 2$): 0.015 m^3/min

End of Certificate of Calibration



Analyzer Performance Test

Calibrated Date: 21 March 2023

Instruments Information

Analyzer Type : SO2 Analyzer
Model : 43C

Manufacturer : Thermo Environmental
Serial Number : 43C-58286-317

Calibrator Unit

Dilutor Model : Dasibi Model 5008
Serial Number : 705
ZERO AIR Generator : API MODEL 701
Serial Number : 1924

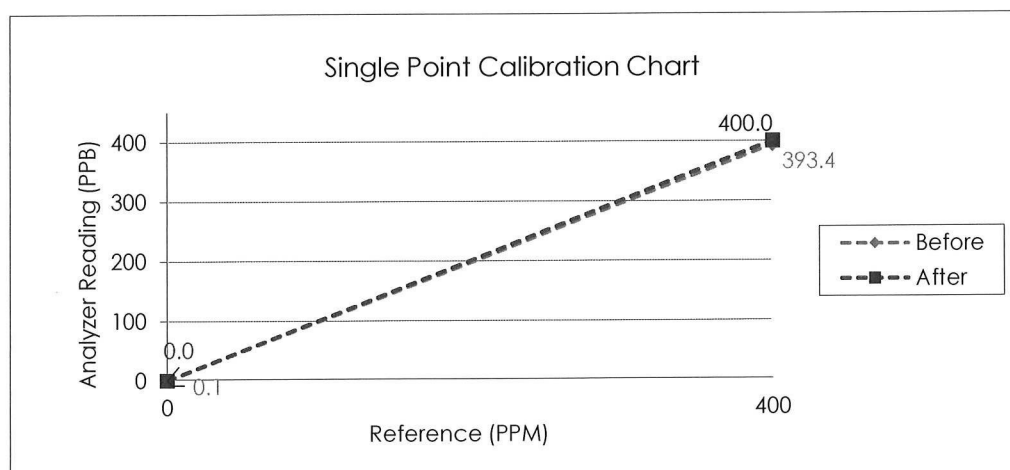
Standard Gas Concentration

Nitric Oxide (NO) 55.47 PPM
 Sulphur Dioxide (SO2) 55.11 PPM
 Carbon Monoxide (CO) 4,535 PPM
 Cylinder number EB0129027
 Expire Date: 29 Oct. 2027

Environment : Temperature 25.5 °C Humidity: 51 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPB)	Reading (PPB)	Drift (PPB)	Reference (PPB)	Reading (PPB)	Drift%
Before	0.0	0.1	0.1	400.0	393.4	-1.7
After	0.0	0.0	0.0	400.0	400.0	0.0



Calibrate By : 
 MR. KITTISAK JANSANGWATTANA

Approve by : 
 MR. PASAGORN SAMOL

Analyzer Performance Test

Calibrated Date: 21 March 2023

Instruments Information

Analyzer Type : SO2 Analyzer
Model : 43C

Manufacturer : Thermo Environmental
Serial Number : 43C-58207-316

Calibrator Unit

Dilutor Model : Dasibi Model 5008
Serial Number : 705
ZERO AIR Generator : API MODEL 701
Serial Number : 1924

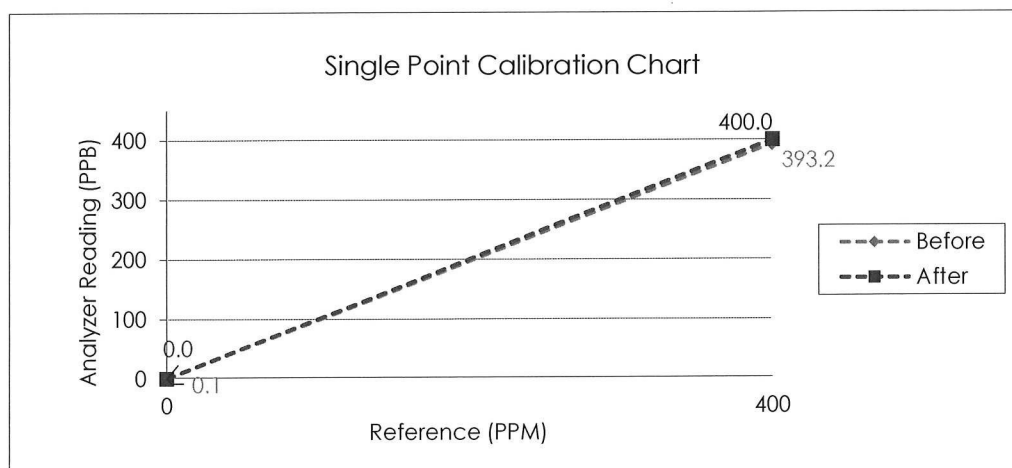
Standard Gas Concentration

Nitric Oxide (NO) 55.47 PPM
Sulphur Dioxide (SO2) 55.11 PPM
Carbon Monoxide (CO) 4,535 PPM
Cylinder number EB0129027
Expire Date: 29 Oct. 2027

Environment : Temperature 25.5 °C Humidity: 51 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPB)	Reading (PPB)	Drift (PPB)	Reference (PPB)	Reading (PPB)	Drift%
Before	0.0	0.1	0.1	400.0	393.2	-1.7
After	0.0	0.0	0.0	400.0	400.0	0.0



Calibrate By : กิตติศักดิ์ จันทะวงษ์
 MR. KITTISAK JANSANGWATTANA

Approve by : 
 MR. PASAGORN SAMOL



บริษัท เอ็นไวร์ เซอร์วิส จำกัด

42 รามอินทรา 14 แยก 9 แขวงท่าแร้ง เขตบางเขน กรุงเทพฯ 10230 โทรศัพท์ 02-9435814-5 โทรสาร 02-9438201
บริษัท เอ็นไวร์ เซอร์วิส จำกัด
ENVIR SERVICE CO., LTD. 42 Raminthra 14 yeak 9, Tha Rang, Bangkhen, Bankok 10230 Tel : 02-9435814-5 Fax : 02-9438201

Analyzer Performance Test

Calibrated Date: 26 January 2023

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 42C	Manufacturer Thermo Environmental S/N: 03263000000891
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Calibration System

Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API Model 701 S/N: 1924	NO Conc 55.47 PPM SO2 Conc 55.11 PPM CO Conc 4,535 PPM Cylinder number EB0129027 Expire Date: 29 Oct. 2027

Environment: Temperature 25.5 °C

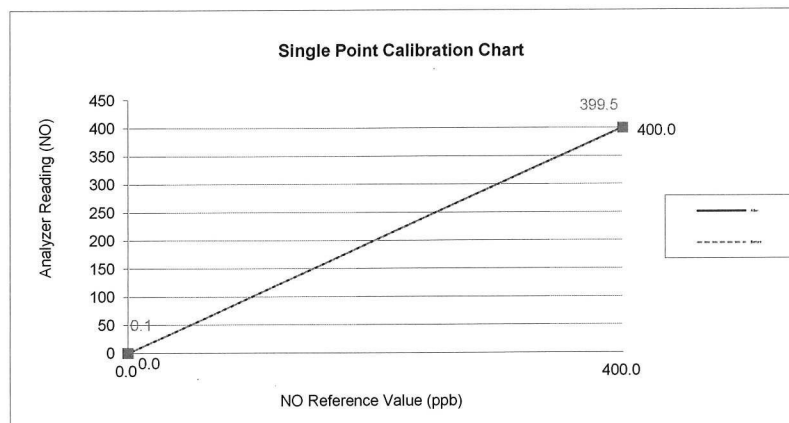
Humidity: 51 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.1	0.0	0.1	399.5	400.0	-0.1
NOx	0.1	0.0	0.1	399.2	400.0	-0.2

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.0	0.0	0.0	400.0	400.0	0.0
NOx	0.0	0.0	0.0	400.0	400.0	0.0



Calibrate By : Mr. Pasagorn Samol



บริษัท เอ็นไวร์ เซอร์วิส จำกัด

42 รามอินทรา 14 แยก 9 แขวงท่าแร้ง เขตบางเขน กรุงเทพฯ 10230 โทรศัพท์ 02-9435814-5 โทรสาร 02-9438201
บริษัท เอ็นไวร์ เซอร์วิส จำกัด
ENVIR SERVICE CO., LTD. 42 Raminthra 14 yeak 9, Tha Rang, Bangkhen, Bangkok 10230 Tel : 02-9435814-5 Fax : 02-9438201

Analyzer Performance Test

Calibrated Date: 26 January 2023

Instruments Information

Analyzer Type: NO/NO ₂ /NO _x Analyzer Model: 42C	Manufacturer Thermo Environmental S/N: 0514811452
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Calibration System

Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API Model 701 S/N: 1924	NO Conc 55.47 PPM SO ₂ Conc 55.11 PPM CO Conc 4,535 PPM Cylinder number EB0129027 Expire Date: 29 Oct. 2027

Environment: Temperature 25.5 °C

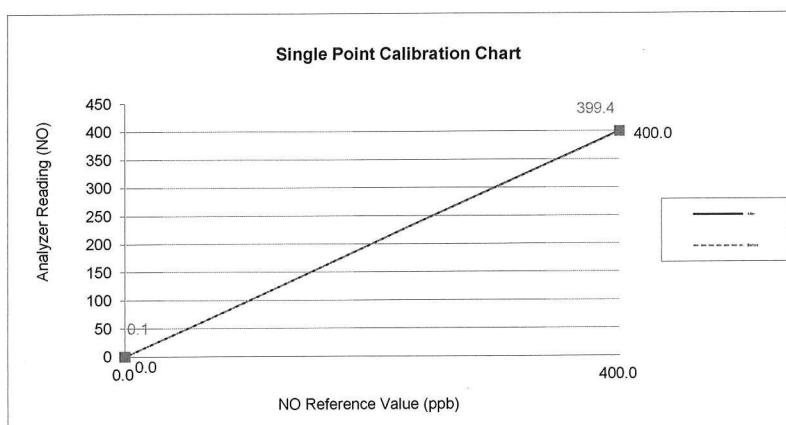
Humidity: 51 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.1	0.0	0.1	399.4	400.0	-0.2
NO _x	0.1	0.0	0.1	399.3	400.0	-0.2

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.0	0.0	0.0	400.0	400.0	0.0
NO _x	0.0	0.0	0.0	400.0	400.0	0.0



Calibrate By : Mr. Pasagorn Samol

ภาคผนวกที่ 6-2
เอกสารสอบเทียบ
ปริมาณสารเจือปนในอากาศที่ระบายออกจากปล่อง

Enviro-Service Co., Ltd.

110/254 Moo 3, Tambon Bang Rak Phathana, Amphur Bang Bua Thong, Nonthaburi 11110

Tel. 098 362 9152, 089 478 7885

E-mail: sales@enviro-ees.com

Certificate No. : E23-09078
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Certificate No. : E23-09078
Page : 1 of 6

CERTIFICATE OF CALIBRATION

Customer : Pacific Laboratory Co., Ltd.
Address : 14/5358 Moo 14, Tambon Bang Bua Thong, Amphoe Bang Bua Thong, Nonthaburi 11110

Description of Equipment : Console meter

Manufacturer : Apex Instrument

Model Number : C-5000

Serial Number : 1846

ID/Control No. : -

Environment Conditions : Temperature (25 ± 2) °C
Humidity (50 ± 15) % RH

Cal. Date : 05/09/2023

Issue Date : 05/09/2023

Calibration Method or Calibration Procedure Used

US EPA Method (United State Environmental Protection Agency)

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

Result of Calibration

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

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

Calibrated by : Mr. Sanya Sangnil

Approved by :

(Mr. Mana Fuekthong)
Technical Manager



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

Meter Console Information				Calibration Conditions				Factors/Conversions			
Console Model Number	C-5000			Date	Time	05/09/2023	01:10 PM	Std Temp	293	K	
Console Serial Number	1846			Calibration Reference No.		SER23-09032		Std Press	760	mm Hg	
DGM Model Number	G1.6			Barometric Pressure		755.99	mmHg	K _i	0.386		
DGM Serial Number	GB/T6968-2011			Calibration Meter Gamma		0.999		Console Leak Check			
								PASS			

Calibration Data											
Run Time				Metering Console				Calibration Meter			
Elapsed (Q)	DGM Orifice DH	Volume Initial (V _m)	Volume Final (V _m)	Outlet Temp Initial (t _m)	Outlet Temp Final (t _m)	Volume Initial (V _{wf})	Volume Final (V _{wf})	Outlet Temp Initial (t _w)	Outlet Temp Final (t _w)	Volume Initial	Volume Final
min	(P _m) mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C	°C	m ³	m ³
12.62	13.0	810.2020	810.3420	26	26	167.51062	167.65118	25	25	25	25
12.58	13.0	810.3420	810.4820	27	27	167.65118	167.79100	25	25	25	25
9.27	25.0	810.4930	810.6330	28	28	167.82218	167.96144	25	25	25	25
9.25	25.0	810.6330	810.7730	28	28	167.96144	168.10076	25	25	25	25
13.83	40.0	810.7820	811.0620	29	29	168.12608	168.40640	25	25	25	25
13.72	40.0	811.0620	811.3420	29	29	168.40640	168.68600	25	25	25	25
10.38	70.0	811.3550	811.6350	30	30	168.69900	168.97872	25	25	25	25
10.42	70.0	811.6350	811.9150	30	30	168.97872	169.25904	25	25	25	25
9.15	90.0	811.9340	812.2140	29	29	169.27672	169.55507	25	25	25	25
9.20	90.0	812.2140	812.4940	29	29	169.55507	169.83526	25	25	25	25

Certificate No. : E23-09078
Page : 3 of 6

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

Meter Console Information			Calibration Conditions			Factors/Conversions		
Console Model Number	C-5000		Date	Time	01:10 PM	Std Temp	293	K
Console Serial Number	1846		Calibration Reference No.	SER23-09032		Std Press	760	mm Hg
DGM Model Number	G1.6		Barometric Pressure	755.99	mmHg	K _i	0.386	
DGM Serial Number	GB/T6968-2011		Calibration Meter Gamma	0.999		Console Leak Check	PASS	

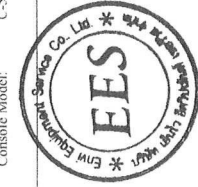
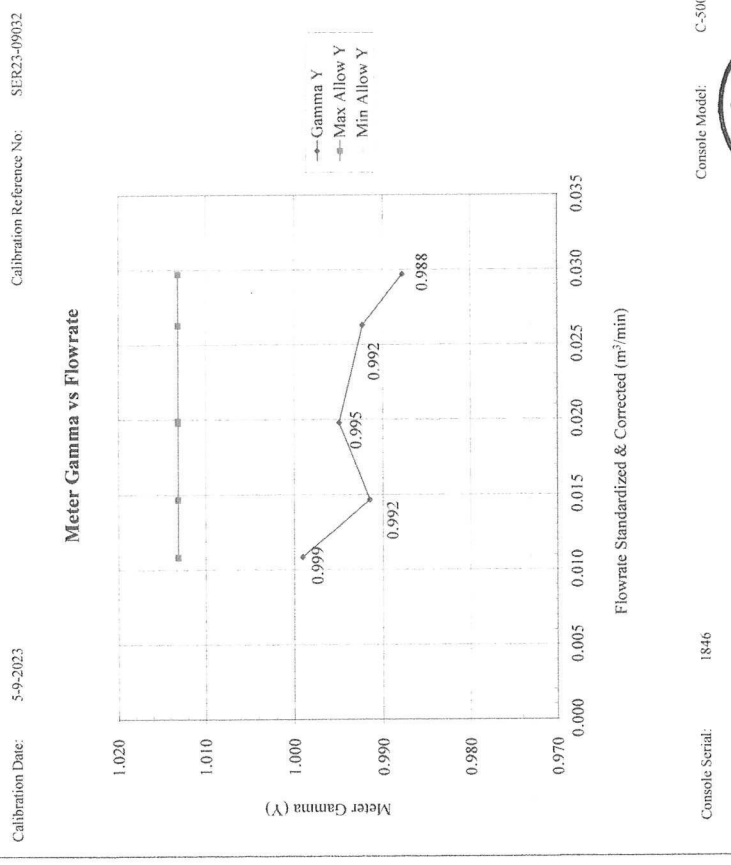
Calibration Data Results											
Standardized Data						Dry Gas Meter					
Dry Gas Meter (V _{std}) m ³	Dry Gas Meter (V _{wet}) m ³	Calibration Meter (Q _{wet}) m ³ /min	Calibration Factor		Flowrate Std & Corr (Q _{std/corr}) m ³ /min	.0212 m ³ /min (ΔH _{std}) mm H ₂ O	Variation		ΔH _{std}	Variation	ΔH _{std}
			Value (Y)	ΔY (ΔY)			Value (Y)	ΔY (ΔY)			
0.137	0.011	0.137	0.011	0.009	0.011	48.508	1.333				
0.137	0.011	0.137	0.011	0.003	0.011	48.764	1.589				
0.137	0.015	0.136	0.015	0.001	0.015	51.387	4.212				
0.137	0.015	0.136	0.015	0.001	0.015	51.158	3.983				
0.275	0.020	0.274	0.020	0.003	0.020	45.351	-1.824				
0.275	0.020	0.273	0.020	0.004	0.020	44.819	-2.356				
0.276	0.027	0.273	0.026	0.001	0.026	45.167	-2.007				
0.276	0.026	0.274	0.026	0.003	0.026	45.263	-1.911				
0.276	0.030	0.272	0.030	0.004	0.030	45.717	-1.458				
0.276	0.030	0.274	0.030	0.001	0.030	45.613	-1.562				
Y Average						47.175	ΔH _{std} Average				

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ±0.02.
For ΔH_{std}, orifice pressure differential that equates to 0.75 cfm (0.0212 m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1 mm).



Certificate No. : E23-09078
Page : 4 of 6

Meter Console Information				Calibration Conditions				Factors/Conversions			
Console Model Number	C-5000	Console Serial Number	1846	Date	05/09/2023	Time	01:10 PM	Std Temp	293	K	
DGM Model Number	G1.6	DGM Serial Number	GB/T6968-2011	Calibration Reference No.	SER23-09032	Calibration Reference Pressure	755.99 mmHg	Std Press	760	mm Hg	
				Calibration Meter Gamma	0.999	Calibration Meter Gamma		K ₁	0.386	Console Leak Check	PASS

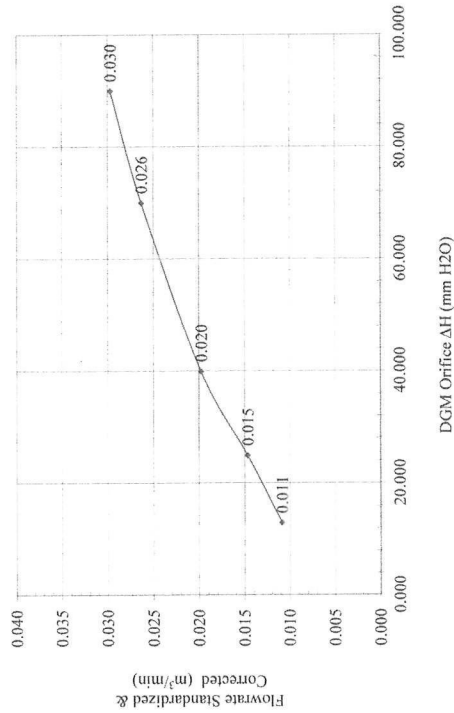
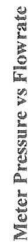


Factors/Conversions

Std Temp	293	K
Std Press	760	mm Hg
K _i	0.386	
Console Leak Check		PASS

Calibration Conditions		
Date	Time	
05/09/2023	03:15 PM	
Calibration Reference No.	SER23-09032	
Reference Thermometer	DIGICON	
Serial Number	183169105	

Calibration Reference No: SER23-09032



Console Model: C-5000



Certificate of Calibration



CUSTOMER

Name
Pacific Laboratory Co., Ltd.

Address
**14/5358 Moo 14, Tambon Bang Bua Thong,
Amphoe Bang Bua Thong, Nonthaburi 11110**
Department/ Division/ Vessel
N/A

UNIT UNDER CALIBRATION (UUC)

Description
Flue gas analyzer
Manufacturers
testo Model 310
S/N.**42848034**
Measuring Range
O2 : 0-21 %Vol, CO : 0-4000 PPM

Cert. No. **SE-CM23SER117**

Cal. Date : 10-Mar-23
Cal. Due : 09-Mar-24
Work Order No. : SE-CM23SER117
Cal. Temp. : 25.0 ± 1°C
Cal. Humidity : 55.0 ± 10 %RH

Reference Standard

Description	Cert. No.	Expired Date
- GASCO Nitrogen = 99.99 %Vol	81-0078RK-01	6-May-25
- Linde Mixture Gas in Nitrogen	3278/22	17-Oct-24
Component : CO = 100 PPM, O2 = 18.0 %		

Function Setup

Items	O2	CO
Low alarm	None	None
High alarm	None	None
Unit	%Vol	PPM

Test Result

Visual Check	Criteria	Result	Operation Check	Criteria	Result
Structure	Proper	Good	Battery storage	Function	Pass
Indication, Symbol and letter	Proper	Good	Suction pump	Function	Pass
Gas sampling hose & probe	Proper	Good			


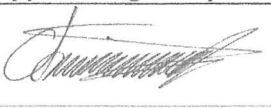

Calibration Result

Parameter	Zero						Span						Respond time Sec.		Judgment	Note:
	Std.	Acc.	Before	Cal.	After	Err.	Std.	Acc.	Before	Cal.	After	Err.	Acc.	Read		
O2 (%Vol)	0.0	± 1.5	0.0	0.0	0.0	0.0	18.0	± 1.0	18.4	18.4	18.4	0.0	≤30	14.0	Pass	- Respond time must be within 30 sec. to reach to 90% of Std. concentration.
CO (PPM)	0.0	0.0	0.0	0.0	0.0	0.0	100.0	± 5	85.0	85.0	85.0	0.0	≤30	18.0	Pass	

Std. = Standard, Read = Reading, Cal. = Calibrate, Acc. = Acceptance, Err. = Error, Sec. = Second

Comment/ Suggestion :

This UUC that has been tested and calibrated to meet the manufacturer's published specifications in accordance with our quality control system. The standards used for calibration are on record and traceable to the National Institute of Standard and Technology (NIST), and have accuracies equal to or greater than the UUC being tested. This result of calibration was found accurated as show on date and place of calibration only.

Engineer Signatory	Approval Signatory	Company Stamp
 Mr. Thaweechai Santawiro (Engineer Specialist) Date : 10-Mar-23	 Mr. Chaiwat Chuekhunthod (Gases Division Chief) Date : 10-Mar-23	 Call Me CALL ME ENGINEER CO., LTD.

Certificate No. C07230008

Calibration Certificate

Equipment: SPECTROPHOTOMETER

Model: DR3900

Serial No.(or ID): 2076219

Manufacturer: HACH

Condition: In Condition

Job No.: KSMT2300196

Received Date: 14 July 2023

Issued Date: 14 July 2023

Page: 1 of 3

Customer

Pacific Laboratory Co., Ltd.

14/5358 Moo 14, Bang Bua Thong, Bang Bua Thong, Nonthaburi 11110 Thailand

Calibration Place

Pacific Laboratory Co., Ltd.(ห้องปฏิบัติการทดสอบ Zone B)

14/5358 Moo 14, Bang Bua Thong, Bang Bua Thong, Nonthaburi 11110 Thailand

Calibration Date

14 July 2023

Environment Condition

Temperature: 29.9 °C ± 0.1 °C

Humidity: 62.4 %RH ± 0.4 %RH

The Method used

In-house method, WI07, based on ASTM E 275-08 and
ASTM E 387-04

Traceability

This certificate is traceable to the CRM maintained by National Institute
of Standards and Technology (NIST) through Sarna Scientific Limited.

The standard for Wavelength Certificate No. 108691 and 108692

The standard for Photometric Certificate No. 109010

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
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 SCIMET Co., Ltd.

(Mr. Dumrong Boonsopon)

Person in charge



(Mr. Thalerngkeat Pongngam)

Authorized signatory

Calibration Results:

Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 5 nm and UUC at 5 nm

Standard Wavelength (nm)	Unit Under Calibration (nm)	Correction (nm)	Uncertainty of Measurement (± nm)
361.02	361	0.02	0.59
417.80	417	0.80	0.59
441.29	441	0.29	0.59
471.51	471	0.51	0.59
479.88	480	-0.12	0.59
513.75	514	-0.25	0.59
528.59	528	0.59	0.59
537.75	537	0.75	0.59
585.56	585	0.56	0.59
641.95	642	-0.05	0.59
684.70	684	0.70	0.59
747.61	747	0.61	0.59
807.04	807	0.04	0.59
879.68	879	0.68	0.59

Calibration Results:

Without Adjustment

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance (Abs)	Unit Under Calibration (Abs)	Correction (Abs)	Uncertainty of Measurement(\pm Abs)
420 nm	0.0000	0.000	0.0000	0.0045
	0.5617	0.560	0.0017	0.0045
	0.7392	0.737	0.0022	0.0045
	1.0550	1.054	0.0010	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.5513	0.550	0.0013	0.0045
	0.7230	0.721	0.0020	0.0045
	1.0324	1.031	0.0014	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.5036	0.505	-0.0014	0.0045
	0.6735	0.673	0.0005	0.0045
	0.9615	0.964	-0.0025	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5176	0.517	0.0006	0.0045
	0.6930	0.691	0.0020	0.0045
	0.9908	0.990	0.0008	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5530	0.552	0.0010	0.0045
	0.7196	0.717	0.0026	0.0045
	1.0301	1.027	0.0031	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.5370	0.536	0.0010	0.0045
	0.6862	0.684	0.0022	0.0045
	0.9822	0.981	0.0012	0.0045

The End of Certificate

ภาคผนวกที่ 6-3
เอกสารสอบเทียบปริมาณความเข้มข้นละอองและสารเคมี
ในบรรยากาศการทำงาน

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Request No.23-66/0141

MTC.No.23-66/0141

Number of page(s) 2

CALIBRATION CERTIFICATE

Nomenclature : DRYCAL DC-LITE FLOWMETER

Manufacturer : BIOS International Corporation, USA.

Serial No.: 104699

Model : DCL-M, Rev 1.09

Scale range : 100 ml/min to 7 l/min

Subdivision : (0.0001, 0.001) l/min

Submitted by : PACIFIC LABORATORY CO.,LTD.

14/5358 Moo14, T.Bang Bua Thong, A.Bang Bua Thong,
Nonthaburi 11110, Thailand.

Received date : 23 December 2022 Condition of measured item : Normal

Calibration date : 5 January 2023

Standard :

Standard	Certificate No.	Date due	Traceability
RTD Thermometer	PSL-T 643/65	1-Jun-24	TISTR
Molbox/PressureTransducer/UpStream	MP-0013-21	25-Jan-23	NIMT
Primary Flow Calibrator S/N 117982	MW-0011-21	8-Apr-23	NIMT
Primary Flow Calibrator S/N 119521	MW-0012-21	31-Mar-23	NIMT

Calibrated by : *Terasak Panna*

(Mr.Terasak Panna)

Approved by : *Kirana Luanghirun*

(Ms.Kirana Luanghirun)

Director

Mechanical Engineering Standards Laboratory

Ref. 2013265122305450001

Issued Date 5 January 2023

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

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

FM.BL.MTC.002 Rev.4

Head Office

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

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Request No.23-66/0141

2/2

MTC.No.23-66/0141

Calibration point : (0.05, 0.1, 0.2, 1.0, 2.0, 3.0) l/min

Ambient condition : Temperature (23 ± 3) °C , Relative humidity (55 ± 15) %

Atmospheric pressure (1010 ± 13) hPa

Calibration method : The flowmeter (UUC) was calibrated by comparison method with standard flowmeter according to CP-370.01.

The reported value is the value that converted to value at reference condition within pressure and temperature of the actual gas entering the UUC

Measurement data :

UUC Value (l/min)	Standard Value (l/min)	Temperature (°C)	Pressure (hPa)	Deviation (%)	Uncertainty (%)
0.0532	0.052339	22.933	1012.22	+1.58	1.05
0.1007	0.99507	22.940	1012.27	+1.20	1.00
0.2027	0.20121	22.989	1012.39	+0.76	0.98
1.013	1.0068	22.977	1012.93	+0.62	0.86
2.008	2.0000	22.955	1013.60	+0.42	0.85
3.010	2.9971	22.949	1014.31	+0.42	0.85

The reported expanded uncertainties are based on standard uncertainties multiplied by a coverage factor $k=2$, which provides a level of confidence of approximately 95%.

The end of calibration certificate.

T₁₂

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

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

FM.BL.MTC.002 Rev.4

Head Office

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

Certificate of Calibration

Certificate No. : 66-200247-2

Page : 1 of 2

Submitted by : Pacific Laboratory Co., Ltd.

14/5358 Moo 14, T.Bang Bua Thong, A.Bang Bua Thong, Nonthaburi 11110 Thailand

Equipment : Electronic Balance

Manufacturer : SHIMADZU

Model : AP225WD

Serial No. : D316301828

ID No. : LAB-BL-003

Capacity : 220 g

Resolution : 0.00001g/102g, 0.0001g/220g

Environment : On site calibration was carried out at the Laboratory, Pacific Laboratory Co., Ltd.

Ambient Temperature : (25.1 to 25.4) °C

Relative Humidity : (62.3 to 64.8) %

Air Pressure : 1007.0 mbar

Date of Received : 31 July 2023

Date of Calibration : 31 July 2023

Date of Issue : 02 August 2023

Calibrated by : Akaradath Thippichai

Calibration Method : In-house method CAL-M2001 based on UKAS Publication ref : LAB 14
Edition 5, July 2015

Reference Standard Instruments : This certification is traceable to the International System of Units

Standard Weights

ID No.	Cert. No.	Due Date	Traceability
E261-E2624	C02222345	10 Nov 2023	National Institute of Metrology (Thailand), (NIMT)

Approved by :



(Surachai Promthong)

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full except with the prior written approval of the Calibratech Co.,Ltd.



Certificate of Calibration

Certificate No. : 66-200247-2

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Departure of indication from nominal value

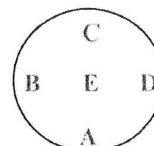
Nominal Value (g)	Correction (g)	Uncertainty \pm (g)
0.001	0.00001	0.000020
0.01	0.00001	0.000021
0.05	0.00001	0.000019
0.1	0.00001	0.000024
1	-0.00001	0.000030
2	0.00000	0.000036
5	-0.00001	0.000046
20	-0.00002	0.000073
50	-0.00004	0.00011
100	-0.00005	0.00020
150	-0.0001	0.00038
200	-0.0001	0.00040

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

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.52$, providing a level of confidence of approximately 95%

Eccentric error

Load test : 50 g
 A B C D E
 0.00002 0.00003 0.00001 0.00004 0.00000 g



Repeatability

Load test : 200 g
 Stdev. : 0.000048 g

- oOo -

Handwritten signature





Document Type: Certificate of Performance (CoP)
Description: CoP for 881 Compact IC pro
Document ID: CoP.881 Version 1.4 / 8.881.3006EN

Metrohm Compliance Service

Certificate of Performance (CoP) for
881 Compact IC pro

Instrument details

Type:	18810000
Serial No.:	PM220395/ME (1881000010137)
Manufacturer:	Metrohm AG Ionenstrasse CH-9100 Herisau Switzerland
Firmware:	5.850.0113
Customer instrument ID:	N/A

Customer details

Name of company:	EMEX Association Co., Ltd.
Address:	27, 29 Bang Mot, Chomthong, Bangkok 10150
Department:	Laboratory
Responsible person:	อุบลจักร วัฒน
Calibration place:	Laboratory EMEX Association Co., Ltd

Date and time of calibration: 22/12/2022 - 08:30

Certificate of Performance (CoP) No.: PM220395/ME (1881000010137)
08:30



ห้องปฏิบัติการวิเคราะห์เอกชน
เลขทะเบียน ว-244



ห้องปฏิบัติการวิเคราะห์เอกชน
เลขทะเบียน ว-244

ใบรับรองการสอบเทียบ “เครื่อง Ion chromatography”
(Calibration Certificate of Ion chromatography)



Document Type
Description
Document ID

Certificate of Performance (CoP)
CoP for 881 Compact IC pro
CoP-881 Version 1.4 / 8.881.3006EN



Certificate of Performance (CoP)

Introduction

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

Calibration status

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

Operational status

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

Declaration

Document

Test instructions used:

C-1 Test instructions for 881 Compact IC pro, Version 1.4

Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date
Millimeter	Fuke	88490180	E11222184	25/05/2023
Temperature meas. Instr.	Fuke	82050101	TMA1221923	10/06/2023
High pressure gauge	Metrohm	345648018313	CC-00017008	11/04/2023
Flow meter	ANALYT-MTC	94306	A02201-280-0001	31/01/2023

Protocol

Instrument had to be repaired beforehand

If yes, see Certificate of Performance (CoP) No.:

Instrument had to be readjusted beforehand

If yes, see Certificate of Performance (CoP) No.:

Yes	No
<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input type="checkbox"/>	<input checked="" type="checkbox"/>

Certificate of Performance (CoP) No.: PM220395IME (1881000010137) - 22/12/2022

08:30



Environmental
and Medical Expert
EMEX ASSOCIATION CO., LTD.

หอนงปฏิตการวเคราะหเชกชน

เลขทะเบียน ว-244

Conclusion of test results

Instrument satisfies the specified technical requirements

Recommended date for next maintenance:

Comments

Yes	No
<input checked="" type="checkbox"/>	<input type="checkbox"/>

Metrohm representative

Metrohm representative confirms correct execution of instrument calibration

Date	Name	Signature
22/12/2022	Mr. Prutchaya Kumpairae	28/12/2022

Customer representative

Customer representative accepts results of instrument calibration

Date	Name	Signature
22/12/2022	คุณฉัตร นามรัก	28/12/2022



Certificate of Performance (CoP) No.: PM220395IME (1881000010137) - 22/12/2022

08:30

หอนงปฏิตการวเคราะหเชกชน

เลขทะเบียน ว-244



Document Type
Description
Document ID

Certificate of Performance (CoP)
CoP for 881 Compact IC pro
CoP.881 Version 1.4 / 8.881.3006EN

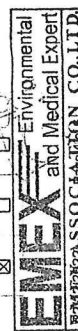


Document Type
Description
Document ID

Certificate of Performance (CoP)
CoP for 881 Compact IC pro
CoP.881 Version 1.4 / 8.881.3006EN

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Visual test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101	Safety test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
102	LED		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
103	Fan		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
104	Communication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
105	Leak detector		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
106	MSB interface		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
107	USB interface		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
108	Column plug interface		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
109	Column heater		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
110	IC pump		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
111	Injector		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
112	Degasser		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
113	MSM (option)		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

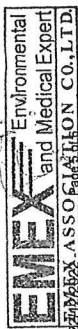


Certificate of Performance (CoP) No.: PM220395/ME (1881000010137) - 25/12/22
08:30

ห่อปฏิบัติการวิเคราะห์เอกชน

เลขทะเบียน ว-244

No.	Title	Comments	Pass		
			Yes	No	N/A
114	Peristaltic pump (option)		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
115	MCS (option)		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



Certificate of Performance (CoP) No.: PM220395/ME (1881000010137) - 25/12/22
08:30

ห่อปฏิบัติการวิเคราะห์เอกชน

เลขทะเบียน ว-244

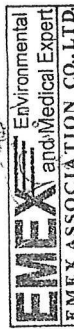


Document Type	Certificate of Performance (CoP)
Description	CoP for 881 Compact IC pro
Document ID	CoP.881 Version 1.4 / 8.881.3006EN

CoP.881 Document History

Date	Version	Author	Description/Changes
16.04.2012	8.881.3004EN	pr	Layout adapted to Metrohm Compliance Service
20.02.2013	8.881.3006EN	pr	Test step 113.2 tolerance increased according C.3 notice of modification CRM-10456
30.03.2021	1.4	pr	Change of document history and versioning (article no. remains the same; new versions are indicated by increase of version number only). Test no. 103 Fan depends on the installed power supply version according C.3 notice of modification CRM-28908.

End of CoP Document



Certificate of Performance (CoP) No.: PM220395/ME (1881000010137) - 22/12/2022
08:30

ห้องปฏิบัติการวิเคราะห์เอกชน
เลขทะเบียน ว-244



Document Type	Certificate of Performance (CoP)
Description	CoP for 850.9010 Conductivity Detector
Document ID	CoP.850 Version 1.3 / 8.850.3023EN

Metrohm Compliance Service

Certificate of Performance (CoP) for 850.9010 Conductivity Detector

Instrument details

Type:	18509010
Serial No.:	PM220395/ME (1850901012155)
Manufacturer:	Metrohm AG, Immenstrasse, CH-9100 Herisau Switzerland
Customer instrument ID:	N/A

Control device details

Type:	1.881.0030
Serial No.:	1881000010137
Firmware:	5.850.0113

Customer details

Name of company:	EMEX Association Co., Ltd.
Address:	27, 29 Bang Mot, Chomthong, Bangkok 10150

Department:	Laboratory
Responsible person:	คุณจักรกร วรศิลป์
Calibration place:	Laboratory EMEX Association Co., Ltd

Date and time of calibration: 22/12/2022 - 08:30



Certificate of Performance (CoP) No.: PM220395/ME (1850901012155)
08:30

ห้องปฏิบัติการวิเคราะห์เอกชน
เลขทะเบียน ว-244

Yes ☐ ☐



Document Type
Description
Document ID

Certificate of Performance (CoP)
CoP for 850.9010 Conductivity Detector
CoP.850 Version 1.3 / 8.850.3023EN

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Visual Inspection		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101	Temperature absolute		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
102	Temperature stability		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
103	Signal noise		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
104	Conductivity dry test		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
105	Conductivity cell (optional)		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

CoP.850 Document History

Date	Article No.	Author	Description/Changes
26.04.2012	8.850.3023EN	Philipp Rüegg	Layout adapted to Metrohm Compliance Service

End of CoP Document

Certificate of Performance (CoP) No.: PM220395/ME (1850901012145)
08:30

EMEX Environmental
and Medical Expert
SOCIETY CO., LTD.
ห้องปฏิบัติการวิเคราะห์เอกชน
เลขทะเบียน ว-244

ภาคผนวกที่ 6-4
เอกสารสอบเทียบระดับความดังเสียง
(Sound Level Meter)

Certificate No.: CP20230169EA

Operation No.: CP2023030041

Certificate of Calibration

Equipment: Sound Calibrator

Manufacturer: TENMARS

Model/Type: TM-100

Serial No.: 190301469

ID No.: -

Customer: Pacific Laboratory Co., Ltd.

Address: 14/5358 Moo 14 T. Bang Bua Thong
A. Bang Bua Thong, Nonthaburi 11110

Received Date: 23 March 2023

Calibrated Date: 31 March 2023

Issued Date: 1 April 2023

Calibrated by: Ms. Juntaporn Kunhakom

Approved by: _____

(Mr. Sittichai Swaksuriyawong)

Group Manager

This report was prepared electronically using applicable electronic signature. Printing or copy of file are considered as a copy of the document.

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor (k) providing a level of confidence of approximately 95%. This certificate may not be reproduced other than in full except with the prior written approval of the Electrical and Electronics Institute, Foundation for Industrial Development.

Certificate No.: CP20230169EA

Calibration Report

Equipment: Sound Calibrator
Manufacturer: TENMARS
Model/Type: TM-100
Serial No.: 190301469
ID No.: -
Ambient Temperature: $(23 \pm 2) ^\circ\text{C}$
Relative Humidity: $(50 \pm 15) \%$
Pressure: $(101.3 \pm 1.5) \text{ kPa}$

Method of Calibration :-

IEC 60942:2017

Condition of this result of calibration

1. Reference standards instrument :-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Standard microphone	4180	2661000	AA-1020-22	14 June 2023
2) Waveform Generator	33511B	MY52302264	CK20220058EA	19 June 2023
3) Audio Analyzing DMM	2015-P	4079144	E1U221042	16 March 2023
4) Pressure humidity and Temperature Transmitter	PTU301	F0640002	CL1-P220024 CD20220164EA	17 March 2023 24 July 2023

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

3. This certification is traceable to the international system of unit maintained at :-

Reference standards instrument for Acoustic function

- National Institute of Metrology (Thailand)

Reference standards instrument for Electrical function

- Electrical and Electronics Institute; ONSC Accredited Calibration No.0119

Result of Calibration:-

1. Function : Sound pressure level

Normal Frequency (Hz)	Specified Sound Pressure level (dB)	Measured value (dB)	Deviated value ^[1] (dB)	Acceptance limit ^[3] (dB)
1000	94	94.20	0.20	± 0.40
1000	114	114.25	0.25	± 0.40

2. Function : Frequency

Normal Sound Pressure level (dB)	Specified Frequency (Hz)	Measured value (Hz)	Deviated value ^[2] (%)	Acceptance limit ^[3] (%)
94	1000	970.5	-3.0	± 1.7
114	1000	965.9	-3.4	± 1.7

Certificate No.: CP20230169EA

Calibration Report

3. Function : Total distortion + noise

Norminal Sound Pressure level (dB)	Norminal Frequency (Hz)	Measured value ^[4] (%)	Acceptance limit ^[5] (%)
94	1000	1.8	3.0
114	1000	2.0	3.0

Uncertainty of measurement

Function	Uncertainty	Maximum-permitted uncertainty of measurement
Sound pressure level	0.10 dB	0.35 dB
Frequency	0.10 %	0.20 %
Total distortion + noise	0.40 %	1.00 %

- Note:
- [1] The deviated value is the absolute value of the difference between the measured value and the corresponding specified sound pressure level.
 - [2] The deviated value is the absolute value of the difference in percent between the measured value and the corresponding specified frequency.
 - [3] The acceptance limit is for the deviated value.
 - [4] The measured value is the total distortion + noise, measured over the frequency range from 20 Hz to 20 kHz.
 - [5] The acceptance limit is for the Measured value.

Remarks: 1. Acceptance limit was IEC 60942:2017 Class 2.
2. The coverage factor $k = 2.00$

- - End of Report - -

Sound Level Meter Calibration Report

Calibrate No. : SLM 194/2566

Calibrate Date : October 10, 2023

Equipment : Sound Calibrator
 Manufacturer : TENMARS
 Model/Type : TM-100
 Serial No. : 190301469
 Customer Name : บริษัท อลูมิเนียม ชีว จิน ฮั่ว จำกัด

[illegible]

Approved By

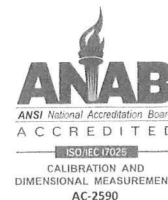
(Miss Sakuna Supparot)
Technician





Professional Calibration & Services Co., Ltd.

50/888, 50/889 Moo 2, Rungsit-Nakornnayok Rd., Bungyeetho, Thunyaburi,
Pathumthani 12130 Thailand
Tel : (+66)2150-6641 (Autoline), (+66)2569-5158
Email : info@p-cal.com www.p-cal.com



Certificate of Calibration

Certificate Number : EL39305/23

Page 1 of 3

Control Number : PCAL153035

Customer Control : -

Description : Sound Calibrator

Manufacturer : SOUNDTEK

Model : ST-120

Serial Number : 211203764

Customer : Pacific Laboratory Co., Ltd.

14/5358 Moo 14, Tambol Bang Bua Thong, Amphoe Bang Bua Thong,
Nonthaburi 11110

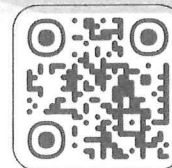
Date of Receipt : 01-Sep-23

Date of Calibration : 01-Sep-23

Environment : Temperature $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$
Relative Humidity $50\% \pm 20\%$

Calibration Method : Calibration Procedure Number CP-EL35

Calibration Results : See data attached



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

This certificate is issued in accordance with ISO/IEC17025 and the conditions of accreditation granted by the Accreditation Body which 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. The results relate only to the item calibrated.

This certificate shall not be reproduced other than in full except without the prior written approval of the Head of Calibration Laboratory of Professional Calibration & Services Co., Ltd.

Calibrated By

Mr. Varavut Sripanyachon

Authorized Signature

(Mr. Songpol Nakanurak)

02-Sep-23

Issued Date

CALIBRATION REPORT

Professional Calibration & Services Co.,Ltd.

Certificate Number : EL39305/23

Page 2 of 3

Equipment Standards Used

Description	Serial No.	Traceability to	Certificate No.	Cal. Due Date
Sound Level Meter	030606101	ANAB : AC-2590	EL09782/23	29-Mar-24
Sound Level Calibrator	141208123	NSC : Calibration 0037	EEL.BP. 16/0366	06-Mar-24

Condition as received : Normal

Definitions :-

- * ANAB - The ANSI National Accreditation Board
- * NSC - National Standardization Council of Thailand

CALIBRATION REPORT

Professional Calibration & Services Co., Ltd.

Certificate No.: EL39305/23

Page : 3 of 3

Calibration Results

Sound Calibration

Nominal	Measured Value	UUC Error	Uncertainty (\pm)
94 dB	93.90 dB	0.10 dB	0.2 dB
114 dB	113.75 dB	0.25 dB	0.2 dB

...End...



CERTIFICATE OF CALIBRATION

NO. 20221215051

Name of Product:	Sound Level Meter
Model:	ST-11D
Serial Number:	820384
Specification:	Class 1
Conclusion:	Pass
Date of calibration:	2022-12-15
Due Date:	2023-12-14

Calibrated by: *Jim Lin*

- I. This report certifies that all calibration equipment used in the test is traceable with the internal ISO9001 procedures and meets all specification given in the Manual(s) or respectively surpass then, and applies only to the unit identified above.
- II. This certificate is produced with advanced equipment & procedures which permit comprehensive quality assurance verification of all data supplied herein.
- III. This certificate of calibration shall not be reproduced except in full, without written permission of the Scarlet Tech Co Ltd Taiwan.

1. Preliminary inspection: OK

2. Type & serial No. of Microphone: AWA14425-54570

4. Measuring up limit: 140 dBA

3. Adjustments to indicated sound levels:

5. Frequency weightings (Acoustic signal tests for Z weighting, other electric signal tests.)

Type of Calibrator B&K 4231

Sound Pressure Level 94.0 dB

Equivalent Free-field Sound Level (reference environment conditions) 93.8 dB

Nominal frequency /Hz	Frequency weighting / dB			Nominal frequency /Hz	Frequency weighting / dB		
	A	C	Z		A	C	Z
10	-71.0	-14.6	0.2	1000	0.0	0.0	-0.1
20	-50.3	-6.4	-0.4	2000	0.1	0.0	0.0
31.5	-39.4	-2.2	0.1	4000	1.3	-0.1	0.0
63	-26.1	-0.8	-0.1	8000	1.2	-0.8	0.0
125	-16.3	-0.2	-0.2	12500	-5.7	-7.2	0.1
250	-8.6	0.1	0.0	16000	-11.7	-13.7	0.2
500	-3.2	0.1	0.0	20000	-23.9	-25.8	-0.6

6. Self-generated noise

Microphone replaced by electrical input signal device

8.8 dB(A)	8.4 dB(C)	15.9 dB(Z)
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7. F&S Weighting

Rate of the F weighting decrease (dB/s)	35.1
Rate of the S weighting decrease (dB/s)	4.4
Deviation of F&S	-0.1

8. Level Linearity (A-weighting at frequency 1 kHz)

Reference sound level 90.0 dB

Max error at 10dB steps upper reference sound level -0.1 dB

Max error at 1dB steps within 5dB of the upper limit linear operating range 0.0 dB

Max error at 10dB steps below reference sound level 0.1 dB

Max error at 1dB steps within 5dB upper the lower limit linear operating range 0.1 dB

9. Tone burst response (A Weighting) :

Single Toneburst duration /ms	Toneburst response /dB			
	L _{AFmax} -L _A	L _{ASmax} -L _A	L _{AE} -L _A	L _{AeqT} -L _A
500	0.0	-4.0	-2.9	-7.0
200	-1.0	-7.4	-6.9	-7.0
50	-18.1	-26.9	-26.9	-7.0
10	-27.2	/	-36.0	-7.0

10. Peak C sound level (500Hz) :

Cycle	One cycle	nominal value	Positive half	nominal value	Negative half	nominal value
LC _{peak} -LC(dB)	3.4	3.5	2.3	2.4	2.3	2.4

11. Overload indication: Pass

12. Statistical analysis function

Sweep signal maximum indicated sound level: 112.8 dB

Sweep amplitude: 40 dB

Scan cycle time: 60 S; Measurement period: 180 S.

Items	Measured value/dB	Theoretical calculated value/dB	Error/dB
L _{Aeq,T}	103.2	103.2	0.0
L ₅	110.8	110.8	0.0
L ₁₀	108.8	108.8	0.0
L ₅₀	92.9	92.8	0.1
L ₉₀	76.9	76.8	0.1
L ₉₅	75.0	74.9	0.1

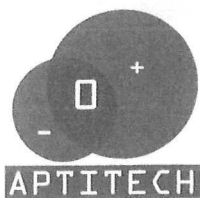
Uncertainty of measurement results: 0.4 dB (k=2)

Environment conditions:

Air temperature: 20 °C
Relative humidity: 60 %
Static pressure: 101.8 kPa

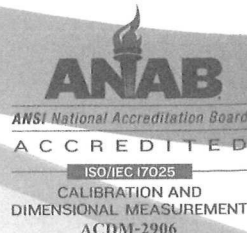
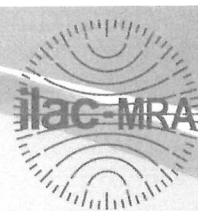
References:

IEC 61672-3 Sound Level Meters Part 3: Periodic tests



APTITECH CALIBRATION CO., LTD.

50/40 Moo 5 T. Lat Sawai, A. Lamlukka, Pathumthani 12150
Tel. +66 2103-6290 Fax. +66 2103-6291
Email. sales@aptitech-cal.com



CERTIFICATE OF CALIBRATION

Certificate Number : SC230375

Customer : Pacific Laboratory Co.,Ltd.
Address : 14/5358 Moo 14 Tambol Bang Bua Thong, Amphoe Bang Thong,
Nonthaburi 11110

Description	: Sound Level Meter	W/O Number	: SC230375
Manufacturer	: Scarlet Tech	Calibration Location	: Laboratory
Model	: ST-11D	Ambient Temperature	: 22 ± 2 °C
Serial Number	: 820968	Ambient Humidity	: 55 ± 15 %RH
ID. Number	: N/A	Received Date	: 25-Aug-2023

This certifies that the above instrument was calibrated in compliance with the Calibration Systems Requirement of ISO/IEC 17025:2017 in accordance with referenced procedures. Standards used to perform this calibration are certified by or traceable to National Institute of Metrology (Thailand) and/or other recognized national measurement institutes which realizes the units of measurement according to the International System of Units (SI Unit).

Measurement uncertainties at the time of test are given where applicable. They are calculated in accordance with the method described in The Expression of Uncertainty and Confidence in Measurement (M3003).

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by coverage factor $k=2$ such that the coverage probability corresponds to approximately 95%. This result of calibration was found accurate as shown on date and place of calibration only.

Standard Equipments

Description	Serial No.	Certificate No.	Traceability	Due Date
Sound Level Calibrator	141011576	CP20230261EA	TISI: 22-LB0119	05-Jul-24

Authority of Calibration

Approved Signatory

Calibration Date : 25-Aug-2023

Issued Date : 28-Aug-2023

Calibrated By : Mr. Rattapong Janpanya

☒ Ms. Siranalan Lertmanesetsiri [Quality Manager]

☐ Mr. Sompoch Srisunart [Technical Manager]

Calibration certificates without signatures are not valid. This certificate applied to only the item identified and shall not be reproduced other than in full, without the specific written approval by APTITECH CALIBRATION CO., LTD.

CALIBRATION REPORT

Certificate Number : SC230375

Calibration Method

The Unit Under Calibration (UUC) was calibrated by comparison measurement with sound level calibrator. The calibration has been accomplished in an ambient environment controlled, base on the in-house calibration procedure. The identification of the laboratory's calibration procedure employed are CP-7.2-01-107

Calibration Results

Appearance and function of use : Good
Results of Calibration : Without any adjustment
Sound Level Calibration
- Frequency Weighting : A
- Resolution : 0.1 dB

Sound Level Measurement (Slow Mode)

Parameter	UUC Range	Standard Value	UUC Reading	UUC Error	(±) Uncertainty
LFp	20-140 dB	93.86 dB	93.8 dB	-0.06 dB	0.60 dB
		113.87 dB	113.7 dB	-0.17 dB	0.60 dB
LSp	20-140 dB	93.86 dB	93.8 dB	-0.06 dB	0.60 dB
		113.87 dB	113.7 dB	-0.17 dB	0.60 dB
LIp	20-140 dB	93.86 dB	93.7 dB	-0.16 dB	0.60 dB
		113.87 dB	113.7 dB	-0.17 dB	0.60 dB

Sound Level Measurement (Fast Mode)

Parameter	UUC Range	Standard Value	UUC Reading	UUC Error	(±) Uncertainty
LFp	20-140 dB	93.86 dB	93.8 dB	-0.06 dB	0.60 dB
		113.87 dB	113.8 dB	-0.07 dB	0.60 dB
LSp	20-140 dB	93.86 dB	93.8 dB	-0.06 dB	0.60 dB
		113.87 dB	113.7 dB	-0.17 dB	0.60 dB
LIp	20-140 dB	93.86 dB	93.8 dB	-0.06 dB	0.60 dB
		113.87 dB	113.7 dB	-0.17 dB	0.60 dB

--- End of Certificate ---

Certificate No.: CP20230169EA

Operation No.: CP2023030041

Certificate of Calibration

Equipment: Sound Calibrator

Manufacturer: TENMARS

Model/Type: TM-100

Serial No.: 190301469

ID No.: -

Customer: Pacific Laboratory Co., Ltd.

Address: 14/5358 Moo 14 T. Bang Bua Thong
A. Bang Bua Thong, Nonthaburi 11110

Received Date: 23 March 2023

Calibrated Date: 31 March 2023

Issued Date: 1 April 2023

Calibrated by: Ms. Juntaporn Kunhakom

Approved by:



(Mr. Sittichai Swaksuriyawong)
Group Manager

This report was prepared electronically using applicable electronic signature. Printing or copy of file are considered as a copy of the document.

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor (k) providing a level of confidence of approximately 95%. This certificate may not be reproduced other than in full except with the prior written approval of the Electrical and Electronics Institute, Foundation for Industrial Development.

Certificate No.: CP20230169EA

Calibration Report

Equipment: Sound Calibrator
Manufacturer: TENMARS
Model/Type: TM-100
Serial No.: 190301469
ID No.: -
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Pressure: (101.3 ± 1.5) kPa

Method of Calibration :-

IEC 60942:2017

Condition of this result of calibration

1. Reference standards instrument :-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Standard microphone	4180	2661000	AA-1020-22	14 June 2023
2) Waveform Generator	33511B	MY52302264	CK20220058EA	19 June 2023
3) Audio Analyzing DMM	2015-P	4079144	E1U221042	16 March 2023
4) Pressure humidity and Temperature Transmitter	PTU301	F0640002	CL1-P220024 CD20220164EA	17 March 2023 24 July 2023

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

3. This certification is traceable to the international system of unit maintained at :-

Reference standards instrument for Acoustic function

- National Institute of Metrology (Thailand)

Reference standards instrument for Electrical function

- Electrical and Electronics Institute; ONSC Accredited Calibration No.0119

Result of Calibration:-

1. Function : Sound pressure level

Normal	Specified Sound	Measured value	Deviated value ^[1]	Acceptance limit ^[3]
Frequency (Hz)	Pressure level (dB)	(dB)	(dB)	(dB)
1000	94	94.20	0.20	±0.40
1000	114	114.25	0.25	±0.40

2. Function : Frequency

Normal Sound	Specified Frequency	Measured value	Deviated value ^[2]	Acceptance limit ^[3]
Pressure level (dB)	(Hz)	(Hz)	(%)	(%)
94	1000	970.5	-3.0	±1.7
114	1000	965.9	-3.4	±1.7

Certificate No.: CP20230169EA

Calibration Report

3. Function : Total distortion + noise

Norminal Sound Pressure level (dB)	Norminal Frequency (Hz)	Measured value ^[4] (%)	Acceptance limit ^[5] (%)
94	1000	1.8	3.0
114	1000	2.0	3.0

Uncertainty of measurement

Function	Uncertainty	Maximum-permitted uncertainty of measurement
Sound pressure level	0.10 dB	0.35 dB
Frequency	0.10 %	0.20 %
Total distortion + noise	0.40 %	1.00 %

- Note:
- [1] The deviated value is the absolute value of the difference between the measured value and the corresponding specified sound pressure level.
 - [2] The deviated value is the absolute value of the difference in percent between the measured value and the corresponding specified frequency.
 - [3] The acceptance limit is for the deviated value.
 - [4] The measured value is the total distortion + noise, measured over the frequency range from 20 Hz to 20 kHz.
 - [5] The acceptance limit is for the Measured value.

Remarks: 1. Acceptance limit was IEC 60942:2017 Class 2.

2. The coverage factor $k = 2.00$

-- End of Report --