



JOON CHEE

ภาคผนวก จ

เอกสารสอบเทียบเครื่องมือวิเคราะห์

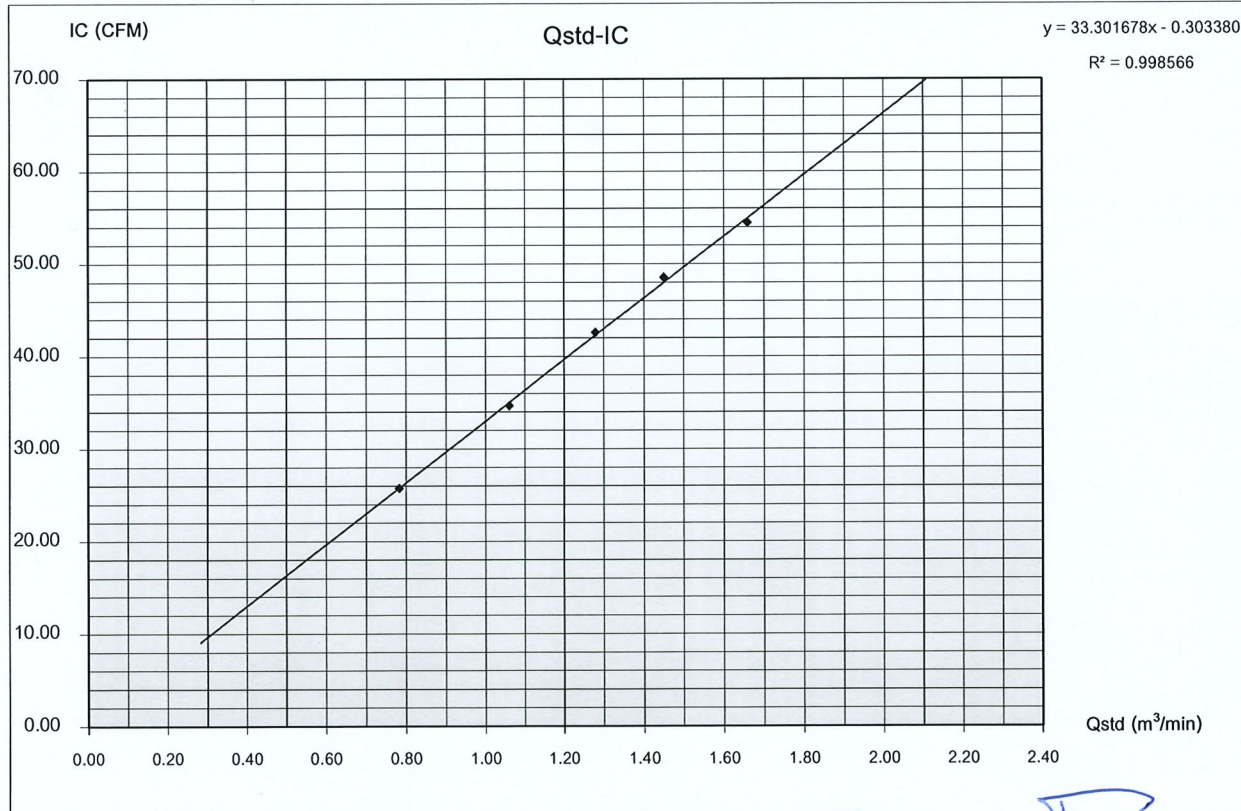
PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	November 13, 2022
บ้านมาบเชิง				Start Time	1:00 PM
Sampler Number	PM-10 No.6	Transfer Standard Type	Orifice	Stop Time	1:10 PM
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Somprasong Thetsakun
Motor Serial Number	6	Calibrator Serial Number	2914		
Recorder Serial Number	4642				

Plate	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric	Start	Stop
No.	Pressure Drop Across Orifice (inH ₂ O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	Qstd = (1/m)[(A-b)]	Sample Flow Rate Indication	$IC = I[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	(°K = °C+273)	Pressure	Meter	Meter
	Positive	Negative	ΔH ₂ O								
5	1.3	1.3	2.6	1.59699	0.78269	26.0	25.75	303.0	758.0		
7	2.4	2.4	4.8	2.16988	1.06077	35.0	34.66	303.0	758.0		
10	3.5	3.5	7.0	2.62038	1.27944	43.0	42.59	303.0	758.0		
13	4.5	4.5	9.0	2.97123	1.44975	49.0	48.53	303.0	758.0		
18	5.9	5.9	11.8	3.40217	1.65893	55.0	54.47	303.0	758.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	758.0		
1	Slope (m)			2.06015	Linear Equation			r ²	0.998566	Pstd(mmHg)	760.0
2	Intercept (b)			-0.01547	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9992827	T _{NTP}	298.0
3	Correlation Coefficient (r)			1.00000	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.980910196	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.990409106	

COMMENT

Andersen Instruments, Inc.



Checked By

(Mr. Prayun Detkla)
Technician

envi research
ENVIRONMENT RESEARCH & TECHNOLOGY CO., LTD.

Approved By

(Mr. Panupon Podang)
Environmental Scientist

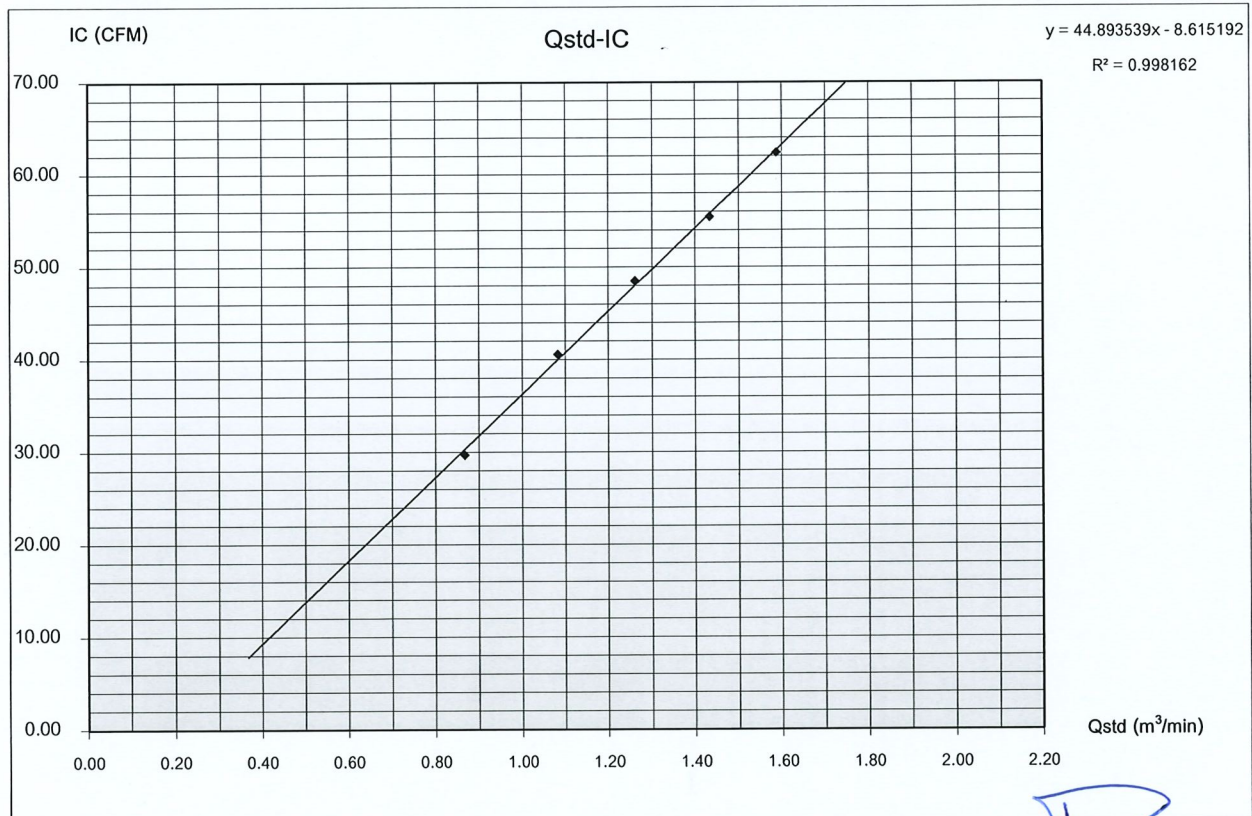
PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	November 13, 2022
วัดเขาคันทรง				Start Time	10:20 AM
Sampler Number	PM-10 No.7	Transfer Standard Type	Orifice	Stop Time	10:30 AM
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Somprasong Thetsakun
Motor Serial Number	B0411-001	Calibrator Serial Number	2914		
Recorder Serial Number	R0411-001				

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric	Start	Stop
	Pressure Drop Across Orifice (inH ₂ O)			[ΔH ₂ O(Pa/P _{std})(T _{std} /Ta)] ^{1/2}	Qstd = (1/m)[(A-b)] (m ³ /min)	ample Flow Rate Indication (ft ³ /min)	IC = [(Pa/P _{std})(T _{std} /Ta)] ^{1/2}	(^K = ^C+273)	Pressure (mmHg)	Meter	Meter
	Positive	Negative	ΔH ₂ O								
5	1.6	1.6	3.2	1.77170	0.86749	30.0	29.71	303.0	758.0		
7	2.5	2.5	5.0	2.21462	1.08249	41.0	40.61	303.0	758.0		
10	3.4	3.4	6.8	2.58267	1.26114	49.0	48.53	303.0	758.0		
13	4.4	4.4	8.8	2.93803	1.43363	56.0	55.46	303.0	758.0		
18	5.4	5.4	10.8	3.25482	1.58740	63.0	62.40	303.0	758.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	758.0		
1	Slope (m)			2.06015	Linear Equation			r ²	0.998162	Pstd(mmHg)	760.0
2	Intercept (b)			-0.01547	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9990806	T _{MTP}	298.0
3	Correlation Coefficient (r)			1.00000	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.980910196	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.990409106	

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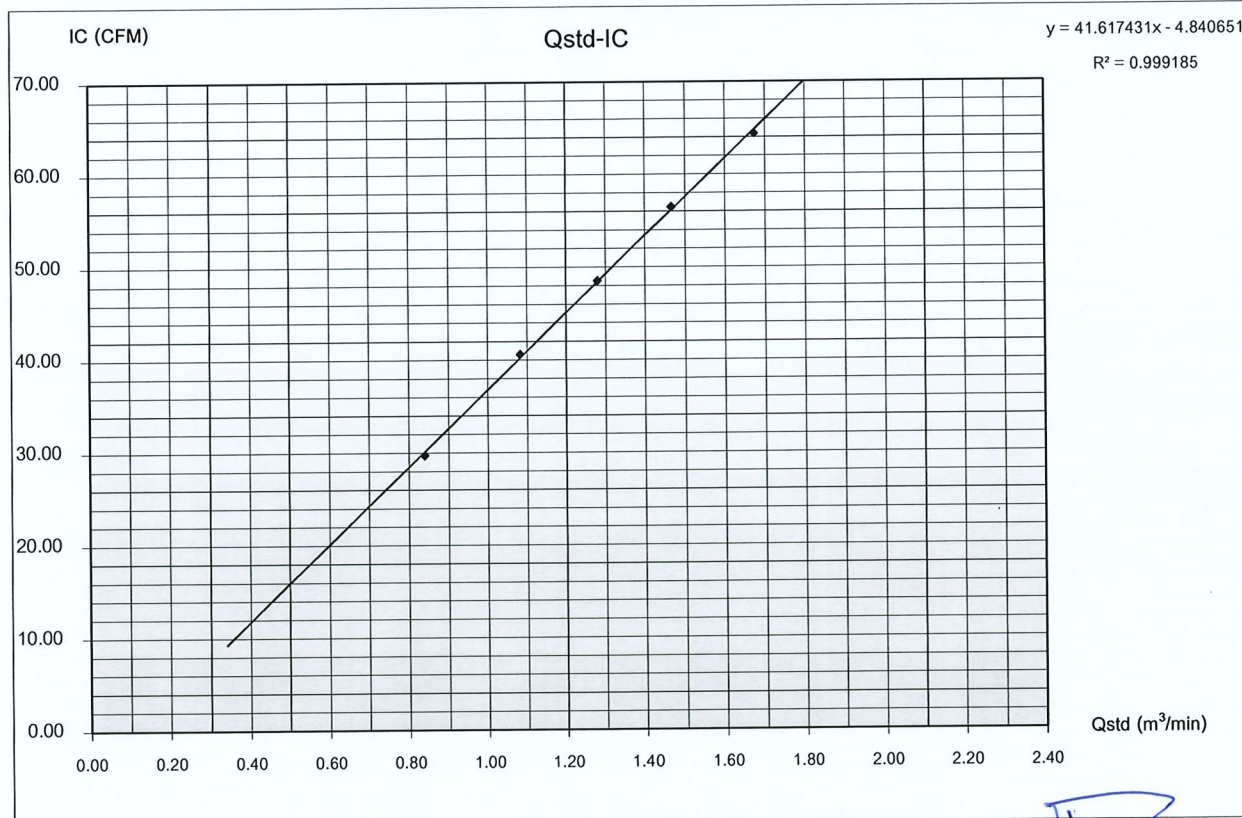
PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	November 13, 2022
บ้านแสนสุข				Start Time	11:10 AM
Sampler Number	PM-10 No.5	Transfer Standard Type	Orifice	Stop Time	11:20 AM
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Somprasong Thetsakun
Motor Serial Number	2015-5	Calibrator Serial Number	2914		
Recorder Serial Number	7356				

Plate	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric	Start	Stop
No.	Pressure Drop Across Orifice (inH ₂ O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	Qstd = (1/m)[(A-b)]	sample Flow Rate Indication	$IC = [((Pa/P_{std})(T_{std}/Ta)]^{1/2}$	("K = °C+273)	Pressure	Meter	Meter
	Positive	Negative	ΔH ₂ O								
5	1.5	1.5	3.0	1.71544	0.84019	30.0	29.71	303.0	758.0		
7	2.5	2.5	5.0	2.21462	1.08249	41.0	40.61	303.0	758.0		
10	3.5	3.5	7.0	2.62038	1.27944	49.0	48.53	303.0	758.0		
13	4.6	4.6	9.2	3.00406	1.46568	57.0	56.45	303.0	758.0		
18	6.0	6.0	12.0	3.43088	1.67286	65.0	64.38	303.0	758.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	758.0		
1	Slope (m)			2.06015	Linear Equation			r ²	0.999185	Pstd(mmHg)	760.0
2	Intercept (b)			-0.01547	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9995924	T _{NTP}	298.0
3	Correlation Coefficient (r)			1.00000	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.980910196	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.990409106	

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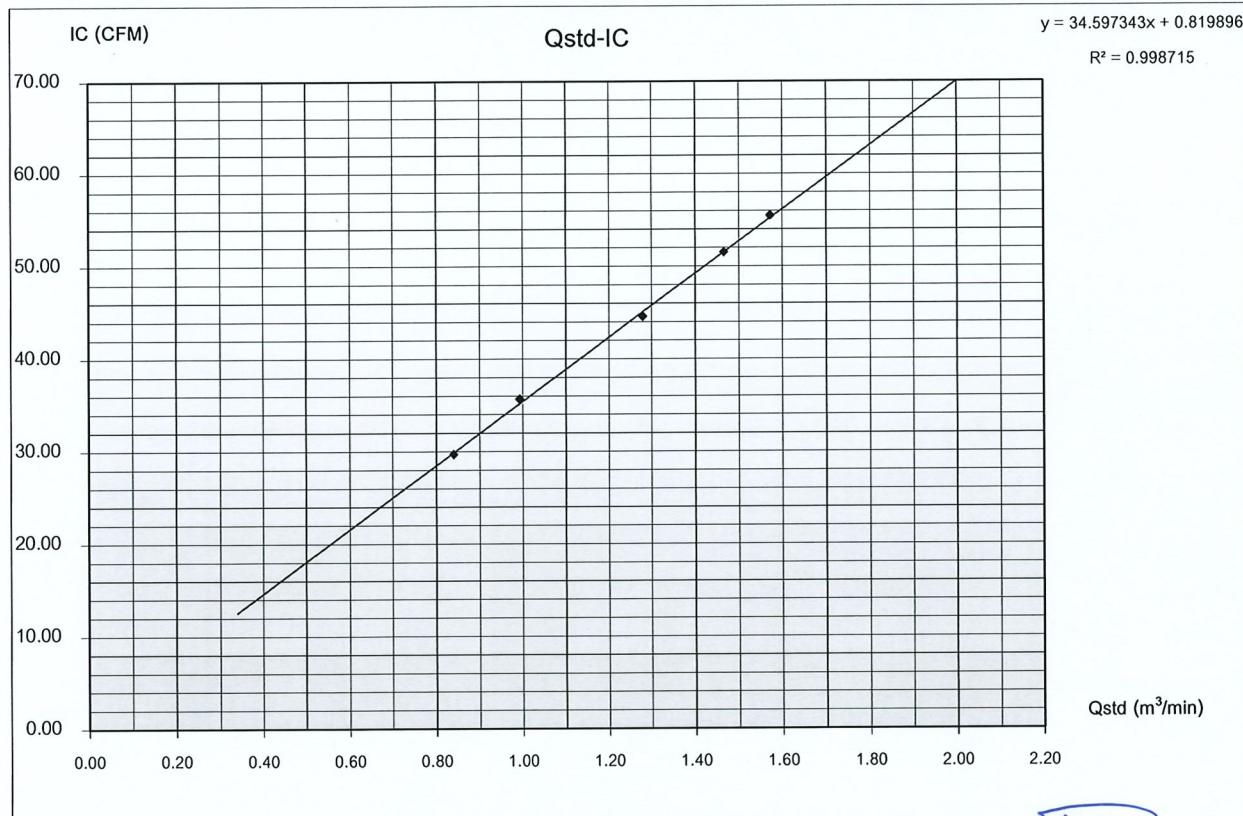
TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	November 13, 2022
บ้านนาบึงเขื่อง				Start Time	1:10 PM
Sampler Number	TSP No.A8	Transfer Standard Type	Orifice	Stop Time	1:20 PM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Somprasong Thetsakun
Motor Serial Number	90	Calibrator Serial Number	2914		
Recorder Serial Number	11452				

Plate	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric	Start	Stop
No.	Pressure Drop Across Orifice (inH ₂ O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	Qstd = (1/m)[(A-b)] (m ³ /min)	ample Flow Rate Indication (ft ³ /min)	IC = I[(Pa/P _{std})(T _{std} /Ta)] ^{1/2}	(°K = °C+273)	Pressure (mmHg)	Meter	Meter
	Positive	Negative	ΔH ₂ O								
5	1.5	1.5	3.0	1.71544	0.84019	30.0	29.71	303.0	758.0		
7	2.1	2.1	4.2	2.02973	0.99275	36.0	35.65	303.0	758.0		
10	3.5	3.5	7.0	2.62038	1.27944	45.0	44.57	303.0	758.0		
13	4.6	4.6	9.2	3.00406	1.46568	52.0	51.50	303.0	758.0		
18	5.3	5.3	10.6	3.22454	1.57271	56.0	55.46	303.0	758.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	758.0		
1	Slope (m)			2.06015	Linear Equation			r ²	0.998715	Pstd(mmHg)	760.0
2	Intercept (b)			-0.01547	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9993573	T _{HTP}	298.0
3	Correlation Coefficient (r)			1.00000	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.980910196	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.990409106	

COMMENT

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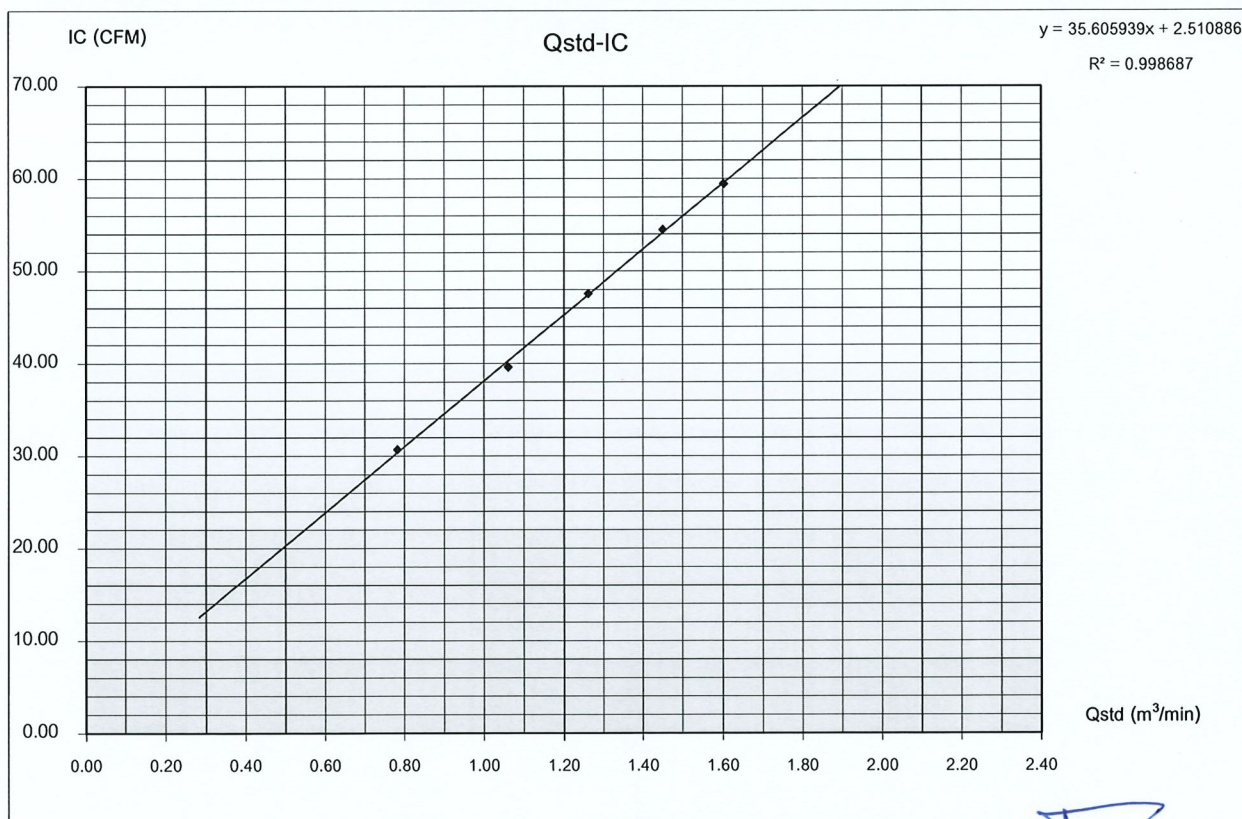
TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	November 13, 2022
วัดเขาคันทรง				Start Time	10:10 AM
Sampler Number	TSP No.A7	Transfer Standard Type	Orifice	Stop Time	10:20 AM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Somprasong Thetsakun
Motor Serial Number	A7	Calibrator Serial Number	2914		
Recorder Serial Number	1557				

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH ₂ O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	$Qstd = (1/m)[(A-b)]$	ample Flow Rate Indication	$IC = I[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$				
	Positive	Negative	ΔH ₂ O		(m ³ /min)	(ft ³ /min)		(°K = °C+273)	(mmHg)		
5	1.3	1.3	2.6	1.59699	0.78269	31.0	30.70	303.0	758.0		
7	2.4	2.4	4.8	2.16988	1.06077	40.0	39.62	303.0	758.0		
10	3.4	3.4	6.8	2.58267	1.26114	48.0	47.54	303.0	758.0		
13	4.5	4.5	9.0	2.97123	1.44975	55.0	54.47	303.0	758.0		
18	5.5	5.5	11.0	3.28482	1.60196	60.0	59.42	303.0	758.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	758.0		
1	Slope (m)			2.06015	Linear Equation			r ²	0.998687	Pstd(mmHg)	760
2	Intercept (b)			-0.01547	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9993433	T _{NTP}	298
3	Correlation Coefficient (r)			1.00000	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.980910196	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.990409106	

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Environmental Scientist

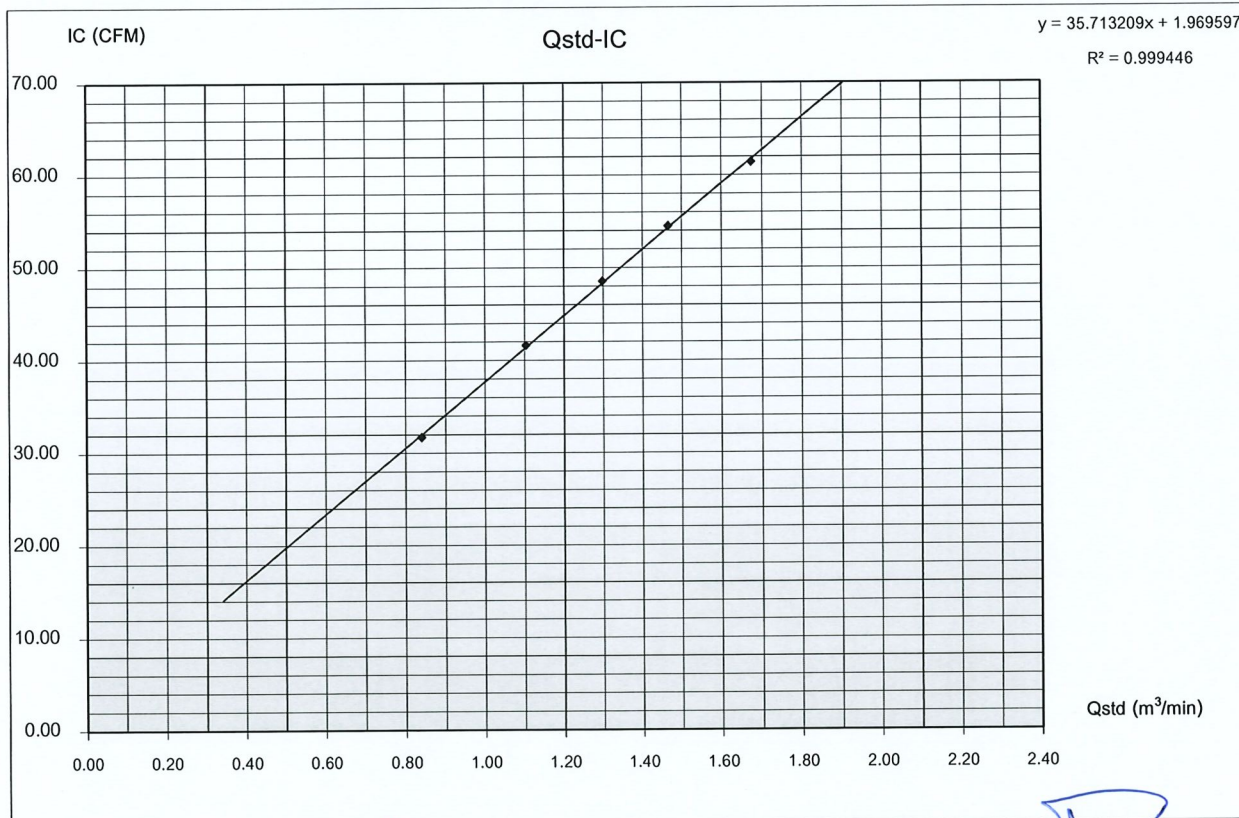
TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	November 13, 2022
บ้านแสนสุข				Start Time	11:20 AM
Sampler Number	TSP No.A4	Transfer Standard Type	Orifice	Stop Time	11:30 AM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Somprasong Thetsakun
Motor Serial Number	2012-07	Calibrator Serial Number	2914		
Recorder Serial Number	31604				

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric	Start	Stop
	Pressure Drop Across Orifice (inH ₂ O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	Qstd = (1/m)[(A-b)]	ample Flow Rate Indication	$IC = I[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	(^°K = ^°C+273)	Pressure (mmHg)	Meter	Meter
	Positive	Negative	ΔH ₂ O								
5	1.5	1.5	3.0	1.71544	0.84019	32.0	31.69	303.0	758.0		
7	2.6	2.6	5.2	2.25848	1.10378	42.0	41.60	303.0	758.0		
10	3.6	3.6	7.2	2.65755	1.29749	49.0	48.53	303.0	758.0		
13	4.6	4.6	9.2	3.00406	1.46568	55.0	54.47	303.0	758.0		
18	6.0	6.0	12.0	3.43088	1.67286	62.0	61.41	303.0	758.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	758.0		
1	Slope (m)			2.06015	Linear Equation			r ²	0.999446	Pstd(mmHg)	760.0
2	Intercept (b)			-0.01547	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.999723	T _{MTP}	298.0
3	Correlation Coefficient (r)			1.00000	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.980910196	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.990409106	

COMMENT

Andersen Instruments, Inc.



Checked By

Prayun
(Mr. Prayun Detkla)
Technician

envi research
ENVIRONMENT RESEARCH & TECHNOLOGY CO., LTD.

Approved By

Pan
(Mr. Panupon Podang)
Environmental Scientist

Certificate of Calibration

Calibration Certification Information			
Cal. Date: March 8, 2022	Rootsmeter S/N: 438320	Ta: 295 °K	
Operator: Jim Tisch		Pa: 754.4 mm Hg	
Calibration Model #: TE-5025A	Calibrator S/N: 2914		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4370	3.3	2.00
2	3	4	1	1.0140	6.4	4.00
3	5	6	1	0.9070	7.9	5.00
4	7	8	1	0.8640	8.8	5.50
5	9	10	1	0.7130	12.8	8.00

Data Tabulation					
Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)}$ (y-axis)
0.9983	0.6947	1.4161	0.9956	0.6929	0.8844
0.9942	0.9805	2.0027	0.9915	0.9778	1.2507
0.9922	1.0939	2.2391	0.9895	1.0910	1.3983
0.9910	1.1470	2.3484	0.9883	1.1439	1.4666
0.9857	1.3824	2.8322	0.9830	1.3787	1.7687
QSTD	m=	2.06015	QA	m=	1.29003
	b=	-0.01547		b=	-0.00966
	r=	1.00000		r=	1.00000

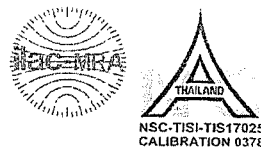
Calculations			
Vstd=	$\Delta Vol((Pa-\Delta P)/Pstd)(Tstd/Ta)$	Va=	$\Delta Vol((Pa-\Delta P)/Pa)$
Qstd=	Vstd/ΔTime	Qa=	Va/ΔTime
For subsequent flow rate calculations:			
Qstd= $1/m \left(\left(\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)} \right) - b \right)$		Qa= $1/m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

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

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



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179/75 Nawong Pracha Pattana Road, Sikan, Donmuang, Bangkok 10210
Tel.:+66 2 011 0505, Fax:+66 2 010 7700
www.playsotec.com



CERTIFICATE OF CALIBRATION

Customer _____ Certificate no. PST-0001-22
Page no. 1 of 3

Company : ENVIRONMENT RESEARCH & TECHNOLOGY CO.,LTD.
Address : 25/114 Moo 6 Soi Chinaket 1, Ngamwongwan Road, Toongsonghong,
City / Province : Laksi, Bangkok
Zip/Postal : 10210

Device

Equipment : Electronic Balance Capacity : 220 g
Manufacturer : METTLER TOLEDO Readability : 0.0001 g
Model : AB204-S ID No. : ERTC-L-In-0048
Serial No. : 1123103723

Environment Conditions

Location of Calibration : Calibration Laboratory at Play Solution Technology Co.,Ltd
Ambient Temperature : 25.9 (°C)
Relative Humidity : 53.1 (%RH)
Barometric Pressure : 1011.5 (mba)
Calibration Procedure : This Calibration was conducted by using In-House calibration procedure number CP-M-001 base on "UKAS LAB 14"
Comment :

Date of Receipt : January 4, 2022

Date of Calibration : January 4, 2022

Issue Date : January 4, 2022

Calibrated by : Kittichai R.
(Kittichai Rattanatham)
Calibrator

Approved by :
(Kittichai Rattanatham)
Approved Signature

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 the conditions of accreditation granted by Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and is traceability to recognize national standards and to the unit of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval prior written approval of the calibration center, Play Solution Technology Co.,Ltd



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www.playsotec.com



CERTIFICATE OF CALIBRATION

Result of Calibration : Without Adjustment Certificate no. PST-0001-22
Page no. 2 of 3

1. Repeatability

Weighing Rang 1 (g)	Norminal Value (g)	Standard Deviation (g)
Max.capacity 220	200	0.00005

Weighing Rang 2 (g)	Norminal Value (g)	Standard Deviation (g)
Max.capacity		

2.Linearity, Departure of Indication from nominal value

Weighing Range 1

Norminal Value (g)	Standard Value (g)	Indication (g)	Error of Indication (g)	Expanded Uncertainty (g)	Factor k
0.001	0.00100	0.0010	0.0000	0.00011	2.07
0.01	0.01000	0.0100	0.0000	0.00011	2.07
0.1	0.10001	0.1000	0.0000	0.00011	2.07
1	1.00001	1.0000	0.0000	0.00011	2.06
5	5.00002	5.0000	0.0000	0.00011	2.06
10	10.00001	10.0000	0.0000	0.00011	2.05
50	50.00003	50.0000	0.0000	0.00013	2.03
100	100.00004	100.0001	0.0001	0.00018	2.00
150	150.00007	150.0001	0.0000	0.00024	2.00
200	200.00006	200.0002	0.0001	0.00031	2.00

Weighing Range 2

Norminal Value (g)	Standard Value (g)	Indication (g)	Error of Indication (g)	Expanded Uncertainty (g)	Factor k

The given extended measurement uncertainty is the standard uncertainty of the measurement multiplied by cover factor ,k as per listed in table above, which corresponds to a confidene level of about 95%

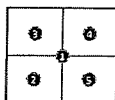
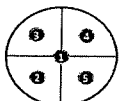
CERTIFICATE OF CALIBRATION

Result of Calibration

Certificate no. PST-0001-22

3.Eccentricity

Test load at least 1/3 of the maximum capacity, typically placed between 1/2 and 1/3 of the distance from the centre of the load receptor to the edge.



Weighing Range 1

Test Load : 100 (g)

Position	Indication (g)
1	100.0001
2	100.0001
3	100.0002
4	100.0001
5	100.0002
Max.Deviation	0.0001

Weighing Range 2

Test Load : (g)

Position	Indication (g)
Max.Deviation	

Standard methode

The calibration was performed by using calibration laboratory's in-house calibration methode : CP-M-001 based on "UKAS LAB 14 : Calibration of weighing machine" : edition 6 | October 2019

Reference standards instrument

Instrument	OIML Class	S/N	Certificate No.	Due Date
Standard Weight Set	E2	4000021952	MM-0183-20	December 8, 2022
Standard Weight Set	-	-	-	-
Standard Weight Set	-	-	-	-
Standard Weight Set	-	-	-	-

Measurement Uncertainty

The given measurement uncertainty is the standard of the measurement multiplied by an extension factor k which corresponds to a confidence level of about 95% for a normal distribution. The standard uncertainty was calculated according to M3003

Traceability : The measurement is traceable to national standard, which realize the physical unit of measurement (SI)

- National institute of Metrology (Thailand) through Calibration Laboratory

END OF REPORT

Calibration Data of NOx Analyzer

Analyzer Performance Test

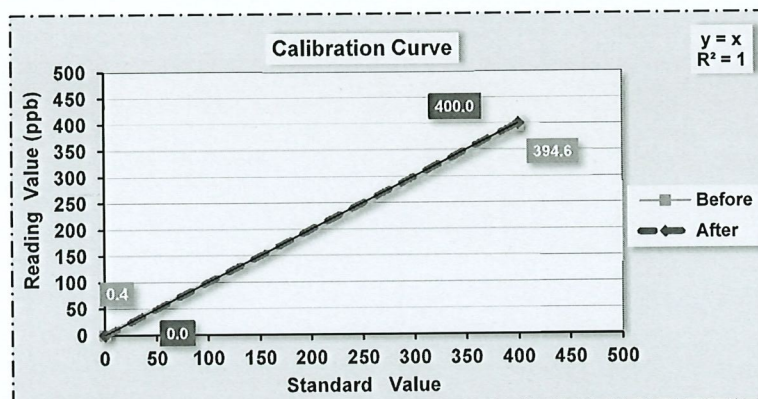
Equipment	Gas Analyzer (NOx)	Customer Name	ไพร์เพียร์ คอนซิลแตนต์
Manufacture	HORIBA	Location	Envi Research
Model	APNA-370	Scientist	Panupon
Serial No.	PA6WVAJ9	Calibration Date	November 11, 2022
Analyzer Unit	ppb	Time	3:00 PM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300T	0172
Standard Gas Components	CO = 4.516 ppm		
Cylinder No : EB0123013	NO = 55.3 ppm		
Expire Date : Oct 22, 2027	SO ₂ = 54.9 ppm		

Single Point Calibration

Standard Gas	Standard Gas Value	Analyzer Value								% Abs Error
		NO _x (ppb)		NO (ppb)		NO ₂ (ppb)		Stability		
		Before	After	Before	After	Before	After	Before	After	
Zero	0	0.2	0.0	0.4	0.0	-0.2	0.0	-	-	-
Span	400	395.3	400.0	394.6	400.0	0.7	0.0	-	-	1.3



STATUS TEST AND VALIDATION OF NOx ANALYZER MODEL APNA-370

Parameter	Unit	Observed Value		Nominal Range
		Before Adjust	After Adjust	
Range	ppb	500	500	0 - 500 Standard
Signal NO	mV	0.3	0.5	Voltage of the measured NO value
Signal NOx	mV	10.1	10.4	Voltage of the measured NOx value
Detector	°C	41.4	41.3	43 °C ± 5 °C
Ambient	kPa	100.2	100.1	Current atmospheric pressure
DC 24V	V	23.5	23.5	24V ±0.5
DC 5V	V	5.0	5.0	5V ±0.5
NO Slope	-	1.28210	1.28210	0.50000 - 2.0000
NOx Slope	-	1.30020	1.30020	0.50000 - 2.0000

Calibrate By :

(MR.PANUPON PODANG)
November 11, 2022



Checked By :

(MS.SUTATIP IM-NOI)
November 11, 2022

Calibration Data of NOx Analyzer

Analyzer Performance Test

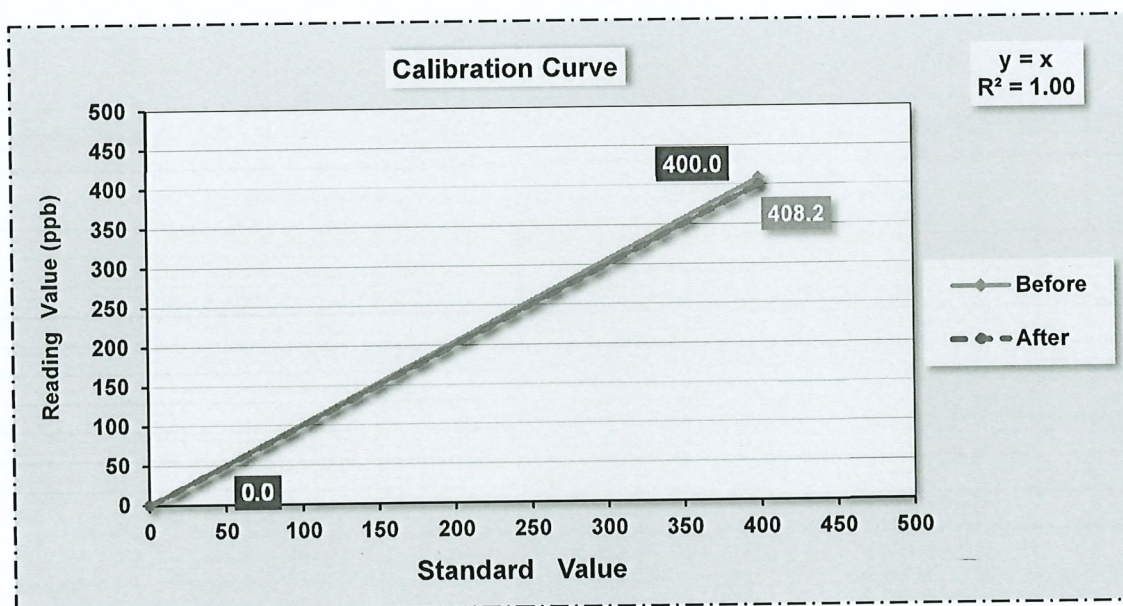
Equipment	Gas Analyzer (NOx)	Customer Name	โพธิ์เกียรติ์ คอนซัลแตนต์
Manufacture	API	Location	Envi Research
Model	200A	Scientist	Panupon
Serial No.	2119	Calibration Date	November 11, 2022
Analyzer Unit	ppb	Time	3:03 PM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300T	0172
Standard Gas Components	CO = 4,516 ppm		
Cylinder No : EB0123013	NO = 55.3 ppm		
Expire Date : Oct 22, 2027	SO ₂ = 54.9 ppm		

Single Point Calibration

Standard Gas	Standard Gas Value	Analyzer Value								% Abs Error
		NO _x (ppb)		NO (ppb)		NO ₂ (ppb)		Stability		
		Before	After	Before	After	Before	After	Before	After	
Zero	0	-0.5	0.0	-0.1	0.0	-0.4	0.0	-	-	-
Span	400	408.1	405.0	408.2	400.0	-0.1	5.0	-	-	2.1



STATUS TEST AND VALIDATION OF NO_x ANALYZER MODEL 200A

Parameter	Display As	Unit	Observed Value		Nominal Range
			Before Adjust	After Adjust	
Range	RANGE	ppb	500	500	0 - 500 standard
Stability	STABIL	ppb	0.90	0.10	< 2 with zero air
Sample Flow	SAMP FL	cc / min	511.00	510.00	500 +/- 50
Ozone Flow	OZONE FL	cc / min	77.00	78.00	80 +/- 10
PMT signal	PMT	mV	37.50	32.80	0 to 5,000
Auto - Zero	AZERO	mV	34.6	34.4	-20 to 150
High Voltage Power Supply	HVPS	V	737.00	737.00	450 to 900
Reaction Cell Temperature	RCELL TEMP	°C	50.20	49.90	50 +/- 1
Box Temperature	BOX TEMP	°C	33.20	33.30	Ambient temp.+3 / -7
PMT Temperature	PMT TEMP	°C	6.80	6.80	7 +/- 1
Converter Temperature	MOLY TEMP	°C	313.60	314.20	315 +/- 5
Reaction Cell Pressure	RCEL	In - Hg - A	10.00	10.00	2 to 10 (Constant)
Sample Pressure	SAMP	In - Hg - A	29.10	29.30	Ambient - 1 (Constant)
NO _x Slope	NO _x SLOPE	-	1.048	1.048	1.000 +/- 0.300
NO _x Offset	NO _x OFFSET	mV	-4.90	-4.90	0 +/- 20
NO Slope	NO SLOPE	-	1.030	1.030	1.000 +/- 0.300
NO Offset	NO OFFSET	mV	-4.10	-4.10	0 +/- 20

Calibrate By :

(MR.PANUPON PODANG)

November 11, 2022



Checked By :

(MS.SUTATIP IM-NOI)

November 11, 2022

Calibration Data of SO₂ Analyzer

Analyzer Performance Test

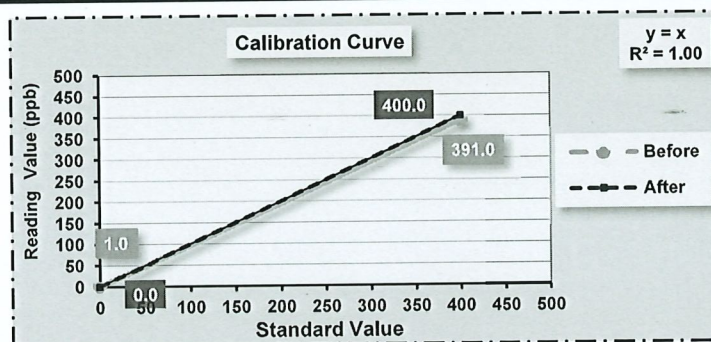
Equipment	Gas Analyzer (SO ₂)	Customer Name	โพธิ์เกียรติ์ คอนซัลแตนต์
Manufacture	Horiba	Location	Envi Research
Model	APSA-370	Scientist	Panupon
Serial No.	A5VTX5AF	Calibration Date	November 11, 2022
Analyzer Unit	ppb	Time	2:55 PM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300T	0172
Standard Gas Components	CO = 4,516 ppm		
Cylinder No : EB0123013	NO = 55.3 ppm		
Expire Date : Oct 22, 2027	SO ₂ = 54.9 ppm		

Single Point Calibration

Standard Gas	Standard Gas Value	Analyzer Value (ppb)		Stability		% Abs Error
		Before	After	Before	After	
Zero	0	1.0	0.0	-	-	-
Span	400	391.0	400.0	-	-	2.3



STATUS TEST AND VALIDATION OF SO₂ ANALYZER MODEL APSA-370

Parameter	Unit	Observed Value		Nominal Range
		Before Adjust	After Adjust	
Range	ppb	500	500	0 - 500 Standard
Signal (SO ₂)	mV	15.9	11.2	Voltage of the measured SO ₂ value
LAMP	mV	237.3	236.8	200 mV - 1200 mV
CELL	°C	34.6	34.5	Ambient temperature + 5 °C - 15 °C
PUMP	Kpa	45.0	44.9	65 kPa or less
AMBIENT	kPa	101.7	101.8	Current atmospheric pressure
DC 24V	V	24.0	24.0	24 V ±0.5 V
DC 5V	V	4.9	4.9	5 V ±0.5 V

Calibrate By :

(MR.PANUPON PODANG)
November 11, 2022

envi research
Checked By :
ENVIRONMENT RESEARCH & TECHNOLOGY CO., LTD.

(MS.SUTATIP IM-NOI)
November 11, 2022

Calibration Data of SO₂ Analyzer

Analyzer Performance Test

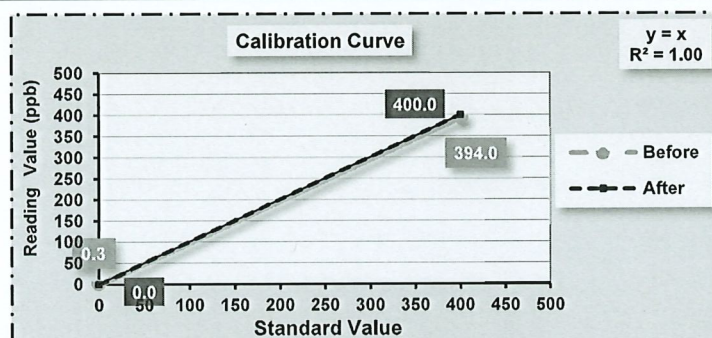
Equipment	Gas Analyzer (SO ₂)	Customer Name	โพธิ์เกียรติ์ คอนซัลแตนต์
Manufacture	Horiba	Location	Envi Research
Model	APSA-370	Scientist	Panupon
Serial No.	V4HC9062	Calibration Date	November 11, 2022
Analyzer Unit	ppb	Time	3:10 PM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300T	0172
Standard Gas Components	CO = 4,516 ppm		
Cylinder No : EB0123013	NO = 55.3 ppm		
Expire Date : Oct 22, 2027	SO ₂ = 54.9 ppm		

Single Point Calibration

Standard Gas	Standard Gas Value	Analyzer Value (ppb)		Stability		% Abs Error
		Before	After	Before	After	
Zero	0	0.3	0.0	-	-	-
Span	400	394.0	400.0	-	-	1.5



STATUS TEST AND VALIDATION OF SO₂ ANALYZER MODEL APSA-370

Parameter	Unit	Observed Value		Nominal Range
		Before Adjust	After Adjust	
Range	ppb	500	500	0 - 500 Standard
Signal (SO ₂)	mV	14.5	13.2	Voltage of the measured SO ₂ value
LAMP	mV	247.7	247.6	200 mV - 1200 mV
CELL	°C	34.9	34.8	Ambient temperature + 5 °C - 15 °C
PUMP	Kpa	46.4	46.2	65 kPa or less
AMBIENT	kPa	101.4	101.4	Current atmospheric pressure
DC 24V	V	24.0	24.0	24 V ±0.5 V
DC 5V	V	4.9	4.9	5 V ±0.5 V

Calibrate By :

(MR.PANUPON PODANG)
November 11, 2022

Checked By :

(MS.SUTATIP IM-NOI)
November 11, 2022



THAI METEOROLOGICAL DEPARTMENT

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

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 20 August, 2022

Certification No. 342/22

Page : 1 of 3

Object : Weather Station

Manufacturer : Davis Instruments Inc.

Type : Vantage Pro2

Serial No. : AS160105025 ID No. : No.24

Customer : Environment Research & Technology Company Limited.
25/113-114 Moo 6 Soi Chinaket 1, Ngamwongwan Road,
Toongsonghong, Laksi, Bangkok 10210.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1007.4 hPa

NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91563

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

N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)
Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec

STANDARD THERMOMETER : Theodor Friedrich : Dry No. 8390/94 Wet No. 8389/94
: Thermoschneider No. 918800

Calibrated by : Signed :
Mr. Watcharapol Subwat
Mechanical Engineer



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 342/22

20 August, 2022

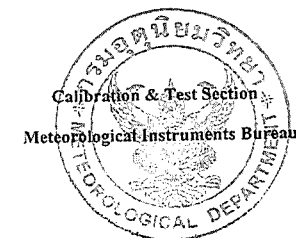
Page : 2 of 3

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H2O	Vacuum inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.9	0.10
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.9	0.10
7.00	-	-	-	6.7	0.30
9.02	-	-	-	8.9	0.12
11.01	-	-	-	10.7	0.31
13.01	-	-	-	13.0	0.01
15.01	-	-	-	14.8	0.21
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.1	-0.08

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

Calibrated by :

Mr. Watcharapol Subwat
Mechanical Engineer





THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 342/22

20 August, 2022

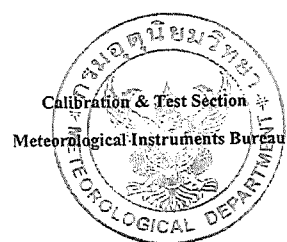
Page : 3 of 3

Standard Temp. °C	Temperature Sensor Reading	
	Reading	Correction
	°C	°C
45.1	45.1	0.0
30.2	30.2	0.0
15.4	15.5	-0.1

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer



Sound Level Meter Calibration Report

Support Equipment Type	: Sound Level Calibrator
Manufacture	: Quest Technologies
Model	: QC-10
Serial No.	: QE8100348
Range of Calibrator	
- Sound Pressure Level	: 94.3 dB.
- Frequency	: 1,000 Hz.
Calibrated By	: Mr.Akarawat Kochabog
Calibration Date	: November 11, 2022
Customer Name	: บริษัท โฟร์เทียร์ คอนซัลแตนต์ จำกัด : โครงการโรงงานผลิตทองแดงบริสุทธิ์และโลหะมีค่า บริษัท จิน จี แมททีเรียล เทคโนโลยี จำกัด

[illegible]

Checked By

Mr. Prayun Detkla
Technician

Approved By

Ms.Sutatip Im-noi
Environmental Scientist



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 121-65/0209

MTC No. EEL. BP. 130/1264

CALIBRATION CERTIFICATE

Submitted by : Environment Research & Technology Co.,Ltd.

Address : 25/114 Moo 6, Soi Chinakert 1, Ngamwongwan Road, Toongsonghong, Laksi, Bangkok, 10210.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
: Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Acoustic Calibrator

Manufacturer : Quest Technology

Model : QC-10

Serial No. : QE8100348

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

2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.

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

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

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

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

7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871.

Ambient Environment

Temperature : $(23 \pm 3) ^\circ\text{C}$

Relative Humidity : $(50 \pm 15) \%$

Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$

Calibration Procedure: CP-102-04 based on IEC 60942-2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 29 Dec. 2021

Date of Calibration : 10 Jan. 2022

1/2

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.BLMTC.002 Rev.4

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Changwat Pathumthani 12120, Thailand
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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)

Request No. 121-65/0209

MTC No. EEL. BP. 130/1264

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

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

Acoustic Output in dB re 20 μ Pa, Corrected to Reference Conditions: 101.325 kPa, 23.0 $^\circ\text{C}$ and 50 %RH.

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	113.81	-0.19	± 0.10	± 0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	994.1	-5.9	± 1.5	$\pm 1.0\%$

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	0.53	± 0.50	$\pm 3.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

(Mr. Weerachai Deechaiyae)

Approved by :

(Mr. Prawate Kluyapa)
Acting Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 10 Jan. 2022

Date of Issue : 11 Jan. 2022

Ref : 2011264122905422003

End of Certificate

2 / 2

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.BLMTC.002 Rev.4

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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

Method 5 Pre-Test Calibration - Liters (L)

UUT Meter Console Information

Model #: 572
Serial #: 0306016
DGM Model #: SK25EX
DGM Serial #: 00005305

Calibration Conditions

Bar. Pressure (mm Hg): 758.3
Ambient Temperature (°C): 24.3
Relative Humidity (%): 74.3
Altitude (m): 1.83
Bar. Pressure Corr. (mm Hg): 758.2

Factors/Conversions

Std. Temp. (K): 293.15
Std. Press. (mm Hg): 760
K₁ (K/mm Hg): 0.3857

Reference Equipment

Calibration Meter Model: DGMR-200H
Cal. Due Date: 03-Jun-23
Serial No.: 0000026
Gamma: 1.0000

UUT Meter (DGM)

Run Time (seconds)	Orifice, ΔH (mm H ₂ O)	Volume			Meter Temperature (°C)		Meter Pressure (in H ₂ O)	Volume (L)			Outlet Temperature (°C)	
		Initial (L)	Final (L)	Total (L)	Initial	Final		Initial	Final	Total	Initial	0.00
Θ	P _{m(g)}	V _{mi}	V _{mf}	V _m	t _{mi}	t _{mf}	P _w	V _{wi}	V _{wf}	V _w	t _{wi}	t _{wf}
840.00	13.00	349453.8	349626.0	172.2	24.0	24.0	0.3	0.00	172.75	172.75	24.0	24.0
630.00	25.00	349626.0	349804.0	178.0	24.0	25.0	0.5	0.00	177.97	177.97	24.0	24.0
450.00	50.00	349804.0	349981.2	177.2	25.0	26.0	0.6	0.00	177.50	177.50	24.0	24.0
360.00	80.00	349981.2	350159.6	178.4	26.0	26.0	2.0	0.00	179.25	179.25	24.0	24.0
300.00	120.00	350159.6	350339.6	180.0	26.0	27.0	2.4	0.00	180.48	180.48	24.0	24.0

Standardized Data

Reference Meter (L)		UUT Meter (L)		Correction Factor		ΔH @ (mm H ₂ O)	
Std. Vol.	Std. Flow	Std. Vol.	Std. Flow	Value	Variance	0.0212 SCMM	Variance
V _{w(Std)}	Q _{w(Std)}	V _{m(Std)}	V _{w(Std)}	Y	ΔY	ΔH@	ΔΔH@
170.14	12.15	169.68	12.2	1.0027	-0.0014	39.2	-1.513
175.36	16.70	175.31	16.7	1.0003	-0.0038	39.9	-0.780
174.94	23.33	174.36	23.3	1.0034	-0.0007	40.9	0.212
177.28	29.55	175.75	29.5	1.0087	0.0046	41.1	0.428
178.67	35.73	177.71	35.7	1.0054	0.0013	42.4	1.653
				1.0041	= Y Avg.	40.7	= ΔH@ Avg. Metric

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.

Note: For ΔH_g, orifice pressure differential that equates to 0.0212m³/min at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2inches (5.1mm) H₂O.

Pass/Fail Judgment :

Pass

Calibrate By :

Bhaskar P.

Approved By:

[Signature]

Date:

23 Sep 22

The instruments listed and described on this certificate have been calibrated against standards traceable to the National Institute of Standards and Technology (N.I.S.T.) and in reference to EPA Method 5, Section 10.3.1.



Certificate of Calibration - Supplemental

Nomenclature

P_b - Barometric Pressure
 DGM - Dry Gas Meter
 K_1 - Constant based on standard temp and press
 t - Run time, in minutes
 P_m - ΔH (Meter Pressure, gauge)
 V_m - Volume collected by test meter, corrected for STP
 $Q_{w(std)}$ - Calculated flow rate of test meter
 K_1 - Critical orifice coefficient
 P_{ref} - Measured pressure of reference meter
 T_{ref} - Temperature measured in reference meter

Equations

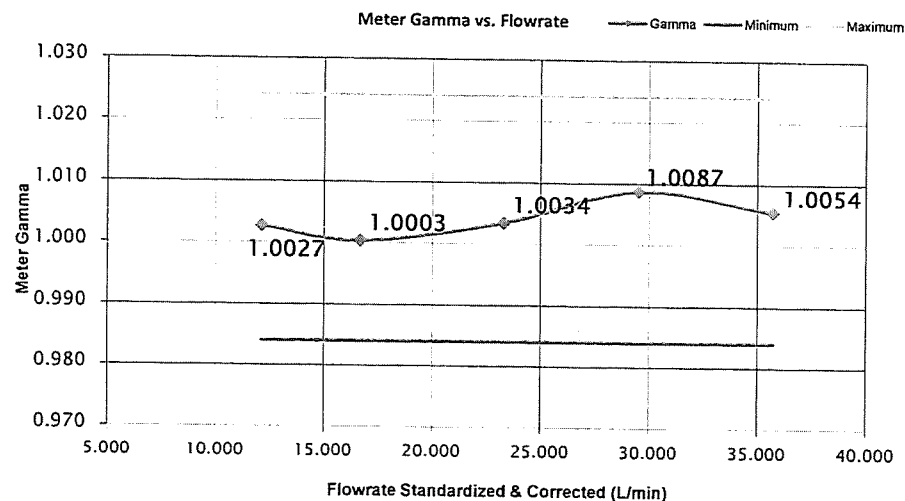
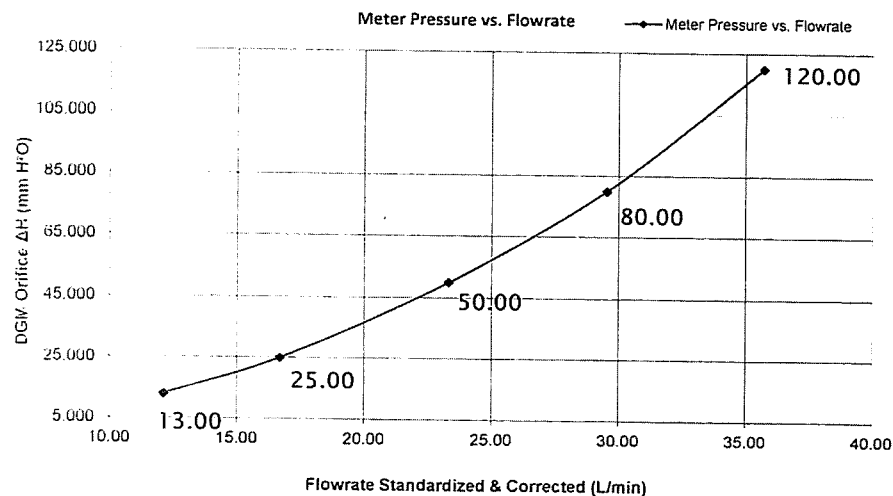
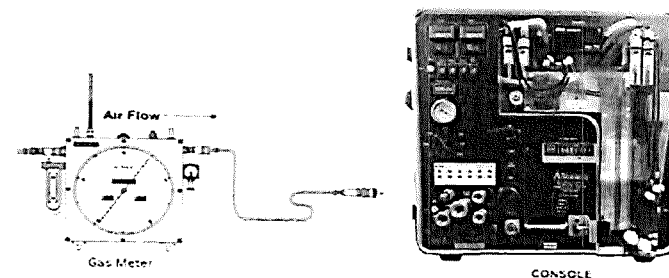
$$V_{w(std)} = Y * K_1 \frac{V_w * (P_{bar} + \frac{P_m(\Delta H)}{13.6})}{T_w}$$

$$V_{m(std)} = \frac{K_1 V_m (P_{bar} + \frac{\Delta H}{13.6})}{T_m}$$

$$K_1 = \frac{T_{std}}{P_{std}} \quad Y = \frac{V_{w(std)}}{V_{m(std)}} \quad Q_{w(std)} = \frac{V_{w(std)}}{t}$$

$$Metric \Delta H_w = \frac{P_{m(ref)} * 0.0011696 * (P_{bar} + \frac{P_{m(ref)}}{13.6})}{T_w} * \left(\frac{T_w * t}{V_w + P_{bar}} \right)^2$$

Calibration Train





Certificate of Calibration

Method 5 Console Sensor Calibration - Metric Units

Console Information

Model #: 572
Serial #: 0306016
Units: Metric

Calibration Conditions

Pbar (mm. Hg): 758.3
Tamb (°C): 24.3
Humidity (%): 74.3
Elevation (m): 1.8
Corr. Pbar (mm. Hg): 758.2

Reference Devices

TC Calibrator Model: CC-VTR-SH
Reference #: 091109289
Barometer Model: 736930
Reference #: EBARODIALSPE01
Pressure Model: 718 30G
Reference #: 9543013

Temperature Display Calibration Data

Reference Point ¹	Reference Temp. °C	Test Thermocouple Calibrations					Reference Point Status ² Pass/Fail
		Probe °C	Stack °C	Filter °C	Exit °C	Aux °C	
1	-18	-17	-18	-19	-18	-18	PASS
2	38	39	37	37	37	36	PASS
3	93	95	93	94	92	92	PASS
4	149	150	149	150	148	148	PASS
5	260	261	259	261	258	258	PASS
6	371	373	371	372	371	370	PASS
7	482	484	482	483	481	481	PASS
8	593	594	593	595	593	592	PASS
9	816	817	816	817	815	815	PASS
10	1038	1040	1039	1040	1037	1038	PASS

Overall Audit Status

NIST Reference Thermocouple ID:

Ref Point	Theoretical Temp.	DGM Thermocouple Sensor Reading	ΔT_{abs} ⁴
#	°C	°C	°C
Ice Water	1	0.1	0.04%
Ambient ⁵	2	24.3	0.06%
Maximum ²			0.06%
Status			PASS

Internal temperature thermocouple is not audited to EPA standards, and should not be used as an official reference for ambient temperature.

Calibrate By:

D. Thompson

Approved By:

M

Date

23 Sep 22

Notes

¹ Suggested, minimum reference points are 10 (0, 100, 200, 300, 500, 700, 900, 1100, 1500, 1900 °F), can test for more.

² For valid test results, the maximum difference between temperature and reference readings should be less than ± 5.4 °F (± 3 °C), for all thermocouples except for the stack thermocouple which should be less than $\pm 1.5\%$ absolute temperature from the reference reading and the exit thermocouple which should be less than ± 2 °F (± 1 °C) from the reference reading (EPA Method 2, Section 6.3 and EPA Method 5, Sections 5.1.1-5.1.1.8).

³ Do not change this cell value, it is instead based on input from Cell H8 at the top of this sheet under "Calibration Conditions".

⁴ Absolute temperature difference and other formulas are calculated based on unit input from cell C8 at the top of this sheet under "Meter Console Information".

⁵ For valid test results, the maximum difference between console and reference barometric pressure readings should be less than ± 0.1 in. Hg (± 2.5 mm Hg). (EPA Method 5, Section 6.1.2)

⁶ For valid test results, the maximum difference between console and reference vacuum readings should be less than ± 0.5 in. Hg (± 12.5 mm Hg).

⁷ For valid test results, the maximum difference between console and reference vacuum readings should be less than ± 0.5 in. Hg (± 12.5 mm Hg).



Neediss Supply Instrument Co., Ltd.



Console Sensor Calibration Data Sheet

Console Information

Model #: 572
Serial #: 0306016
Units: Metric
Type: "English"

Calibration Conditions

Pbar (mm. Hg): 758.3
Tamb (°C): 24.3
Humidity (%): 74.3
Altitude (m): 1.8
Corr. Pbar (mm. Hg): 758.2

Reference Devices

TC Simulator Model: CC-VTR-SH
Reference #: 091109289
Barometer Model: 736930
Reference #: EBARODIALSPE01
Digital Pressure Calibrator Model: 718 30G
Reference #: 3891001

Pressure Gauge / Manometer Calibration Data

Console Vacuum Calibration			
Reference Point	Reference Vacuum	Console Vacuum	Reference Point Status ⁶ Pass/Fail
#	in. Hg	in. Hg	
1	-5.0	-5.5	PASS
2	-10.0	-10.5	PASS
3	-20.0	-20.5	PASS

Reference Point ¹	ΔH Manometer Calibration			Reference Point Status ² Pass/Fail
	Reference mm H2O	Positive (+) Pitot mm H2O	Negative (-) Pitot mm H2O	
1	-200.000	0.0	-202.0	PASS
2	-150.000	0.0	-150.0	PASS
3	-100.000	0.0	-100.0	PASS
4	-80.000	0.0	-80.0	PASS
5	-50.000	0.0	-50.0	PASS
6	0.000	0.0	0.0	PASS
7	50.000	50.0	0.0	PASS
8	80.000	80.0	0.0	PASS
9	100.000	100.0	0.0	PASS
10	150.000	150.0	0.0	PASS
11	200.000	200.0	0.0	PASS

ΔH Overall Audit Status

Reference Point ¹	ΔP Manometer Calibration			Reference Point Status ² Pass/Fail
	Reference mm H2O	Positive (+) Pitot mm H2O	Negative (-) Pitot mm H2O	
1	-200.000	0.0	-200.2	PASS
2	-150.000	0.0	-150.2	PASS
3	-100.000	0.0	-100.2	PASS
4	-80.000	0.0	-80.2	PASS
5	-50.000	0.0	-50.2	PASS
6	0.000	0.0	0.0	PASS
7	50.000	50.0	0.0	PASS
8	80.000	80.2	0.0	PASS
9	100.000	100.0	0.0	PASS
10	150.000	150.2	0.0	PASS
11	200.000	200.2	0.0	PASS

ΔP Overall Audit Status

Calibrate By:

D. Thompson

Approved By:

M

Date

23 Sep 22

Notes

¹ Suggested, minimum reference points are 10 (0, 100, 200, 300, 500, 700, 900, 1100, 1500, 1900 °F), can test for more.

² For valid test results, the maximum difference between temperature and reference readings should be less than ± 5.4 °F (± 3 °C), for all thermocouples except for the stack thermocouple which should be less than $\pm 1.5\%$ absolute temperature from the reference reading and the exit thermocouple which should be less than ± 2 °F (± 1 °C) from the reference reading.

³ Do not change this cell value, it is instead based on input from Cell H8 at the top of this sheet under "Calibration Conditions".

⁴ Absolute temperature difference and other formulas are calculated based on unit input from cell C8 at the top of this sheet under "Meter Console Information".

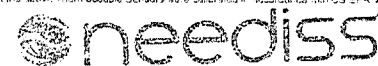
⁵ For valid test results, the maximum difference between console and reference barometric pressure readings should be less than ± 0.1 in. Hg (± 2.5 mm Hg). (EPA Method 5, Section 6.1.2)

⁶ For valid test results, the maximum difference between console and reference vacuum readings should be less than ± 0.5 in. Hg (± 12.5 mm Hg).

⁷ For valid test results, the maximum difference between console and reference vacuum readings should be less than ± 0.5 in. Hg (± 12.5 mm Hg).

⁸ For valid test results, the maximum difference between console and reference vacuum readings should be less than ± 0.5 in. Hg (± 12.5 mm Hg).

⁹ For valid test results, the maximum difference between console and reference vacuum readings should be less than ± 0.5 in. Hg (± 12.5 mm Hg).



Neediss Supply Instrument Co., Ltd.



Console Sensor Audit QA Sheet

Meter Console Information (UUT)

Model #: 572
Serial #: 0306016
Units: Metric

Calibration Conditions

Pbar (mm. Hg): 758.3
Amb. Temp. (°C): 24.3
Humidity (%): 74.3
Altitude (m): 1.8
Corrected Pbar (mm. Hg): 758.2

Reference Devices

TC Simulator Model: CC-VTR-SH
Reference #: 91109269
Barometer Model: 369307
Reference #: EBARODIALSPE01
Digital Pressure Calibrator Model: 718 30G
Reference #: 9543013

Audit Data

Reference Point	Reference Temp.	Thermocouple Probe Audit						Reference Point Status ¹
		Aux	Stack	Probe	Oven	Filter	Exit	
	°C	°C	°C	°C	°C	°C	°C	Pass/Fail
Room	24.3	25	24	24	24	24	23	PASS
Ice Water	0.2	1	0	0	0	0	0	PASS

Console Vacuum Audit

Reference Point	Reference Vacuum	Console Vacuum	Reference Point Status ³
#	in. Hg	in. Hg	Pass/Fail
1	-17.0	-17.5	PASS

Calibrate By: Pattamagorn P.

Approved By: M

Date: 23 Sep 22

Notes

¹For valid test results, the maximum difference between test and reference readings should be less than 5.4 °F (3 °C), for all thermocouples except for the stack thermocouple which should be less than 1.5% absolute temperature from the reference reading and the exit thermocouple which should be less than 2°F (1 °C) from the reference reading (EPA Method 2, Section 6.3 and EPA Method 5, Sections 6.1.1.7-6.1.1.8)

²For valid test results, the maximum difference between console and reference barometric pressure readings should be less than 0.1 in. Hg (2.5 mm Hg). (EPA Method 5, Section 6.1.2)

³For valid test results, the maximum difference between console and reference vacuum readings should be less than 0.5 in. Hg (12.5 mm Hg)

I certify that the above Thermocouple, Barometric and Vacuum Sensors were calibrated and audited in accordance with US EPA Methods, CFR 40 Part 60



Neediss Supply Instrument Co., Ltd.

Certificate No: G 650027
Date of issue : 21-Jan-22

Instrument description : Flue gas Analyzer
Instrument model : Testo 350 New
Instrument serial no. : 62227989
ID no. or control no. : -
Manufacturer : testo SE
Probe description : -
Probe model : -
Probe serial : -
Customer name : Environment Research & Technology Co., Ltd.
Customer address : 25/114 Moo 6, Soi Chinnakhet 1, Ngamwongwan Rd., Toongsonghong, Laksi, Bangkok 10210 Thailand
Total pages of certificate : 2 Pages
Receiving no. : L-220101
Receiving date. : 18-Jan-22
Parameter of calibration : Gas Calibration(Oxygen 2.501,10.00,21.00 %vol, Carbon Monoxide 80.97,309.9,1003 ppm, Nitrogen Dioxide 80.62 ppm, Nitric Oxide 150.9 ppm, Sulphur Dioxide 100.9 ppm)
Condition of UUC. : Used
Ambient condition : All of the Measurment ware caried out the stabilized labotary
Temperature : 23 ±5 °C
Humidity : 55 ± 15 %RH
Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210
Calibration procedure no. : WI-CL-28-C
*The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurent
Multiplied by coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.
This certificate is applied only to item under test Environmental condition.
This Calibration Certificate may not be reporduced other than in full except with the permission of the issuing laboratory.
Calibration certificates without signature and seal not valid.
This calibration certificate documents are tracebility to national standards, which realize measurement according to the
International System of Units (SI).*
Date of calibration : 20-Jan-22

Mr. Sedtawut Nueathong
Calibration Technician

Mrs. Nongluck Wongsettee
Technical Manager

Certificate No.: G 650027

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O2) 2.501 % Vol	2431/19	Linde	16-Jul-23
Oxygen (O2) 10.00 % Vol	2453/19	Linde	18-Jul-23
Oxygen (O2) 21.00 % Vol	2426/19	Linde	16-Jul-23
Carbon monoxide (CO) 80.97 ppm	2842/21	Linde	24-Jun-23
Carbon monoxide (CO) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide (CO) 1003 ppm	2829/21	Linde	23-Apr-23
Nitrogen Dioxide (NO2) 80.62 ppm	3240/21	Linde	25-Jul-23
Nitric Oxide (NO) 150.9 ppm	2857/21	Linde	27-Jun-23
Sulphur Dioxide (SO2) 100.9 ppm	4942/20	Linde	20 Nov 22

Measured room conditions

Temperature : 22.9 °C Humidity : 54.3 %RH Pressure : 1017.6 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,200 ml/min Gas pressure : 1024.3 mbar

Calibration Results (without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.501	2.47	-0.031	0.20
O2 (%Vol)	10.00	9.88	-0.12	0.40
O2 (%Vol)	21.00	21.13	0.13	0.80
CO (ppm)	80.97	81	0.03	2.8
CO (ppm)	309.9	311	1.1	11
CO (ppm)	1003	1004	1	34
*NO2 (ppm)	80.62	81.3	0.68	5.0
*NO (ppm)	150.9	152	1.1	5.0
*SO2 (ppm)	100.9	102	1.1	5.0

Remark : 1 cmol/mol = 1 %vol. , 1 µmol/mol = 1 ppm.

* Calibrations marked Not TISI Accredited "in this Certificate have been included for completeness."

End of Report



Certificate of Calibration

Certificate Number : MB2-020-2022
Equipment : Electronic Balance
Manufacturer : Radwag
Model : WTB2000
Serial Number : 460680
ID Number : Stack 1
Max Capacity : 2000 (g)
Resolution : 0.01 (g)

Page 1 of 2 Pages

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor k , providing a level of confidence of approximately 95 %. The uncertainty evaluation has been carried out in accordance with UKAS M3003 requirements. This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI). This Certificate may not be reproduced other than in full except with the prior written approval of Calibration Center, Intro TSC Co., Ltd.

Customer Reference : F411 **Customer :** Environment Research&Technology Co., Ltd.
CSRS No.: CSRS01430122 **25/114 Moo 6 Soi Chinaket 1, Ngamongwan Road.,**
Date of Receipt : 20-Jan-22 **Toongsonghong, Laksi, Bangkok 10210**
Date of Calibration : 20-Jan-22 **Location :** Mass Calibration Laboratory

Condition of this result of calibration

1. Reference Standard instruments :

Instruments	Model	Serial No.	Certificate No.	Due Date
Standard Weight Set (1 g to 5000 g)	N/A	N/A	21M1065	15-Jun-22

2. This Certification is traceable to the International System of Unit maintained at : -

- Technology Promotion Association (Thailand-Japan)

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

Method : Measurement In-house Method Calibration Procedure No. CP-CL-07 base on UKAS Publication Ref : Lab 14 : 2019

Environmental Conditions :

Temperature : (20 ± 2) °C

Humidity : (50 ± 15) %

Air Pressure : (1010 ± 10) mbar

Calibrated By : Mr. Montree Kaewlodla

Date of Issued : 21-Jan-22

Approved Signatory :

[Signature]

Mr. Panuchit Samart

FM-CL-11-05



Certificate Number : MB2-020-2022

Page 2 of 2 Pages

Calibration Result (Weight) : Adjustment by External Weight

1. Repeatability of Reading

Nominal Value (g)	Standard Deviation (g)	Maximum diff. Between successive (g)
2000	0.000	0.00

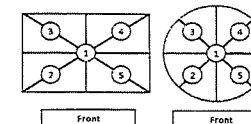
2. Error of indication from nominal value

Nominal Value (g)	Balance Reading (g)	Correction Value (g)	Uncertainty (±) (g)	factor k	Balance Reading Before Adjust (g)
Unload	0.00	0.00	0.0082	2.00	0.00
200	200.00	0.00	0.0082	2.00	200.00
400	400.00	0.00	0.0083	2.00	400.00
600	600.00	0.00	0.0085	2.00	600.03
800	800.00	0.00	0.0087	2.00	800.08
1000	1000.00	0.00	0.0087	2.00	1000.10
1200	1200.00	0.00	0.095	2.00	1200.12
1400	1400.00	0.00	0.095	2.00	1400.15
1600	1600.00	0.00	0.095	2.00	1600.18
1800	1800.00	0.00	0.095	2.00	1800.21
2000	2000.00	0.00	0.095	2.00	2000.24

3. Eccentric or off-center loading

Nominal Value (g)	Reference Position				
	Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)
1000	1000.00	999.97	1000.00	999.99	999.98

Eccentric Error = 0.03 (g)



End of report

[Signature]



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 22CH12

Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Eutech
Model : pHTestr 30
Serial No. : 3015177
ID No. : NO.25
Condition As-Received: Used Item
Received Date : 29 December 2021
Calibration Date : 05 January 2022
Reference : 2112-0752WN-8
Submitted by : Environment Research & Technology Company Limited.
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,
Toongsonghong, Lakki, Bangkok 10210
Ambient Temperature : (25 \pm 2.5) °C
Relative Humidity : (50 \pm 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with standard
voltage calibrator and direct measurement
with certified reference material (CRM)

Calibrated by : Walalak Sirithean

Approved by :

Approved Signatory

- (☒) Malee Butkruea
(☐) Saithip Meangmai
(☐) Warakorn Lernagtrakul

Issue Date : 7 January 2022

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 head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0036339



Cert.No.: 22CH12

Page.: 2 of 2

Condition of this calibration result

1. Certified Reference Materials : The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.008	CPA chem	761016	02 Aug 2023
pH 6.982	CPA chem	761017	02 Aug 2022
pH 10.015	CPA chem	761018	02 Aug 2022

2. This certificate is valid only to the item calibrated on date and place of calibration.

Calibration Results

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4,7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement (\pm)	Coverage factor k
pH Electrode S/N.: 3015177	4.008	4.02	N/A	0.0085	2.05
	6.982	6.98	N/A	0.011	2.00
	10.015	10.02	N/A	0.0095	2.00

Remark

- pH meter does not have voltage mode.
- Can not connect the BNC because the plug does not match with the socket.
- N/A = Not Available

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

-o0o-

Malu

a 1088738

Mettler-Toledo (Thailand) Ltd.
846/4 - 846/5 Lasalle Rd., Bangna Tai Sub-District
Bangna District, Bangkok 10260
+66 2723 0382
MT-TH.ServiceSupport@mt.com



Accuracy Calibration Certificate

Customer

Company: ENVIRONMENT RESEARCH&TECHNOLOGY CO., LTD.
Address: 25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Rd., Toongsongho
City: Lakki Contact: Ramita Taengthai
Zip / Postal: 10210
State / Province: Bangkok
Order Number:



Weighing Device

Manufacturer: Mettler Toledo Instrument Type: Weighing Instrument
Model: MS204S/01 Asset Number: ERTC-L-IN-088
Serial No.: B334691537 Terminal Model: N/A
Building: N/A Terminal Serial No.: N/A
Floor: 5 Terminal Asset No.: N/A
Room: 504

Range	Max. Capacity	Readability (d)
1	220 g	0.0001 g

Procedure

Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)
METTLER TOLEDO Work Instruction: CP/W002/20
This calibration certificate contains measurements for As Found calibration. No As Left calibration was performed because the device was not modified after As Found calibration. Therefore, results for As Left correspond to As Found.
The sensitivity/span of the weighing instrument was adjusted before calibration with a built-in weight.
In accordance with EURAMET cg-18 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific calibration conditions.

	Temperature	Humidity
As Found	Start: 23.9 °C End: 24.2 °C	Start: 45.8 % End: 54.8 %

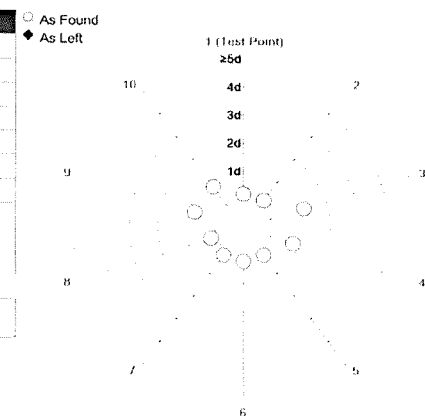
As Found Calibration Date: 19-Jan-2022 Calibrator: Suwicha Choykamchu
As Left Calibration Date: N/A
Issue Date: 20-Jan-2022 Approved Signatory: Kasakorn Tassanachaisakul
☒ Kasakorn Tassanachaisakul
☐ Santi Jitniyom
☐ Surachet Sukkate

Measurement Results

Repeatability

Test Load: 100 g

	As Found	As Left
1	99.9998 g	N/A
2	99.9998 g	N/A
3	99.9997 g	N/A
4	99.9999 g	N/A
5	99.9998 g	N/A
6	99.9998 g	N/A
7	99.9998 g	N/A
8	99.9998 g	N/A
9	99.9999 g	N/A
10	99.9999 g	N/A
Standard Deviation	0.00006 g	N/A



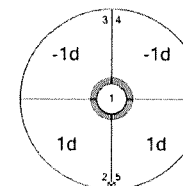
The "d" in the graph represents the readability of the range/interval in which the test was performed.

The results of this graph are based upon the absolute values of the differences from the mean value.

Eccentricity

Test Load: 100 g

Position	As Found	As Left
1	99.9998 g	N/A
2	99.9999 g	N/A
3	99.9997 g	N/A
4	99.9997 g	N/A
5	99.9999 g	N/A
Maximum Deviation	0.0001 g	N/A



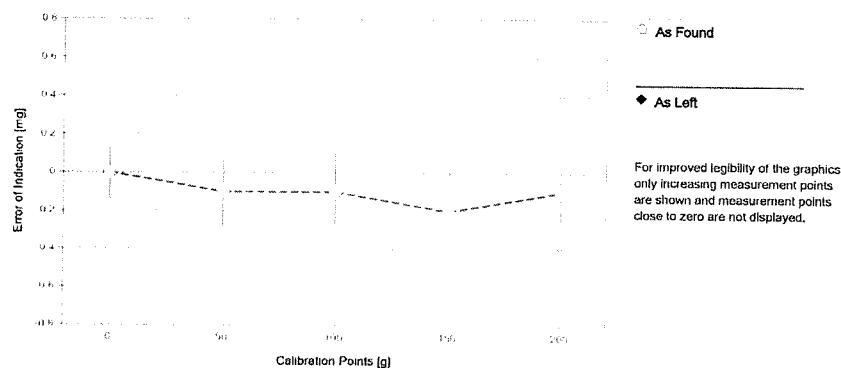
As Found

The "d" in the graph represents the readability of the range/interval in which the test was performed.

Error of Indication

As Found

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.0000 g	0.14 mg	2
2	0.0500 g	0.0500 g	0.0000 g	0.15 mg	2
3	0.1000 g	0.1000 g	0.0000 g	0.15 mg	2
4	0.5000 g	0.5000 g	0.0000 g	0.15 mg	2
5	1.0000 g	1.0000 g	0.0000 g	0.15 mg	2
6	5.0000 g	5.0000 g	0.0000 g	0.16 mg	2
7	10.0000 g	10.0000 g	0.0000 g	0.16 mg	2
8	50.0000 g	49.9999 g	-0.0001 g	0.19 mg	2
9	99.9999 g	99.9998 g	-0.0001 g	0.25 mg	2
10	149.9999 g	149.9997 g	-0.0002 g	0.35 mg	2
11	199.9999 g	199.9998 g	-0.0001 g	0.39 mg	2



The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor k – which can be larger than 2 according to EURAMET cg-18. The value of the measurand lies within the assigned range of values with a probability of approximately 95%.

The user is responsible for maintaining environmental conditions and the settings of the weighing instrument when it was calibrated.

Test Equipment

All weights used for metrological testing are traceable to national or international standards. The weights were calibrated and certified by an accredited calibration laboratory.

Weight Set 1: OIML E2

Weight Set No.: WS03 Date of Issue: 21-Sep-2021
Certificate Number: 175498 Calibration Due Date: 14-Mar-2023

Thermo Hygrometer

Equipment No.: IN281 Date of Issue: 25-May-2021
Certificate Number: 21H1100 Calibration Due Date: 10-May-2022

26-1-65

Remarks

FACT adjustment functionality activated

Equipment condition: Good

Next calibration according to customer's procedure

End of Accredited Section

The information below and any attachments to this calibration certificate are not part of the accredited calibration.

26-1-65

Measurement Uncertainty of the Weighing Instrument in Use

Stated is the expanded uncertainty with $k=2$ in use. The formula shall be used for the estimation of the uncertainty under consideration of the errors of indication. The value R represents the net load indication in the unit of measure of the device.

Temperature coefficient for the evaluation of the measurement uncertainty in use: $1.5 \cdot 10^{-6} / K$

Temperature range on site for the evaluation of the measurement uncertainty in use: 4 K

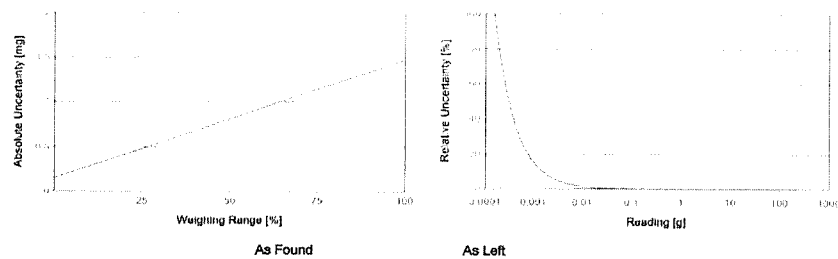
Linearization of Uncertainty Equation

	Range		As Found	As Left
	d	Max		
1	0.0001 g	220 g	$U_1 = 0.15 \text{ mg} + 0.00599 \text{ mg/g} \cdot R$	N/A

To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

Absolute and Relative Measurement Uncertainty in Use for Various Net Indications (Examples)

Net Indication	As Found		As Left	
0.0220 g	0.15 mg	0.68%	N/A	N/A
0.2200 g	0.15 mg	0.069%	N/A	N/A
2.2000 g	0.16 mg	0.0074%	N/A	N/A
22.0000 g	0.28 mg	0.0013%	N/A	N/A
220.0000 g	1.5 mg	0.00067%	N/A	N/A



GWP® Certificate



As
Found



As
Left



The weighing device meets the given
process requirements.

The weighing device meets the given
process requirements.

Tests Performed: ☒ As Found ☐ As Left ☐ No adjustments/modifications made. As Left results correspond to As Found.

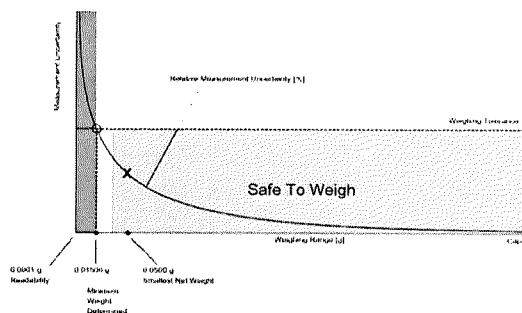
Process Requirements

Weighing Tolerance: 1%

Smallest Net Weight: 0.0500 g

Safety Factor: 2

Safe Weighing Range



While the values in this graph reflect the actual calibration results, the measurement uncertainty curves are simply a visual representation. This graph reflects As Left testing, unless only As Found was performed.

26-1-65

26-1-65

Minimum Weight

As Found Minimum Weight Table

Minimum weights for different weighing tolerances and safety factors					
Tolerance	Safety Factor				
	1	2	3	5	10
0.1%	0.15146 g	0.30476 g	0.45993 g	0.77601 g	1.60147 g
0.2%	0.07550 g	0.15146 g	0.22788 g	0.38211 g	0.77601 g
0.5%	0.03015 g	0.06037 g	0.09066 g	0.15146 g	0.30476 g
1%	0.01506 g	0.03015 g	0.04525 g	0.07550 g	0.15146 g
2%	0.00753 g	0.01506 g	0.02260 g	0.03770 g	0.07550 g
5%	0.00301 g	0.00602 g	0.00904 g	0.01506 g	0.03015 g

✓ Pass: The determined minimum weight meets the requirement for the smallest net weight.

As Left Minimum Weight Table

Minimum weights for different weighing tolerances and safety factors					
Tolerance	Safety Factor				
	1	2	3	5	10
0.1%	0.15146 g	0.30476 g	0.45993 g	0.77601 g	1.60147 g
0.2%	0.07550 g	0.15146 g	0.22788 g	0.38211 g	0.77601 g
0.5%	0.03015 g	0.06037 g	0.09066 g	0.15146 g	0.30476 g
1%	0.01506 g	0.03015 g	0.04525 g	0.07550 g	0.15146 g
2%	0.00753 g	0.01506 g	0.02260 g	0.03770 g	0.07550 g
5%	0.00301 g	0.00602 g	0.00904 g	0.01506 g	0.03015 g

✓ Pass: The determined minimum weight meets the requirement for the smallest net weight.

At these net minimum weight values, the measurement uncertainty of the weighing device is equal to or less than 1/1 (no safety factor), 1/2, 1/3, 1/5, or 1/10 of the required tolerance. The values are calculated with $k = 2$ and based on the linear formula of the measurement uncertainty of the weighing device in use.

The safety factor for As Found is always 1. This implies no safety factor. As Found testing looks at the behavior of the instrument from the past until test occurred. For the past, it is necessary to know that the tolerance was met, but not the safety factor. The safety factor is a proactive measure to apply for future measurements.

Notes on minimum weight values in above table:

1. If "N/A" is shown above, no appropriate value could be calculated.
2. METTLER TOLEDO is not responsible for the definition of the process requirements.

Measurement Results

Results Summary

	Repeatability	Eccentricity	Error of Indication
As Found	✓	✓	✓
As Left	✓	✓	✓

✓ = Passed

✗ = Failed

! = Safety Factor not met

Repeatability

Test Load: 100 g

Tolerance	Control Limit	As Found		As Left	
		Std. Deviation	Result	Std. Deviation	Result
0.1%	N/A		N/A		N/A
0.2%	0.00005 g		✗		✗
0.5%	0.00013 g	0.00006 g*	✓	0.00006 g*	✓
1%	0.00025 g		✓		✓
2%	0.00050 g		✓		✓
5%	0.00125 g		✓		✓

*The calculated standard deviation value is below the rounding error of the balance. The $0.41 \cdot d$ rule is used for the assessment of this repeatability test and the calculation of the minimum weight.

The weighing tolerance is met if the standard deviation is less than or equal to the corresponding control limit.

Eccentricity

Test Load: 100 g

Tolerance	Control Limit	As Found		As Left	
		Deviation	Result	Deviation	Result
0.1%	0.0500 g		✓		✓
0.2%	0.1000 g		✓		✓
0.5%	0.2500 g	0.0001 g	✓	0.0001 g	✓
1%	0.5000 g		✓		✓
2%	1.0000 g		✓		✓
5%	2.5000 g		✓		✓

The weighing tolerance is met if the deviation is less than or equal to the corresponding control limit.

Error of Indication

As Found

Reference Value	Error	Control limits for various weighing tolerances					
		0.1%	0.2%	0.5%	1%	2%	5%
0.0000 g	0.0000 g	N/A	N/A	N/A	N/A	N/A	N/A
50.0000 g	-0.0001 g	0.0250 g	0.0500 g	0.1250 g	0.2500 g	0.5000 g	1.2500 g
99.9999 g	-0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
149.9999 g	-0.0002 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
199.9999 g	-0.0001 g	0.1000 g	0.2000 g	0.5000 g	1.0000 g	2.0000 g	5.0000 g
Result		✓	✓	✓	✓	✓	✓

As Left

Reference Value	Error	Control limits for various weighing tolerances					
		0.1%	0.2%	0.5%	1%	2%	5%
0.0000 g	0.0000 g	N/A	N/A	N/A	N/A	N/A	N/A
50.0000 g	-0.0001 g	0.0250 g	0.0500 g	0.1250 g	0.2500 g	0.5000 g	1.2500 g
99.9999 g	-0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
149.9999 g	-0.0002 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
199.9999 g	-0.0001 g	0.1000 g	0.2000 g	0.5000 g	1.0000 g	2.0000 g	5.0000 g
Result		✓	✓	✓	✓	✓	✓

The weighing tolerance is met if the error (of indication) for each test point is less than or equal to the corresponding control limit for that particular weighing tolerance. Results at or close to the zero point cannot be assessed.

Service Date: 2022-01-19
Document Number: TH2065-165-011922-LABBalanceHR
ENVIRONMENT RESEARCH&TECHNOLOGY CO., LTD
25/114 Moo 6, Soi Chinakel 1, Ngamwongwan Rd., Toongsongho อ.ต.จ.บ. 10210, Bangkok 10210
Ramita Taengthai

METTLER TOLEDO

Balance Health Report

Device Details

System Details			
Manufacturer:	Mettler Toledo	Accessory 1:	
Model:	MS204S	Accessory 2:	
Serial number:	B334601537	Weight set for routine testing:	Yes /
Firmware:	1.74		

History

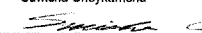
Device History		Service History	
Instrument in use:	Yes	Last preventive maintenance:	< 1 year
Instrument age:	> 10 years	Last instrument calibration:	< 1 year
Spare parts available:	Yes	Last minimum weight determination:	
Regulations:	ISO		
Process tolerance in %:	1%	Routine testing performed:	Yes
Smallest sample net weight:	0.05g		

Check List

Environmental Conditions		General & Functional Checks	
Room temperature fluctuation	✓	Levelling	✓
Exposure to direct sun	✓	Cleanliness	✓
Vibrations	✓	Completeness - missing parts see additional remarks	✓
Draft	✓	Settings optimized for operating environment	✓
Dirt or dust	✓	Other - objections noted as additional remarks	—
Static	✓	Electrical Component Checks	
Mechanical Component Checks		Power supply	✓
Draft shield	✓	Sliding door drive	—
Weighing pan position	✓	Internal weight drive	✓
Housing	✓	Display	✓
Other - objections noted as additional remarks	—	Other - objections noted as additional remarks	—

Recommendations

Measurement Result Quality		Process Efficiency	
Instrument calibration		Uninstall instrument	
Identify safe weighing range		Replace instrument	
GWP verification / risk assessment		Replace / add parts (see additional remarks)	
Preventive maintenance		Onsite repair	
Perform routine testing with test weights		Depot repair	
User training		Use of accessories (see additional remarks)	

Contact	Name: Ramita Taengthai	Position: N/A	Phone: 0866334490	Email: ramita@enviresearch.co.th
Additional Remarks & Recommendations				Engineer Details
				Date: 19-Jan-2022
				Name: Suwicha Choykamichu
				Signature: 

This is not a certificate.

It should not be used to interpret final results for the testing of these devices.

Legend: ✓ Good/Pass ⚠ Needs Attention ✗ Bad/Fail — Not Applicable



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3 : EQUIPMENT CALIBRATION AND TESTING SERVICES

534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250

TEL. 0-2717-3000 FAX. 0-2719-9484



Cert.No.: 22TW242

Page.: 2 of 2

Cert.No.: 22TW242

Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : YSI
Model : 5000-115
Serial No. : 17H104220
ID No. : ERTC-L-In.137
Received Date : 26 October 2022
Test Date : 27 October 2022
Reference : 2210-0840WN-1
Submitted by : Environment Research & Technology Company Limited.
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,
Toongsonghong, Laksi, Bangkok 10210
Laboratory Condition : Temperature (25 ± 5) °C
Humidity (50 ± 20) %
Test Procedure : In - house method : CP-CH9
by Comparison Technique with Azide Modification Method
Tested by : Walalak Sirithean

Approved by :

Approved Signatory

(✓) Malee Butkruea
() Saithip Meangmai
() Warakorn Lernagatrakul

Issue Date : 1 November 2022

Condition of this result of calibration

1. Reference Standard Instruments :

This certification is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center, Technology Promotion Association (Thailand-Japan).

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Burette	-	130BU10	21CG1389	25 Mar 2023
2) Balance	1126143764	140RC004	22MM50	20 Sep 2023

2. Standard Material :-

Material	Manufacturer	Lot.No.	Assay
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 15K100353

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.14	8.13	0.0071

This report was certified only for the instrument we tested. It is allowable to use for study the system efficiency. The environmental impact control and present to organization it may concerned Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced other in full, without written approval of the laboratory


-o0o-

Mettler-Toledo (Thailand) Ltd.
846/4 - 846/5 Lasalle Rd., Bangna Tai Sub-District
Bangna District, Bangkok 10260
+66 2723 0382
MT-TH.ServiceSupport@mt.com



Accuracy Calibration Certificate

Customer

Company: ENVIRONMENT RESEARCH&TECHNOLOGY CO., LTD.
Address: 25/114 Moo 6, Soi Chinakel 1, Ngamwongwan Rd., Toongsongho
City: Lakso Contact: Ramita Taengthai
Zip / Postal: 10210
State / Province: Bangkok
Order Number: 

Weighing Device

Manufacturer: Mettler Toledo Instrument Type: Weighing Instrument
Model: MS204TS/00 Asset Number: ERTC-L-IN-114
Serial No.: B547728937 Terminal Model: N/A
Building: N/A Terminal Serial No.: N/A
Floor: 5 Terminal Asset No.: N/A
Room: 504

Range	Max. Capacity	Readability (d)
1	220 g	0.0001 g

Procedure



Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)
METTLER TOLEDO Work Instruction: CP/W002/20

This calibration certificate contains measurements for As Found calibration. No As Left calibration was performed because the device was not modified after As Found calibration. Therefore, results for As Left correspond to As Found.

The sensitivity/span of the weighing instrument was adjusted before calibration with a built-in weight.

In accordance with EURAMET cg-18 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific calibration conditions.

	Temperature		Humidity	
As Found	Start: 23.8 °C	End: 24.5 °C	Start: 49.7 %	End: 55.1 %

As Found Calibration Date: 19-Jan-2022 Calibrator: 
As Left Calibration Date: N/A
Issue Date: 20-Jan-2022
Approved Signatory: 
☒ Kassakorn Tassanachaisakul
☐ Santi Jitniyom
☐ Surachet Sukkate

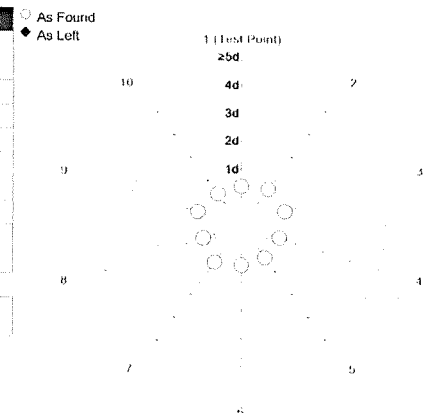
Measurement Results

Repeatability

Test Load: 100 g

	As Found	As Left
1	99.9999 g	N/A
2	99.9998 g	N/A
3	99.9998 g	N/A
4	99.9999 g	N/A
5	99.9999 g	N/A
6	99.9999 g	N/A
7	99.9998 g	N/A
8	99.9999 g	N/A
9	99.9998 g	N/A
10	99.9999 g	N/A

Standard Deviation	0.00005 g	N/A
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The "d" in the graph represents the readability of the range/interval in which the test was performed.

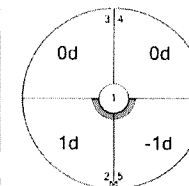
The results of this graph are based upon the absolute values of the differences from the mean value.

Eccentricity

Test Load: 100 g

Position	As Found	As Left
1	99.9998 g	N/A
2	99.9999 g	N/A
3	99.9998 g	N/A
4	99.9998 g	N/A
5	99.9997 g	N/A

Maximum Deviation	0.0001 g	N/A
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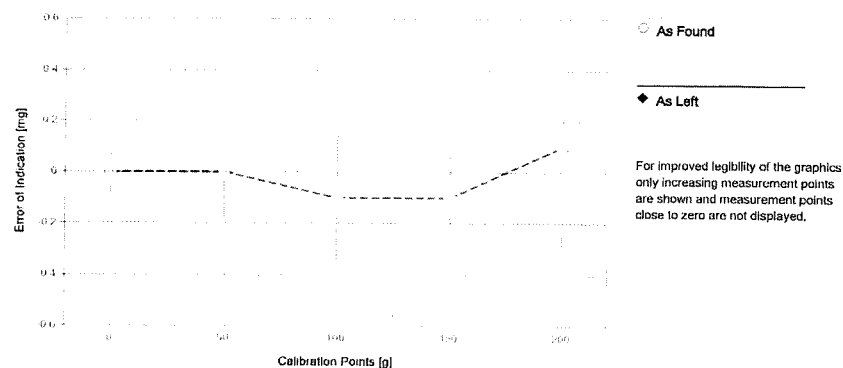
As Found

The "d" in the graph represents the readability of the range/interval in which the test was performed.

Error of Indication

As Found

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.0000 g	0.12 mg	2
2	0.0500 g	0.0500 g	0.0000 g	0.13 mg	2
3	0.1000 g	0.1000 g	0.0000 g	0.13 mg	2
4	0.5000 g	0.5000 g	0.0000 g	0.13 mg	2
5	1.0000 g	1.0000 g	0.0000 g	0.13 mg	2
6	5.0000 g	5.0000 g	0.0000 g	0.14 mg	2
7	10.0000 g	10.0000 g	0.0000 g	0.14 mg	2
8	50.0000 g	50.0000 g	0.0000 g	0.18 mg	2
9	99.9999 g	99.9998 g	-0.0001 g	0.24 mg	2
10	149.9999 g	149.9998 g	-0.0001 g	0.34 mg	2
11	199.9999 g	200.0000 g	0.0001 g	0.39 mg	2



The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor k – which can be larger than 2 according to EURAMET cg-18. The value of the measurand lies within the assigned range of values with a probability of approximately 95%.

The user is responsible for maintaining environmental conditions and the settings of the weighing instrument when it was calibrated.

Test Equipment

All weights used for metrological testing are traceable to national or international standards. The weights were calibrated and certified by an accredited calibration laboratory.

Weight Set 1: OIML E2

Weight Set No.: WS03 Date of Issue: 21-Sep-2021
Certificate Number: 175498 Calibration Due Date: 14-Mar-2023

Thermo Hygrometer

Equipment No.: IN281 Date of Issue: 25-May-2021
Certificate Number: 21H1100 Calibration Due Date: 10-May-2022

Remarks

FACT adjustment functionality activated

Equipment condition: Good

Next calibration according to customer's procedure

End of Accredited Section

The information below and any attachments to this calibration certificate are not part of the accredited calibration.

Measurement Uncertainty of the Weighing Instrument in Use

Stated is the expanded uncertainty with $k=2$ in use. The formula shall be used for the estimation of the uncertainty under consideration of the errors of indication. The value R represents the net load indication in the unit of measure of the device.

Temperature coefficient for the evaluation of the measurement uncertainty in use: $3.0 \cdot 10^{-6} / K$

Temperature range on site for the evaluation of the measurement uncertainty in use: 4 K

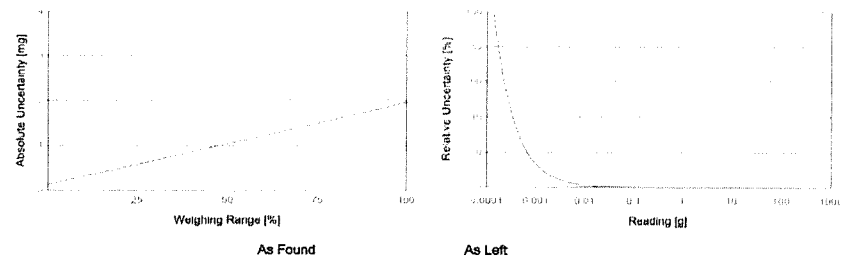
Linearization of Uncertainty Equation

Range	d		Max	As Found	As Left
	d	Max			
1	0.0001 g	220 g		$U_1 = 0.13 \text{ mg} + 0.00828 \text{ mg/g} \cdot R$	N/A

To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

Absolute and Relative Measurement Uncertainty in Use for Various Net Indications (Examples)

Net Indication	As Found		As Left	
0.0220 g	0.13 mg	0.59%	N/A	N/A
0.2200 g	0.13 mg	0.060%	N/A	N/A
2.2000 g	0.15 mg	0.0067%	N/A	N/A
22.0000 g	0.31 mg	0.0014%	N/A	N/A
220.0000 g	2.0 mg	0.00089%	N/A	N/A



GWP® Certificate



As
Found



As
Left



The weighing device meets the given
process requirements.

The weighing device meets the given
process requirements.

Tests Performed: ☒ As Found ☐ As Left ☒ No adjustments/modifications made. As Left results correspond to As Found.

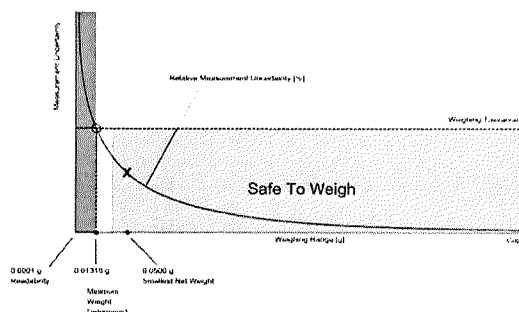
Process Requirements

Weighing Tolerance: 1%

Smallest Net Weight: 0.0500 g

Safety Factor: 2

Safe Weighing Range



While the values in this graph reflect the actual calibration results, the measurement uncertainty curves are simply a visual representation. This graph reflects As Left testing, unless only As Found was performed.

26-1-65

26-1-65

Minimum Weight

As Found Minimum Weight Table

Minimum weights for different weighing tolerances and safety factors					
Tolerance	Safety Factor				
	1	2	3	5	10
0.1%	0.13276 g	0.26775 g	0.40503 g	0.68670 g	1.43539 g
0.2%	0.06610 g	0.13276 g	0.19997 g	0.33610 g	0.68670 g
0.5%	0.02637 g	0.05284 g	0.07939 g	0.13276 g	0.26775 g
1%	0.01318 g	0.02637 g	0.03960 g	0.06610 g	0.13276 g
2%	0.00659 g	0.01318 g	0.01977 g	0.03298 g	0.06610 g
5%	0.00263 g	0.00527 g	0.00790 g	0.01318 g	0.02637 g

✓ Pass: The determined minimum weight meets the requirement for the smallest net weight.

As Left Minimum Weight Table

Minimum weights for different weighing tolerances and safety factors					
Tolerance	Safety Factor				
	1	2	3	5	10
0.1%	0.13276 g	0.26775 g	0.40503 g	0.68670 g	1.43539 g
0.2%	0.06610 g	0.13276 g	0.19997 g	0.33610 g	0.68670 g
0.5%	0.02637 g	0.05284 g	0.07939 g	0.13276 g	0.26775 g
1%	0.01318 g	0.02637 g	0.03960 g	0.06610 g	0.13276 g
2%	0.00659 g	0.01318 g	0.01977 g	0.03298 g	0.06610 g
5%	0.00263 g	0.00527 g	0.00790 g	0.01318 g	0.02637 g

✓ Pass: The determined minimum weight meets the requirement for the smallest net weight.

At these net minimum weight values, the measurement uncertainty of the weighing device is equal to or less than 1/1 (no safety factor), 1/2, 1/3, 1/5, or 1/10 of the required tolerance. The values are calculated with $k = 2$ and based on the linear formula of the measurement uncertainty of the weighing device in use.

The safety factor for As Found is always 1. This implies no safety factor. As Found testing looks at the behavior of the instrument from the past until test occurred. For the past, it is necessary to know that the tolerance was met, but not the safety factor. The safety factor is a proactive measure to apply for future measurements.

Notes on minimum weight values in above table:

1. If "N/A" is shown above, no appropriate value could be calculated.
2. METTLER TOLEDO is not responsible for the definition of the process requirements.

Measurement Results

Results Summary

	Repeatability	Eccentricity	Error of Indication
As Found	✓	✓	✓
As Left	✓	✓	✓

✓ = Passed

✗ = Failed

! = Safety Factor not met

Repeatability

Test Load: 100 g

Tolerance	Control Limit	As Found		As Left	
		Std. Deviation	Result	Std. Deviation	Result
0.1%	N/A		N/A		N/A
0.2%	0.00005 g		✓		✓
0.5%	0.00013 g	0.00005 g*	✓	0.00005 g*	✓
1%	0.00025 g		✓		✓
2%	0.00050 g		✓		✓
5%	0.00125 g		✓		✓

*The calculated standard deviation value is below the rounding error of the balance. The 0.41*d rule is used for the assessment of this repeatability test and the calculation of the minimum weight.

The weighing tolerance is met if the standard deviation is less than or equal to the corresponding control limit.

Eccentricity

Test Load: 100 g

Tolerance	Control Limit	As Found		As Left	
		Deviation	Result	Deviation	Result
0.1%	0.0500 g		✓		✓
0.2%	0.1000 g		✓		✓
0.5%	0.2500 g	0.0001 g	✓	0.0001 g	✓
1%	0.5000 g		✓		✓
2%	1.0000 g		✓		✓
5%	2.5000 g		✓		✓

The weighing tolerance is met if the deviation is less than or equal to the corresponding control limit.

Error of Indication

As Found

		Control limits for various weighing tolerances					
Reference Value	Error	0.1%	0.2%	0.5%	1%	2%	5%
0.0000 g	0.0000 g	N/A	N/A	N/A	N/A	N/A	N/A
50.0000 g	0.0000 g	0.0250 g	0.0500 g	0.1250 g	0.2500 g	0.5000 g	1.2500 g
99.9999 g	-0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
149.9999 g	-0.0001 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
199.9999 g	0.0001 g	0.1000 g	0.2000 g	0.5000 g	1.0000 g	2.0000 g	5.0000 g
Result		✓	✓	✓	✓	✓	✓

As Left

		Control limits for various weighing tolerances					
Reference Value	Error	0.1%	0.2%	0.5%	1%	2%	5%
0.0000 g	0.0000 g	N/A	N/A	N/A	N/A	N/A	N/A
50.0000 g	0.0000 g	0.0250 g	0.0500 g	0.1250 g	0.2500 g	0.5000 g	1.2500 g
99.9999 g	-0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
149.9999 g	-0.0001 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
199.9999 g	0.0001 g	0.1000 g	0.2000 g	0.5000 g	1.0000 g	2.0000 g	5.0000 g
Result		✓	✓	✓	✓	✓	✓

The weighing tolerance is met if the error (of indication) for each test point is less than or equal to the corresponding control limit for that particular weighing tolerance. Results at or close to the zero point cannot be assessed.

Service Date: 2022-01-19
Document Number: TH2065-164-011922-LABBalanceHR
ENVIRONMENT RESEARCH&TECHNOLOGY CO., LTD
25/114 Moo 6, Soi Chinakot 1, Ngamwongwan Rd., Toongsongho อ.บางบัวทอง, Laksi, Bangkok 10210
Ramita Taengthai

METTLER TOLEDO

Balance Health Report

Device Details

System Details			
Manufacturer:	Mettler Toledo	Accessory 1:	
Model:	MS204TS	Accessory 2:	
Serial number:	B547728937	Weight set for routine testing:	Yes /
Firmware:	3.50		

History


Device History		Service History	
Instrument in use:	Yes	Last preventive maintenance:	< 1 year
Instrument age:	3-10 years	Last instrument calibration:	< 1 year
Spare parts available:	Yes	Last minimum weight determination:	< 1 year
Regulations:	ISO		
Process tolerance in %:	1%	Routine testing performed:	Yes
Smallest sample net weight:	0.0500 g		

Check List

Environmental Conditions		General & Functional Checks	
Room temperature fluctuation	✓	Levelling	✓
Exposure to direct sun	✓	Cleanliness	✓
Vibrations	✓	Completeness - missing parts see additional remarks	✓
Draft	✓	Settings optimized for operating environment	✓
Dirt or dust	✓	Other - objections noted as additional remarks	—
Static	✓	Electrical Component Checks	
Mechanical Component Checks		Power supply	✓
Draft shield	✓	Sliding door drive	✓
Weighing pan position	✓	Internal weight drive	✓
Housing	✓	Display	✓
Other - objections noted as additional remarks	—	Other - objections noted as additional remarks	—

Recommendations

Measurement Result Quality		Process Efficiency	
Instrument calibration		Uninstall instrument	
Identify safe weighing range		Replace instrument	
GWP verification / risk assessment		Replace / add parts (see additional remarks)	
Preventive maintenance		Onsite repair	
Perform routine testing with test weights		Depot repair	
User training		Use of accessories (see additional remarks)	

Contact	Name: Ramita Taengthai	Position: N/A	Phone: 0866334400	Email: ramita@onviresearch.co.th
Additional Remarks & Recommendations		Engineer Details		
		Date:	19-Jan-2022	
		Name:	Suwicha Choykamchu	
		Signature:		

This is not a certificate.

It should not be used to interpret final results for the testing of these devices.

Legend: ✓ Good/Pass ⚠ Needs Attention ✗ Bad/Fail — Not Applicable

26-1-65

26-1-65



Inctech Metrological Center Co.Ltd.
39/1 Soi 82, Sukhapiban 5 Rd., O ngoen,
Saimai, Bangkok 10220, Thailand
Tel. (662) 909-8820 (Auto 10 lines) www.imcinstrument.com



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39/1 Soi 82, Sukhapiban 5 Rd., O ngoen,
Saimai, Bangkok 10220, Thailand
Tel. (662) 909-8820 (Auto 10 lines) www.imcinstrument.com



Certificate No. : MT22-1359
Page : 2 of 4

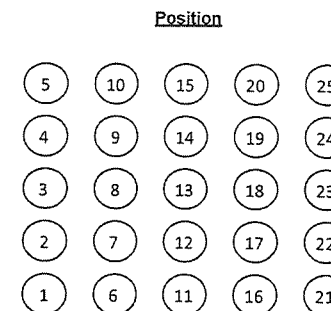
Certificate of Calibration

Customer : Environment Research & Technology Co.,Ltd.
Address : 25/114 M.6 Soi Chinaket 1, Ngamwongwan Rd., Toongsonghong, Laksi Bangkok 10210

Description : Heating Block
Manufacturer : Hanna
Model : HI 839800-02
Serial No. : 05220025101
Identification No. : ERTC-L-In-165
Calibration Place : Temperature Laboratory

Order No. : 0149/22
Received date : Jan 14, 2022
Calibration date : Jan 18, 2022
Environment Condition :
Temperature : (23+/-3) °C
Humidity : (50+/-15) %RH

Calibration Method : Calibration were conducted using In-house calibration procedure CP-MT-009 According to comparison with LXI Data Acquisition Switch Unit.



↑
Top view

Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
LXI Data Acquisition Switch Unit with RTD Sensor	34972A	MY57003222	MT21-5866	Oct 11, 2022

Function : Temperature measurement (Cont.)
Calibration point : 105, 150 °C
Immersion depth : 50 mm.

Result : Without adjustment

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

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

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

Position No.	UUC* setting (°C)	Standard reading (°C)	UUC* correction (°C)	Uncertainty of measurement (+/- °C)
1	105	104.622	-0.378	0.17
2	105	104.536	-0.464	0.17
3	105	104.661	-0.339	0.17
4	105	104.742	-0.258	0.17
5	105	104.488	-0.512	0.17
6	105	104.392	-0.608	0.17
7	105	104.551	-0.449	0.17
8	105	104.532	-0.468	0.17
9	105	104.448	-0.552	0.17
10	105	104.395	-0.605	0.17
11	105	104.530	-0.470	0.17
12	105	104.648	-0.352	0.17
13	105	105.110	0.110	0.17
14	105	105.241	0.241	0.17
15	105	105.109	0.109	0.17

UUC* = Unit under calibration

Calibrated by : Miss Jarunee Tubsay
Issue date : Jan 18, 2022

Approved by : (Mr.Panuwat Phukan)

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



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39/1 Soi 82, Sukhapiban 5 Rd., O ngoen,
Saimai, Bangkok 10220, Thailand
Tel. (662) 909-8820 (Auto 10 lines) www.imcinstrument.com



Certificate No. : MT22-1359
Page : 3 of 4

Function : Temperature measurement Result : Without adjustment
Calibration point : 105, 150 °C
Immersion depth : 50 mm.

Position No.	UUC* setting (°C)	Standard reading (°C)	UUC* correction (°C)	Uncertainty of measurement (+/- °C)
16	105	104.521	-0.479	0.17
17	105	104.633	-0.367	0.17
18	105	105.114	0.114	0.17
19	105	105.228	0.228	0.17
20	105	104.821	-0.179	0.17
21	105	104.648	-0.352	0.17
22	105	104.652	-0.348	0.17
23	105	104.533	-0.467	0.17
24	105	104.482	-0.518	0.17
25	105	104.421	-0.579	0.17

Function : Temperature measurement (Cont.) Result : Without adjustment
Calibration point : 105, 150 °C
Immersion depth : 50 mm.

Position No.	UUC* setting (°C)	Standard reading (°C)	UUC* correction (°C)	Uncertainty of measurement (+/- °C)
1	150	149.354	-0.646	0.17
2	150	149.542	-0.458	0.17
3	150	149.368	-0.632	0.17
4	150	149.554	-0.446	0.17
5	150	149.635	-0.365	0.17
6	150	149.582	-0.418	0.17
7	150	149.688	-0.312	0.17
8	150	149.624	-0.376	0.17
9	150	149.522	-0.478	0.17
10	150	149.501	-0.499	0.17
11	150	150.114	0.114	0.17
12	150	150.201	0.201	0.17
13	150	150.118	0.118	0.17
14	150	150.109	0.109	0.17
15	150	150.111	0.111	0.17

UUC* = Unit under calibration

25-1-65



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39/1 Soi 82, Sukhapiban 5 Rd., O ngoen,
Saimai, Bangkok 10220, Thailand
Tel. (662) 909-8820 (Auto 10 lines) www.imcinstrument.com



Certificate No. : MT22-1359
Page : 4 of 4

Function : Temperature measurement Result : Without adjustment
Calibration point : 105, 150 °C
Immersion depth : 50 mm.

Position No.	UUC* setting (°C)	Standard reading (°C)	UUC* correction (°C)	Uncertainty of measurement (+/- °C)
16	150	149.902	-0.098	0.17
17	150	149.745	-0.255	0.17
18	150	149.702	-0.298	0.17
19	150	149.828	-0.172	0.17
20	150	149.741	-0.259	0.17
21	150	149.822	-0.178	0.17
22	150	149.836	-0.164	0.17
23	150	149.878	-0.122	0.17
24	150	149.802	-0.198	0.17
25	150	149.798	-0.202	0.17

UUC* = Unit under calibration

-oOo-

25-1-65

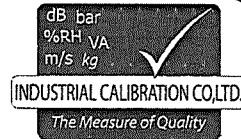
Industrial Calibration Co., Ltd.

38/41 Moo. 3, Lum Luk Ka Road., Khu Khot Subdistrict,
Lam Luk Ka District, Phatum Thani 12130 Thailand.

Tel : +66 (02) 991 0440

Fax : +66 (02) 531 6294

Email : info@industrial.co.th



CERTIFICATE No.CAL03002-22..... PAGE1..... OF2.....

Certificate of Calibration

Equipment : EC/ TDS/ TEMPERATURE METER

Manufacture : HM DIGITAL

Model / Type : COM-100

Serial No. : PONPE5851661

ID No. : N/A

Customer : Environment Research & Technology Co., Ltd.

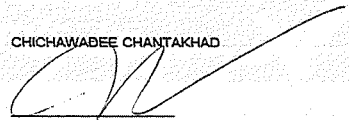
25/114 Moo 6, Soi Chinnaket 1, Ngamwongwan Road., Tungsohong, Laksi, Bangkok 10210

Environment: 25 +/- 3°C (IN-HOUSE); 50 +/- 20%RH

Date Of Receipt : MAR 1, 2022

Date Of Calibration : MAR 3, 2022

Calibration By : CHICHAWADEE CHANTAKHAD

Approved By : 
(CHINNAWAT DUMPUT)

Date of Issue : MAR 3, 2022

MEASUREMENT UNCERTAINTY :

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR $k = 2$, WHICH EFFECTIVE DEGREE OF FREEDOM $V_{eff} > 100$ CORRESPONDS A LEVEL OF CONFIDENCE OF APPROXIMATELY 95 %

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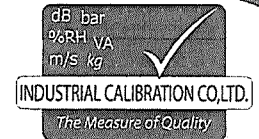
Industrial Calibration Co., Ltd.

38/41 Moo. 3, Lum Luk Ka Road., Khu Khot Subdistrict,
Lam Luk Ka District, Phatum Thani 12130 Thailand.

Tel : +66 (02) 991 0440

Fax : +66 (02) 531 6294

Email : info@industrial.co.th



CERTIFICATE No.CAL03002-22..... PAGE2..... OF2.....

Calibration Report

ORDER No. 2009-066

RECEIVED DATE : MAR 1, 2022

CALIBRATION DATE : MAR 3, 2022

DESCRIPTION:		MANUFACTURER:	
EC/ TDS/ TEMPERATURE METER		HM DIGITAL	
MODEL:	SERIAL No.	IDENTIFICATION No:	MADE IN :
COM-100	PONPE5851661	N/A	N/A
CALIBRATION METHOD :			
THIS INSTRUMENT WAS CALIBRATED BY COMPARISON WITH STANDARD BUFFER SOLUTION IN-HOUSE METHOD			
REFERENCE STANDARD :			
DESCRIPTION :	MODEL	S/N No.	CERTIFICATE No.
STANDARD BUFFER SOLUTION	ECCON1413BT	01X211207	060/01

TRACEABILITY:

THE CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT: NIST
-NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

RANGE : 1413 μ S

RESOLUTION : 1 μ S

FUNTION : CONDUCTIVITY MEASUREMENT

CALIBRATION	STANDARD	UUC*	UUC*	UNCERTAINTY
POINT	SETTING CONDUCTIVITY	READING	CORRECTION	MASUREMENT
(μ S)	(μ S)	(μ S)	(μ S)	(μ S)
1413	1413	1420	-7	12

REMARK : UUC* UNIT UNDER CALIBRATION

- END OF CERTIFICATE -



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22TM151

Page.: 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven
Manufacturer : Binder
Model : FED 115 E2
Serial No. : 11-22823
ID No. : ERTC-L-In.-076
Submitted by : Environment Research & Technology Company Limited
25/114 Moo 6 Soi Chinaket 1,
Ngamwongwan Road, Toongsonghong, Laksi,
Bangkok 10210
Location : Laboratory (ERTC)
Received Order : 5 January 2022
Calibration Date : 5 January 2022
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Man Pattanapongpaiboon

Approved by :

Man
Approved Signatory

(/) Pornthippa Tameyakul
(✓) Malee Butkruea
() Suwit Imjai

Issue Date : 21 January 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.

2b-1-65

A 0036818



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2201-0006ON-2

Cert. No.: 22TM151

Page.: 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34970A	MY44031769	21LM12	02 Sep 2022

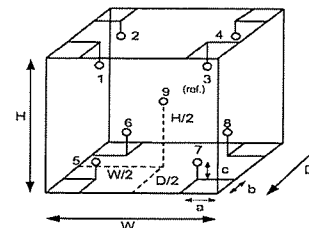
2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Environment during calibration		
	Beginning	Finished
Temp. (°C)	27	27
REL.Humid. (%)	54	58
AC Supply (Volt)	219	222

Probe Installation Details :

a =	5.0	cm	D =	0.40	m
b =	5.0	cm	W =	0.60	m
c =	5.0	cm	H =	0.48	m
			Capacity =	0.12	m ³

Ref. Std. ID No.: @ Calibration Point		
Position :	(180) °C	(104) °C
1	20-09TC-01	9RTD-2/1
2	20-09TC-02	9RTD-2/2
3	20-09TC-03	9RTD-2/3
4	20-09TC-04	9RTD-2/4
5	20-09TC-05	9RTD-2/5
6	20-09TC-06	9RTD-2/6
7	20-09TC-07	9RTD-2/7
8	20-09TC-08	9RTD-2/8
9 (ref.)	20-09TC-09	9RTD-2/9

Man
2b-1-65

a 1090220



Equipment : Hot Air Oven
 Condition As-Received : Used Item
 Reference : 2201-0006ON-2
 Result of Calibration :- (*) Without Adjustment
 Function of UUC* : Temperature Source
 Fresh air setting : Close

Cert. No.: 22TM151
 Page.: 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
104	104	104	0.11	1.1	1.4	0.69	2
180	180	180	0.43	3.3	5.6	1.5	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
104	103.167	102.948	104.098	104.155	104.013	103.198	103.619	103.294	103.159
180	177.080	177.342	181.816	181.065	179.474	177.914	181.064	179.354	178.751

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

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.

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

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
 CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
 534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
 TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22TM152
 Page.: 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven
 Manufacturer : Memmert
 Model : UF 110
 Serial No. : B414.0652
 ID No. : ERTC-L-In.-098
 Submitted by : Environment Research & Technology Company Limited
 25/114 Moo 6 Soi Chinaket 1,
 Ngamwongwan Road, Toongsonghong, Laksi,
 Bangkok 10210
 Location : Laboratory (ERTC)
 Received Order : 5 January 2022
 Calibration Date : 5 January 2022
 Ambient Temperature : (26 ± 10) °C
 Relative Humidity : (50 ± 30) %
 Calibrated by : Man Pattanapongpaiboon

Approved by :
 Approved Signatory

() Pornthippa Tameyakul
 (/) Malee Butkruea
 () Suwit Imjai

Issue Date : 21 January 2022

The Uncertainties are for a confidence probability of approximately 95%

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 Approval of the head of Corporate Services 3 : Equipment Calibration and Testtime Services.

24-1-65

a 1090219

24-1-65

A 0036819



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2201-0006ON-3

Cert. No.: 22TM152
Page.: 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34970A	MY44031769	21LM12	02 Sep 2022

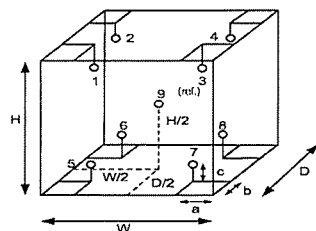
2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Environment during calibration		
	Beginning	Finished
Temp. (°C)	27	27
REL.Humid. (%)	54	58
AC Supply (Volt)	219	222

Ref. Std. ID No.: @ Calibration Point		
Position :	(180) °C	(104) °C
1	20-09TC-01	9RTD-2/1
2	20-09TC-02	9RTD-2/2
3	20-09TC-03	9RTD-2/3
4	20-09TC-04	9RTD-2/4
5	20-09TC-05	9RTD-2/5
6	20-09TC-06	9RTD-2/6
7	20-09TC-07	9RTD-2/7
8	20-09TC-08	9RTD-2/8
9 (ref.)	20-09TC-09	9RTD-2/9

Probe Installation Details : Dimension of Chamber :

a =	5.0	cm	D =	0.40	m
b =	5.0	cm	W =	0.56	m
c =	5.0	cm	H =	0.48	m
			Capacity =	0.11	m ³

26-1-63 Maku.

a 1090218



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2201-0006ON-3
Result of Calibration :- (*) Without Adjustment

Cert. No.: 22TM152
Page.: 3 of 3

Function of UUC* : Temperature Source

Fresh air setting : Close

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor k
104.0	104.0	104.0	0.11	1.0	1.9	0.42	2
180.0	180.0	180.0	0.51	2.3	4.2	1.2	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
104.0	1	2	3	4	5	6	7	8	9 (ref.)
180.0	105.219	103.394	103.908	104.133	104.348	104.096	103.878	104.103	104.360
	182.291	178.691	178.879	180.031	180.761	180.026	180.572	180.044	180.253

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

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.

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

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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

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26-1-63 Maku.

a 1090217



Document Type	Calibration Certificate (CC)
Description	CC for 930 Compact IC Flex
Document ID	CC.930 Version 1.0 / 8.930.3002EN

Metrohm

Compliance Service

Calibration Certificate (CC) for 930 Compact IC Flex

Instrument details

Type:	1.930.2560
Serial No.:	221307/ME (1930200024120)
Manufacturer:	Metrohm AG Ionenstrasse CH-8100 Herisau Switzerland
Customer instrument ID:	N/A
System Designation Number:	CAL220387/ME

Customer details

Name of company:	Environment Research & Technology Company Limited
Address:	25/114 Moo 6 Soi Chinaket 1, Ngamwongwan Road, Toongsonghong, Laksi, Bangkok 10210
Department:	Laboratory
Responsible person:	ดร.วิมลวรรณ วัฒนพานิช
Calibration place:	Laboratory Environment Research & Technology Company Limited

Date and time of calibration:	07/06/2022 - 08:45
-------------------------------	--------------------



Document Type	Calibration Certificate (CC)
Description	CC for 930 Compact IC Flex
Document ID	CC.930 Version 1.0 / 8.930.3002EN

Calibration Certificate (CC)

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 Calibration Certificate (CC) 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

Protocol

	Yes	No
Instrument had to be repaired beforehand	<input type="checkbox"/>	<input checked="" type="checkbox"/>
If yes, see Calibration Certificate (CC) No.:		
Instrument had to be readjusted beforehand	<input type="checkbox"/>	<input checked="" type="checkbox"/>
If yes, see Calibration Certificate (CC) No.:		



Document Type Calibration Certificate (CC)
Description CC for 930 Compact IC Flex
Document ID CC.930 Version 1.0 / 8.930.3002EN

Conclusion of test results

	Yes	No
Instrument satisfies the specified technical requirements	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Recommended date for next maintenance:		

Comments

Metrohm representative

	Yes	No
Metrohm representative confirms correct execution of instrument calibration	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Date	Name	Signature
07/06/2022	Mr.Prutchaya Kumparee	<i>Prutchaya K.</i>

Customer representative

	Yes	No
Customer representative accepts results of instrument calibration	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Date	Name	Signature
07/06/2022	คุณสมชาย คุมปะเร	<i>สมชาย คุมปะเร</i>



Document Type Calibration Certificate (CC)
Description CC for 930 Compact IC Flex
Document ID CC.930 Version 1.0 / 8.930.3002EN

Test results

Module	Module Calibration Certificate No.	Pass		
		Yes	No	N/A
930 Basic unit	221307/ME (24120)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Professional IC pump	221307/ME (29512)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Professional Injector / Valve	221307/ME (25047)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Professional Degasser	221307/ME (24427)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Professional Peristaltic pump	221307/ME (23748)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Professional MSM	221307/ME (05503)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Professional MCS	221307/ME (24570)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CC.930 Document History

Date	Article no.	Author	Description/Changes
24.05.2013	8.930.3002EN	Stephan Wohlwender	Creation

End of CC Document



Document Type	Calibration Certificate (CC)
Description	CC for 930 Basic unit
Document ID	CC.930 Basic unit Version 1.0 / 8.930.3001EN

Metrohm Compliance Service

Module Calibration Certificate (CC) for 930 Basic unit

Module

Assembly No.:	3.940.1200
Serial No.:	221307/ME (24120)
Firmware:	5.940.0101
Date and time of calibration:	07/06/2022 - 08:45

Instrument

Type:	1.930.2560
Serial No.:	1930200024120
System Designation Number:	CAL220387/ME

Declaration

Document

Test instructions used:	C.1 Test instructions for 930 Basic unit, Version 1.0
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Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date
Multimeter	Fluke	68-490190	E1U222184	25/05/2023
Temperature meas. Instr.	DTM3000	3332/T19	TMU211732	16/06/2022

System Designation Number: CAL220387/ME
Calibration Certificate (CC)No.: 221307/ME (24120) - 07/06/2022 - 08:45

Page 1 of 3



Document Type	Calibration Certificate (CC)
Description	CC for 930 Basic unit
Document ID	CC.930 Basic unit Version 1.0 / 8.930.3001EN

Test results

No.	Title	Comments	Pass		N/A
			Yes	No	
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"/>

System Designation Number: CAL220387/ME
Calibration Certificate (CC)No.: 221307/ME (24120) - 07/06/2022 - 08:45

Page 2 of 3

No.	Title	Comments	Pass				
			Yes	No	N/A		
109	Column heater (optional)						
109.1 Temperature absolute							
		Nominal value [°C]	Measured value [°C]	Tolerance [°C]			
	Set temperature	35.0	35.4	± 0.5	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
109.2 Temperature stability							
		Maximum t [°C]	Minimum t [°C]	Tolerance [°C]			
		35.005	34.986	<0.05	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CC.930 Basic unit Document History

Date	Article no.	Author	Description/Changes
24.05.2013	8.930.3001EN	Stephan Wohlwender	Creation

End of CC Document

Metrohm Compliance Service

Module Calibration Certificate (CC) for Professional Degasser

Module

Assembly No.:	3.850.3410
Serial No.:	221307/ME (24427)
Date and time of calibration:	07/06/2022 - 08:45

Instrument

Type:	1.930.2560
Serial No.:	1930200024120
System Designation Number:	CAL220387/ME

Declaration

Document

Test instructions used:	C.1 Test instructions for Professional Degasser, Version 1.0
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Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date



Document Type	Calibration Certificate (CC)
Description	CC for Professional Degasser
Document ID	CC.Professional Degasser Version 1.0 / 8.940.3004EN

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Communication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101	Vacuum build-up		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CC.Professional Degasser Document History

Date	Article no.	Author	Description/Changes
21.05.2013	8.940.3004EN	Stephan Wohlwender	Creation

End of CC Document



Document Type	Calibration Certificate (CC)
Description	CC for Professional Injector / Valve
Document ID	CC.Professional Injector / Valve Version 1.0 / 8.940.3003EN

Metrohm Compliance Service

Module Calibration Certificate (CC) for Professional Injector / Valve

Module

Assembly No.:	3.850.3060
Serial No.:	21307/ME (25047)
Date and time of calibration:	07/06/2022 - 08:45

Instrument

Type:	1.930.2560
Serial No.:	1930200024120
System Designation Number:	CAL220387/ME

Declaration

Document

Test instructions used:	C.1 Test Instructions for Professional Injector / Valve, Version 1.0
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Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date



Document Type	Calibration Certificate (CC)
Description	CC for Professional Injector / Valve
Document ID	CC.Professional Injector / Valve Version 1.0 / 8.940.3003EN

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Communication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101	Switching operation		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CC.Professional Injector / Valve Document History

Date	Article no.	Author	Description/Changes
21.05.2013	8.940.3003EN	Stephan Wohlwender	Creation

End of CC Document



Document Type	Calibration Certificate (CC)
Description	CC for Professional MCS
Document ID	CC.Professional MCS Version 1.0 / 8.940.3005EN

Metrohm Compliance Service

Module Calibration Certificate (CC) for Professional MCS

Module

Assembly No.:	3.850.3410
Serial No.:	221307/ME (24570)
Date and time of calibration:	07/06/2022 - 08:45

Instrument

Type:	1.930.2560
Serial No.:	1930200024120
System Designation Number:	CAL220387/ME

Declaration

Document

Test instructions used:	C.1 Test instructions for Professional MCS, Version 1.0
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Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date
Flow meter	ANALYT-MTC	94308	AD2201-280-0001	31/01/2023



Document Type Calibration Certificate (CC)
Description CC for Professional MCS
Document ID CC.Professional MCS Version 1.0 / 8.940.3005EN

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Communication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101	Vacuum build-up		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title		Pass		
			Yes	No	N/A
102	Air flow without cartridge		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Nominal value [sccm]			
		10.0 – 15.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title		Pass		
			Yes	No	N/A
103	Air flow with cartridge		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Nominal value [sccm]			
		>8.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CC.Professional MCS Document History

Date	Article no.	Author	Description/Changes
21.05.2013	8.940.3005EN	Stephan Wohlwender	Creation

End of CC Document

System Designation Number: CAL220387/ME
Calibration Certificate (CC)No.: 221307/ME (24570) - 07/06/2022 - 08:45

Page 2 of 2



Document Type Calibration Certificate (CC)
Description CC for Professional Peristaltic pump
Document ID CC.Professional Peristaltic pump Version 1.0 / 8.940.3007EN

Metrohm Compliance Service

Module Calibration Certificate (CC) for Professional Peristaltic pump

Module

Assembly No.:	3.850.3200
Serial No.:	221307/ME (23748)
Date and time of calibration:	07/06/2022 - 08:45

Instrument

Type:	1.930.2560
Serial No.:	1930200024120
System Designation Number:	CAL220387/ME

Declaration

Document

Test instructions used:	C.1 Test instructions for Professional Peristaltic pump, Version 1.0
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Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date

System Designation Number: CAL220387/ME
Calibration Certificate (CC)No.: 221307/ME (23748) - 07/06/2022 - 08:45

Page 1 of 2

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Communication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101	Rotation CW		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
102	Rotation CCW		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
103	Speed control		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CC.Professional Peristaltic pump Document History

Date	Article no.	Author	Description/Changes
21.05.2013	8.940.3007EN	Stephan Wohlwender	Creation

End of CC Document

Metrohm Compliance Service

Module Calibration Certificate (CC) for Professional IC pump

Module

Assembly No.:	3.850.3000
Serial No.:	221307/ME (29512)
Date and time of calibration:	07/06/2022 - 08:45

Instrument

Type:	1.930.2560
Serial No.:	1930200024120
System Designation Number:	CAL220387/ME

Declaration

Document

Test instructions used:	C.1 Test instructions for Professional IC pump, Version 1.0
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Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date
High pressure gauge	Metrohm	05108	CAL0252-21Q0119	22/09/2022

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Installation		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101	Communication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
102	Pump head detection		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
103	Deaerate		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
104	Pump dynamics		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title		Maximum [MPa]	Minimum [MPa]	Difference [%]	Pass		
						Yes	No	N/A
105	Pulsation							
	Standard pump head		11.02	10.74	<5.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Macro pump head		N/A	N/A	<10.0	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Pass

No.	Title		Nominal value [MPa]	Measured value [MPa]	Tolerance [%]	Pass		
						Yes	No	N/A
106	Pressure transducer							
			10.91	11	± 10.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title		Nominal value [mL]	Measured value [mL]	Tolerance [mL]	Pass		
						Yes	No	N/A
107	Flow rate							
	Standard pump head		4.0	4.1	± 0.2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Macro pump head		20.0	N/A	± 1.0	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

No.	Title	Comments	Pass		
			Yes	No	N/A
108	Shut off at minimum pressure		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
109	Shut off at maximum pressure		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title		Maximum [MPa]	Minimum [MPa]	Difference [MPa]	Pass		
						Yes	No	N/A
110	Leak test							
			18.45	17.95	<1.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CC.Professional IC pump Document History

Date	Article no.	Author	Description/Changes
21.05.2013	8.940.3002EN	Stephan Wohlwender	Creation

End of CC Document



Document Type	Calibration Certificate (CC)
Description	CC for Professional MSM
Document ID	CC.Professional MSM Version 1.0 / 8.940.3006EN

Metrohm Compliance Service

Module Calibration Certificate (CC) for Professional MSM

Module

Assembly No.:	3.940.3000
Serial No.:	221307/ME (05503)
Date and time of calibration:	07/06/2022 - 08:45

Instrument

Type:	1.930.2560
Serial No.:	1930200024120
System Designation Number:	CAL220387/ME

Declaration

Document

Test instructions used:	C.1 Test instructions for Professional MSM, Version 1.0
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Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date



Document Type	Calibration Certificate (CC)
Description	CC for Professional MSM
Document ID	CC.Professional MSM Version 1.0 / 8.940.3006EN

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Communication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101	Switching operation		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CC.Professional MSM Document History

Date	Article no.	Author	Description/Changes
21.05.2013	8.940.3006EN	Stephan Wohlwender	Creation

End of CC Document



Document Type	Calibration Certificate (CC)
Description	CC for 850.9010 Conductivity Detector
Document ID	CC.850 Version 1.3 / 8.850.3022EN

Metrohm Compliance Service

Calibration Certificate (CC) for 850.9010 Conductivity Detector

Instrument details

Type:	18509010
Serial No.:	221308/ME (1850901042128)
Manufacturer:	Metrohm AG, Ionenstrasse, CH-9100 Herisau Switzerland
Customer instrument ID:	N/A
System Designation Number:	CAL220387/ME

Control device details

Type:	1.930.2560
Serial No.:	1930200024120
Firmware:	5.940.0101

Customer details

Name of company:	Environment Research & Technology Company Limited
Address:	25/114 Moo 6 Soi Chinaket 1, Ngamwongwan Road, Toongsonghong, Laksi, Bangkok 10210
Department:	Laboratory
Responsible person:	คุณสุภากร นามะกุล
Calibration place:	Laboratory Environment Research & Technology Company Limited

Date and time of calibration:	07/06/2022 - 08:45
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System Designation Number: CAL220387/ME
Calibration Certificate (CC) No.: 221308/ME (1850901042128) - 07/06/2022 - 08:45



Document Type	Calibration Certificate (CC)
Description	CC for 850.9010 Conductivity Detector
Document ID	CC.850 Version 1.3 / 8.850.3022EN

Calibration Certificate (CC)

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 Calibration Certificate (CC) 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 850.9010 Conductivity Detector, Version 1.3
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Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date
Temperature meas. instr.	DTM3000	3332/T19	TMU211732	16/06/2022
Conductivity standard (opt.)	Metrohm	21190059	12-0187	25/09/2022

Protocol

	Yes	No
Instrument had to be repaired beforehand	<input type="checkbox"/>	<input checked="" type="checkbox"/>
If yes, see Calibration Certificate (CC) No.:		
Instrument had to be readjusted beforehand	<input type="checkbox"/>	<input checked="" type="checkbox"/>
If yes, see Calibration Certificate (CC) No.:		

System Designation Number: CAL220387/ME
Calibration Certificate (CC) No.: 221308/ME (1850901042128) - 07/06/2022 - 08:45



Document Type Calibration Certificate (CC)
Description CC for 850.9010 Conductivity Detector
Document ID CC.850 Version 1.3 / 8.850.3022EN

Conclusion of test results

Instrument satisfies the specified technical requirements

Yes ☒ No ☐

Recommended date for next maintenance:

Comments

Metrohm representative

Metrohm representative confirms correct execution of instrument calibration

Yes ☒ No ☐

Date Name Signature
07/06/2022 Mr.Prutchaya Kumpairee Prutchaya K.

Customer representative

Customer representative accepts results of instrument calibration

Yes ☒ No ☐

Date Name Signature
07/06/2022 นายประจักษ์ คุ้มไพเร่ ศิวะ คุ้มไพเร่



Document Type Calibration Certificate (CC)
Description CC for 850.9010 Conductivity Detector
Document ID CC.850 Version 1.3 / 8.850.3022EN

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Communication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title		Nominal value [°C]	Measured value [°C]	Tolerance [°C]	Pass		
						Yes	No	N/A
101	Temperature absolute	Temperature 1	34.996	35.4	± 1.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Temperature 2	40.001	40.1	± 1.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title		Maximum t [°C]	Minimum t [°C]	Difference [°C]	Pass		
						Yes	No	N/A
102	Temperature stability		40.001	39.998	< 0.010	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title		Drift compensated [nS/cm]	Tolerance [nS/cm]	Pass		
					Yes	No	N/A
103	Signal noise	1 M	0.251	< 0.4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		20 k 5	4.386	< 10.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title	Comments	Pass		
			Yes	No	N/A
104	Conductivity dry test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title		Pass		
			Yes	No	N/A
105	Conductivity cell (optional)				
105.1	System installation and preparation		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
105.2	Write a method		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
105.3	Measurement				
	Nominal value [µS/cm]	Measured value [µS/cm]			
	91.32	92.31	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Tolerance [%]			
		± 10			

CC.850 Document history

Date	Article No.	Author	Description/Changes
26.04.2012	8.850.3022EN	Philipp Rüegg	Layout adapted to Metrohm Compliance Service

End of CC Document

Metrohm Compliance Service

Calibration Certificate (CC) for 863 Compact Autosampler

Instrument details

Type:	18630010
Serial No.:	221309/ME (1863001022147)
Manufacturer:	Metrohm AG Ionenstrasse CH-9100 Herisau Switzerland
Firmware:	5.863.0022
Customer instrument ID:	N/A
System Designation Number:	CAL220387/ME

Customer details

Name of company:	Environment Research & Technology Company Limited
Address:	25/114 Moo 6 Soi Chinaket 1, Ngamwongwan Road, Toongsonghong, Laksi, Bangkok 10210
Department:	Laboratory
Responsible person:	นายสุวิทย์ วัฒนศิริ
Calibration place:	Laboratory Environment Research & Technology Company Limited

Date and time of calibration: 07/06/2022 - 11:15



Document Type Calibration Certificate (CC)
Description CC for 863 Compact Autosampler
Document ID CC.863 Version 1.0 / 8.863.3003EN

Calibration Certificate (CC)

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 Calibration Certificate (CC) 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 863 Compact Autosampler, Version 1.0

Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date
Multimeter	Fluke	88450190	E1U222184	25/05/2023

Protocol

	Yes	No
Instrument had to be repaired beforehand If yes, see Calibration Certificate (CC) No.:	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Instrument had to be readjusted beforehand If yes, see Calibration Certificate (CC) No.:	<input type="checkbox"/>	<input checked="" type="checkbox"/>



Document Type Calibration Certificate (CC)
Description CC for 863 Compact Autosampler
Document ID CC.863 Version 1.0 / 8.863.3003EN

Conclusion of test results

	Yes	No
Instrument satisfies the specified technical requirements	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Recommended date for next maintenance:		

Comments

Metrohm representative

	Yes	No
Metrohm representative confirms correct execution of instrument calibration	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Date	Name	Signature
07/06/2022	Mr.Prutchaya Kumparee	Prutchaya K.

Customer representative

	Yes	No
Customer representative accepts results of instrument calibration	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Date	Name	Signature
07/06/2022	นายประจักษ์ คุ้มประวีร์	นายประจักษ์ คุ้มประวีร์

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Visual check		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101	Safety check		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
102	Getting started (system self test)		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
103	Serial number, date and time check		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
104	Prepare the instrument for diagnosis		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
105	Display test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
106	Keyboard test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
107	Prepare the instrument for service		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
108	Contrast test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
109	Remote test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title	Comments	Pass		
			Yes	No	N/A
110	RS bridge test (USB-RS232-bridge)		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	RS-232/1		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	RS-232/2		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title	Comments	Pass		
			Yes	No	N/A
111	Table test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
112	Lift test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
113	Peristaltic pump test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
115	Test end		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CC.863 Document history

Date	Article No.	Author	Description/Changes
03.08.2011	8.863.3003EN	Giuseppe Conte	Layout adapted to Metrohm Compliance Service

End of CC document



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CERTIFICATE OF CALIBRATION

Issue Date : 28 December 2021
Certificate No. : 21-1224-004
Work Order No. : 21/1224

Customer Name : Environment research & Technogy Co., Ltd.
25/114 Moo6 Soi Chinaket1, Ngamwongwan Road,
Toongsonghong, Laksi, Bangkok 10210
Date of Received : 15 December 2021
Date of Calibration : 15 December 2021

Instrument Details : Description : Temperature Controlled Enclosures [Incubator]
Manufacturer : Accuplus
Model : Smart i250
Serial No. : 2059-0218-0002
ID No. : ERTC-L-IN-143
Resolution : 0.1 °C
Location : Laboratory

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

Environmental Conditions :

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

Traceability of Measurement :

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

Calibrated by : Mr. Sitthisak Tonglim
Calibration Engineer
Approved by :
(Mr. Anuwat Yaklermjit)
Laboratory Manager

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Crystal Calibration Sales and Service Co., Ltd.

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45/48 Soi Salathammassop31, Salathammassop Rd.,
Salathammassop, Thawewatthana, Bangkok 10170 Thailand

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



CERTIFICATE OF CALIBRATION

Issue Date : 28 December 2021
Certificate No. : 21-1224-004
Work Order No. : 21/1224

Details of Calibration

1. Reference Standards Instrument

Instrument	Model	Serial No./Ins No.	Certificate No.	Due Date
Data Acquisition unit	34972A	MY57006241	21-719-014	03 September 2022
Sensor type	RTD	RTD# 101-109	21-719-014	03 September 2022

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

3. Condition of item : Used

4. Calibration site : On - Site

5. Result of Calibration : Without adjustment

6. Evaluate Condition : Time Constant : - Hour 50 Minute At cal. point 20 °C
Air vent : Off
Fan speed status : Fixed Fan Speed

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

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

9. Dimensions of chamber : W = 0.5 m ; D = 0.5 m ; H = 0.9 m

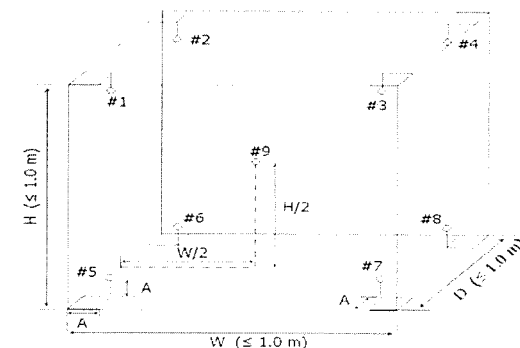


Diagram of Chamber

15-1-65
PAGE 2/3



CRYSTAL CALIBRATION SALES AND SERVICE CO., LTD.

45/48 Soi Salathammasop31, Salathammasop Rd.,

Salathammasop, Thawewatthana, Bangkok 10170 Thailand

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



CERTIFICATE OF CALIBRATION

Certificate No. : 21-1224-004

Issue Date : 28 December 2021

Work Order No. : 21/1224

Result of Temperature Distribution and Performance Check

Table1 : Reporting of Temperature Distribution

Calibration point (°C)	Average Measured Temperature (°C) @ Sensor No. (Sensor No.9 is REF)									Uncertainty ± (°C)
	#1	#2	#3	#4	#5	#6	#7	#8	#9	
20.0	20.26	20.08	20.22	20.11	20.18	20.12	20.09	20.16	19.91	0.60

Table 2 : Reporting of Performance check

Indicator Set Point (°C)	Indicator Reading (°C)			Stability ± (°C)	Uniformity (°C)	Overall variation (°C)
	MAX	MIN	Average			
20.0	20.0	19.6	19.9	0.39	0.58	1.03

Note

Customer would like to find internal temperature in chamber and this report customer request and accepted in certificate

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

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

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

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

Uniformity - the maximum difference of measured temperatures at any sensors and the measured temperature

at the reference location which are observed at the same time or at as close an observation time as possible

to determine the temperature pattern or homogeneity within the chamber under steady state conditions.

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

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

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

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



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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 22TM4
Page.: 1 of 3

Certificate of Calibration

Equipment : Incubator
Manufacturer : Binder
Model : ED 115
Serial No. : 950433
ID No. : ERTC-L-In.-009
Submitted by : Environment Research & Technology Company Limited
25/114 Moo 6 Soi Chinaket 1,
Ngamwongwan Road, Toongsonghong, Lakxi,
Bangkok 10210
Location : 408/2 ห้องปฏิบัติการนมอาหารเลี้ยงเชื้อ
Received Order : 5 January 2022
Calibration Date : 6 January 2022
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Khit Ruttanaprapachai

Approved by :
Approved Signatory

(/) Pornthippa Tameyakul
(/) Malee Butkruea
() Suwit Imjai

Issue Date : 19 January 2022

The Uncertainties are for a confidence probability of approximately 95%

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26-1-65

A 0036711



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2201-0006ON-5
Procedure Used :-

Cert. No.: 22TM4
Page.: 2 of 3

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34970A	MY44060450	21LM4/1	06 Mar 2022

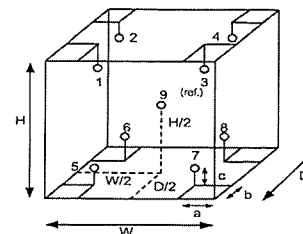
2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details :

a = 5.0 cm
b = 5.0 cm
c = 5.0 cm

Dimension of Chamber :

D = 0.50 m
W = 0.60 m
H = 0.50 m
Capacity = 0.15 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	26	26
REL.Humid. (%)	59	61
AC Supply (Volt)	221	222

Position :	Ref. Std. ID No.:
1	19-14RTD-01
2	19-14RTD-02
3	19-14RTD-03
4	19-14RTD-04
5	19-14RTD-05
6	19-14RTD-06
7	21-14RTD-07
8	19-14RTD-08
9 (ref.)	19-14RTD-09

26-1-65

a 1089977



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2201-0006ON-5
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 22TM4
Page.: 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
35	35	35	0.17	0.22	0.48	0.66	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
35	35.011	35.019	34.925	34.979	34.842	34.791	34.848	34.825	34.886

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

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.

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

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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

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26-1-65

Mlu.



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Cert. No. : 22CHO5

Page : 2 of 3

Cert.No.: 22CHO5
Page.: 1 of 3

Certificate of Calibration

Equipment : UV-VIS Spectrophotometer
Manufacturer : Perkin Elmer
Model : LAMBDA 25
Serial No. : 501S12101510
ID No. : ERTC-L-In.-077
Condition As-Received: Used Item
Received Date : 05 January 2022
Calibration Date : 06 January 2022
Reference : 2201-0006ON-15
Submitted by : Environment Research & Technology Company Limited.
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,
Toongsonghong, Laksi, Bangkok 10210
Calibration Place : ห้องปฏิบัติการวิเคราะห์คุณภาพอากาศ
Ambient Temperature : (24.9 - 24.8) °C (On-Site)
Relative Humidity : (47 - 44) % (On-Site)
Calibration Procedure : In - house method :
CP-OCH4 based on ASTM E 275-01
Calibrated by : Uthen Kankawi

Approved by :

Malee Butkruea
Approved Signatory

(☒) Malee Butkruea
(☐) Saithip Meangmai
(☐) Warakorn Lernagatrakul

Issue Date : 19 January 2022

Condition of calibration result

1. Reference Standard Material :

Material	Serial No.	Certificate No.	Due date
1. Absorbance Standard set	32589	85657	17 July 2022
2. Absorbance Standard set	32592	85658	17 July 2022
3. Absorbance Standard set	32593	85665	17 July 2022
4. Absorbance Standard set	32596	85666	17 July 2022
5. Wavelength Standard set	29829	94776	02 Sep 2023
6. Wavelength Standard set	29829	94777	02 Sep 2023
7. Stray Light Standard set	32629	107773	23 July 2022

2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This certificate is traceable to the International System of Unit maintained at :

- National Physical Laboratory (NPL), The United Kingdom of Great Britain and Northern Ireland
- National Institute of Standards and Technology (NIST), The United States of America

4. Spectral BandWidth : 1 nm

Scan Speed : 60 nm/min

Calibration Results : without adjustment

Wavelength Accuracy

Certified Values of Reference Material (nm)	UUC Reading (nm)	Uncertainty of Measurement (± nm)	Coverage Factor k
360.89	360.99	0.12	2.00
459.99	459.97	0.12	2.00
536.52	536.49	0.12	2.00
638.00	637.94	0.12	2.00
879.41	878.89	0.12	2.00

The Uncertainties are for a confidence probability of approximately 95%

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26-1-65

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Cert. No. : 22CHO5

Page : 3 of 3

Calibration Results : without adjustment

Photometric Accuracy

Wavelength (nm)	Certified Values of Reference Material (Abs)	UUC Reading (Abs)	Uncertainty of Measurement (\pm Abs)	Coverage Factor k
350.0	Zero	0.0000	0.0046	2.00
	0.4256	0.4235	0.0046	2.00
	Zero	0.0000	0.0050	2.00
	0.6411	0.6388	0.0050	2.00
546.1	Zero	0.0000	0.0028	2.00
	0.5267	0.5258	0.0028	2.00
	0.7000	0.6987	0.0028	2.00
	0.9837	0.9804	0.0028	2.00
635.0	Zero	0.0000	0.0028	2.00
	0.5685	0.5682	0.0028	2.00
	0.7650	0.7640	0.0028	2.00
	1.0761	1.0734	0.0028	2.00

Stray Light

* Straylight at 279.73 nm \pm 0.11 nm	Reading at 279.73 nm \pm 0.11 nm
Abs	2.0665
%T	0.8288

Remark

- The Potassium Dichromate filled cells are measured against a Perchloric acid blank.
- Each individual filter is measured against the empty filter holder (blank) used to zero the spectrophotometer
- Cut-off wavelength of stray light reference material (Potassium Iodide) = 279.73 nm \pm 0.11 nm
- Result = Pass, If Absorbance > 2.00 Abs and Transmission < 1.0 %T at Wavelength 279.73 nm \pm 0.11 nm
- * : Not NSC-ONSC Accredited

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

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26-1-65

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a 1089957



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TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No. : 22CHO6

Page : 2 of 3

Cert.No.: 22CHO6
Page.: 1 of 3

Certificate of Calibration

Equipment : Spectrophotometer
Manufacturer : Hach
Model : DR 2700
Serial No. : 1486078
ID No. : ERTC-L-In.-094
Condition As-Received: Used Item
Received Date : 05 January 2022
Calibration Date : 06 January 2022
Reference : 2201-0006ON-14
Submitted by : Environment Research & Technology Company Limited.
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,
Toongsonghong, Laksi, Bangkok 10210
Calibration Place : ห้องปฏิบัติการวิเคราะห์
Ambient Temperature : (25.9 - 24.8) °C (On-Site)
Relative Humidity : (42 - 44) % (On-Site)
Calibration Procedure : In - house method :
CP-OCH4 based on ASTM E 275-01
Calibrated by : Uthen Kankawi

Approved by :

Malee
Approved Signatory

- (/) Malee Butkruea
() Saithip Meangmai
() Warakorn Lerngagtrakul

Issue Date : 19 January 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

26-1-65

Condition of calibration result

1. Reference Standard Material :

Material	Serial No.	Certificate No.	Due date
1. Absorbance Standard set	32593	85665	17 July 2022
2. Absorbance Standard set	32596	85666	17 July 2022
3. Wavelength Standard set	29829	94776	02 Sep 2023
4. Wavelength Standard set	29829	94777	02 Sep 2023

2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This certificate is traceable to the International System of Unit maintained at :

- National Physical Laboratory (NPL), The United Kingdom of Great Britain and Northern Ireland
- National Institute of Standards and Technology (NIST), The United States of America

4. Spectral BandWidth : - nm
Scan Speed : - nm/min

Calibration Results : without adjustment

Wavelength Accuracy

Certified Values of Reference Material (nm)	UUC Reading (nm)	Uncertainty of Measurement (± nm)	Coverage Factor k
418.40	418	0.59	2.00
537.00	536	0.59	2.00
585.56	586	0.59	2.00
638.00	638	0.59	2.00
879.68	879	0.59	2.00

26-1-65

Malee

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a 1089960



Cert. No. : 22CHO6

Page : 3 of 3

Calibration Results : without adjustment

Photometric Accuracy

Wavelength (nm)	Certified Values of Reference Material (Abs)	UUC Reading (Abs)	Uncertainty of Measurement (\pm Abs)	Coverage Factor k
440.0	Zero	0.000	0.0028	2.00
	0.5634	0.558	0.0028	2.00
	0.7024	0.697	0.0028	2.00
	0.9872	0.978	0.0028	2.00
546.1	Zero	0.000	0.0028	2.00
	0.5267	0.525	0.0028	2.00
	0.7000	0.699	0.0028	2.00
	0.9837	0.981	0.0028	2.00
635.0	Zero	0.000	0.0028	2.00
	0.5685	0.566	0.0028	2.00
	0.7650	0.761	0.0028	2.00
	1.0761	1.070	0.0028	2.00

Remark

- Each individual filter is measured against the empty filter holder (blank) used to zero the spectrophotometer

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

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M. A.

a 1089959

Preventive Maintenance Kjeldahl

Service No. PM22-S08-072

1. Customer Information

Customer Name	Instrument	Serial Number	Service Date
บริษัท เอ็นไวรอนเม้นท์ รีเสิร์ช แอนด์ เทคโนโลยี จำกัด 25/114 หมู่ 6 ซ.พินเขต 1 ด.งามวงศ์วาน ฟุ่งสองห้อง หลักสี่ กรุงเทพมหานคร 10210 ติดต่อ: คุณจาวรรณ Tel: 080-075 1451 Fax: -	K - 355	1000142231	22-Jun-2022 PM_1/1

2. Instrument

2.1 Cooling water (if it connected)	OK	NOT OK	Remark
- Temperature 15 – 20 °C	/		CTL-911
- Cooling water inlet	/		
- Cooling water outlet	/		
- Control Temperature	/		Set temp 15 C

2.2 Cleaning	DONE	NOT DONE	Remark
- Outside Instrument	/		
- Inside Instrument	/		
- Splash protector	/		
- Condenser	/		


Buchi (Thailand) Limited

Preventive Maintenance Kjeldahl

2.3 Visual Test	OK	NOT OK	Remark
- Screw Coupling (between splash protector and condenser)	/		
- Condenser	/		
- Splash protector		/	เริ่มเสื่อมสภาพ
- Hypalon connection (connection tube)		/	เริ่มเสื่อมสภาพ
- Rubber bung		/	เริ่มเสื่อมสภาพ
- Ventilation valve	/		
- PTFE tube	/		
- Cooling water inlet	/		
- Cooling water outlet	/		
- Magnetic valve	/		

2.4 System control	OK	NOT OK	Remark
- Key board	/		
- Display	/		
- Program	/		
- Adding H ₂ O	/		Reagent 1
- Adding NaOH	/		Reagent 2
- Adding H ₃ BO ₃	-		Do not have
- Aspiration	-		Do not have


Buchi (Thailand) Limited

Preventive Maintenance Kjeldahl

3. Function Test

Addition H ₂ O	0 ml	Reaction time	0 min
Addition NaOH	0 ml	Distillation time	5 min
Addition H ₃ BO ₃	0 ml	Steam capacity	100%
		Aspiration	SAM

Result: Water in receiving vessel now approximately 170 ml, 171 ml

4. Summary



All specifications OK	Specification not OK
OK	

Comments

- Preventive Maintenance + Performance test 1/1
- Change part the Hose chemicles supply(043185) 1 pcs.
- TEST Run เครื่องทำงานปกติ

Signature BUCHI

- Service by Keen Date 16 - Jun - 2022

- Approve by Suphan C. Date 20 - Jun - 2022



Buchi (Thailand) Limited

Preventive Maintenance Block Digestion

Service No. PM22-S08-072

1. Customer Information

Customer Name	Instrument	Serial Number	Service Date
บริษัท เอ็นไวรอนเม้นท์ รีเสิร์ช แอนด์ เทคโนโลยี จำกัด 25/114 หมู่ 6 ซ.ชินเขต 1 ถ.งามวงศ์วาน พังสองห้อง หลักสี่ กรุงเทพมหานคร 10210 ติดต่อ: คุณแจรวรรณ Tel: 080-075 1451 Fax: -	K- 449	1000299283	16-Jun-2022 PM_1/1



2. Instrument

	OK	NOT OK	Remark
2.1 Housing			
- Clean the housing	/		
- Visual check	/		
- Check for defects (e.g. cracks)	/		

	OK	NOT OK	Remark
2.2 Heating			
- Clean aluminum block	/		
- Visual check	/		
- Check heating element	/		



Buchi (Thailand) Limited

Preventive Maintenance Block Digestion

2.3 Visual Check	OK	NOT OK	Remark
- Connection to suction	/		
- PTFE seal	/		
- O-ring	/		
- Glass holder set	/		
- Suction module	/		

2.4 Function test (This test does not use digestion vessels!)

- Select and store in .Program 9 by following parameters:
 - **Step 1** Ramp 1 Temp. 55°C Time 2 min.
 - **Step 2** Ramp 2 Temp. 70°C Time 2 min.
 - **Step 3** Ramp 3 Temp. 85°C Time 2 min.
 - **Step 4** Ramp 4 Temp. 100°C Time 2 min.
 - **Step 5** Cool Time 10 min.
- Check following functions:
 - Press key "Start": Start Time 00.00
 - 0 min. press key .Start. again starts heating from room temperature (LED Heating on)
 - 5 min. reaches 55°C (LED off) Lift goes down (K-438 only)
 - 6 min. starts heating again (LED on)
 - 7 min. reaches 70°C (LED off)
 - 8 min. starts heating again (LED on)
 - 9 min. reaches 85°C (LED off)
 - 10 min. starts heating again (LED on)
 - 11 min. reaches 100°C (LED off)
 - 12 min. starts cooling (fan on) Lift goes up (K-438 only)
 - 22 min. End / Scrubber off; LED still flashing displays 'power off delay - cooling' (Instrument will switch off automatically, if temperature of the heating block drops below 60°C)
- **Note:**
 - This are only approximate times starting from room temperature and they can vary slightly!
 - Not all heating positions have exactly the same heating output! (Constructive matter)
 - Temperatures may overshoot set temperatures. (only below 100°C)

Function test

☒ OK ☐ NOT OK



Preventive Maintenance Block Digestion

2.5 System control	OK	NOT OK	Remark
- Keyboard	/		
- Display	/		
- Program	/		

3. Summary

All specifications OK	Specification not OK
OK	

Comments

- Preventive Maintenance + Performance test_1/1
- Change part the set Pt1000 temp. sensor(1106773) 1 pcs.
- TEST Run เครื่องทำงานปกติ

Signature BUCHI

- Service by Keen Date 16 - Jun - 2022

- Approve by Suphan C. Date 20 - Jun - 2022



Preventive Maintenance Kjeldahl

2.5 System Distillation	OK	NOT OK	Remark
- Boiler	/		6.9 A
- Water level sensor	/		
- One way valve	/		
- Pressure switch	/		
- Thermostat	/		
- Steam valve1 (Y4)	/		
- Steam valve2 (Y5)	-		Do not have
- Drain valve (Y3)	-		Do not have
- Water 3/2 way valve (Y1)	-		Do not have

2.6 Hose	OK	NOT OK	Remark
- Unisil hose	/		
- Hypalon hose	/		
- Drain hose	-		Do not have
- Viton hose	/		
- Silicone hose	-		Do not have

2.7 Diaphragm pump	OK	NOT OK	Remark
- Diaphragm pump for H ₂ O	/		
- Diaphragm pump for NaOH	/		
- Diaphragm pump for H ₃ BO ₃	-		Do not have

2.8 Program test	OK	NOT OK	Remark
- Distillation	-		Do not have
- Aspiration	-		Do not have
- Preheating	-		Do not have
- Cleaning	-		Do not have

Preventive Maintenance Scrubber

Service No. PM22-S08-072

1. Customer Information

Customer Name	Instrument	Serial Number	Service Date
บริษัท เอ็นไวรอนเม้นท์ รีเสิร์ช แอนด์ เทคโนโลยี จำกัด 25/114 หมู่ 6 ซ.ชินเขต 1 ถ.งามวงศ์วาน พังสองห้อง หลักสี่ กรุงเทพมหานคร 10210 ติดต่อ: คุณจารุวรรณ Tel: 080-075 1451 Fax: -	B - 414	0700002874	16-Jun-2022 PM_1/1

2. Instrument

2.1 Cooling water (If it connected)	OK	NOT OK	Remark
- Temperature 10 – 20 °C	/		CTL-901
- Cooling water inlet	/		
- Cooling water outlet	/		Set temp 15 C

2.2 Cleaning	DONE	NOT DONE	Remark
- Housing	/		
- Condenser	/		
- Swirl disc	/		

Preventive Maintenance Scrubber

2.3 Visual Check

	OK	NOT OK	Remark
- Hose connection to suction	/		
- Glassware	/		
- Lip gasket	/		
- GL-14 connector	/		
- Activated charcoal	/		

2.4 Flush Pump

- Make sure, the bypass valve is closed completely (for maximum suction power).
- Disconnect the silencer, move it down (or take it away from the instrument), and flush out the pump with at least 500 mL of distilled water through the pump inlet, until the collected washing water is clean.
 - Switch on the instrument and collect the waste water from the pump output in a suitable vessel.

Flush pump

☒ OK

☐ NOT OK

2.5 Washing Solution

- Sodium hydroxide 8-10 %, max. 20 %
- Sodium carbonate
 - dissolve 600 g Na_2CO_3 in 3 L distilled warm water, or
 - dissolve 1.7 kg Na_2CO_3 in 10 H_2O in 3 L distilled warm water

Washing solution

☒ OK

☐ NOT OK

Preventive Maintenance Scrubber

3. Summary

All specifications OK	Specification not OK
OK	

Comments

- Preventive Maintenance + Performance test_1/1
- TEST Run เครื่องทำงานปกติ

Signature BUCHI

- Service by Keen Date 16 - Jun - 2022

- Approve by Suphan C. Date 20 - Jun - 2022

Performance Test

Service No. PM22-S08-072

1. Customer Information

Customer Name	Instrument	Serial Number	Service Date
บริษัท เอ็นไวรอนเม้นท์ รีเสิร์ช แอนด์ เทคโนโลยี จำกัด 25/114 หมู่ 6 ซอยชินเขต 1 ถนนงามวงศ์วาน แขวงทุ่งสอง ห้อง เขตหลักสี่ กรุงเทพมหานคร 10210 Tel: 02-954-7745 Fax:	K-355 K-449 B-414	1000142231 1000299283 0700002874	16 June 2022 (PM1/1)

2. Methods and Reagents

Digestion (assay 100.1%)	
Standard Substance:	Glycine
Theoretical %N content	18.618%
Catalyst	Mixed catalyst 10 g
Sulfuric acid	20 ml
Heating Level or Temp	420 องศา
Digestion time	90 min
Cooling time	30 min

Distillation and Titration (assay 100.2%)	
Standard Substance	Ammonium Sulfate
Theoretical %N content	21.24%
Titration method	Boric acid
Distilled water	50 ml
NaOH 32 %	90 ml
Boric acid 2 %	60 ml
Titant	0.5 N H ₂ SO ₄


Buchi (Thailand) Limited

Performance Test

3. Results

No.	Sample	Sample Weight (g)	Volume of titrant (ml)	Nitrogen (%)	Recovery Rate (%)
1	Blank	-	0.05		
2	Blank	-	0.05		
3	Ammonium Sulfate	0.2056	6.25	21.12	99.48
4	Ammonium Sulfate	0.2061	6.30	21.24	100.04
5	Ammonium Sulfate	0.2061	6.30	21.24	100.04
6	Ammonium Sulfate	0.2063	6.30	21.22	99.94
Average				21.20%	99.87 %

Recovery Rate: 99.87 % ☒ Passed ☐ Failed
Relative Standard Deviation (RSD): 0.27 % ☒ Passed ☐ Failed

No.	Sample	Sample Weight (g)	Volume of titrant (ml)	Nitrogen (%)	Recovery Rate (%)
1	Blank	-	0.05		
2	Blank	-	0.05		
3	Glycine	0.2060	5.55	18.70	100.11
4	Glycine	0.2059	5.55	18.71	100.16
5	Glycine	0.2067	5.55	18.64	99.77
6	Glycine	0.2064	5.55	18.66	99.92
Average				18.68%	99.99%

Recovery Rate: 99.99 % ☐ Passed ☐ Failed
Relative Standard Deviation (RSD): 0.18 % ☐ Passed ☐ Failed

Note:

- The recovery rate should be between 98 – 102 %
- The relative standard deviation should be lower than 1 %


Buchi (Thailand) Limited

Performance Test

4. Summary

All specifications OK	Specification not OK
OK	



Comments

% Recovery : Pass



Buchi (Thailand) Limited

Signature BUCHI

- Service by Jiraporn Date 16 June 2022


- Approve by Surethan C. Date 20 June 2022

Personal Pump Calibration Report


Equipment Type : Personal Pump
Equipment Range : 0.005 – 5.0 L/min
Calibration Range : 0.01 – 3.0 L/min
Calibration Type : DryCal Bubble Type
Volume for Calibration : 0.2 L/min, 1.0 L/min, 1.7 L/min, 2.0 L/min
Calibrated By : Ms.Natnalita Kotphan
Calibration Date : November 15, 2022
Customer Name : บริษัท โฟร์เทียร์ คอนซัลแตนต์ จำกัด : โครงการโรงงานผลิตทองแดงบริสุทธิ์และโลหะมีค่า
บริษัท จูน จี แมททีเรียล เทคโนโลยี จำกัด

Item	Personal Pump Serial Number	High Flow/ Low Flow	First Time	Second Time	Third Time	Average	Uncertainty
1	ERTC17 : LFS113-67	0.2 L/min	0.2051	0.2052	0.2058	0.2053	±0.0004
2	ERTC21 : 3-44611	0.2 L/min	0.2057	0.2057	0.2056	0.2056	±0.0001
3	ERTC27 : 3-43439	0.2 L/min	0.2021	0.2023	0.2026	0.2023	±0.0003
4	ERTC28 : 3-43441	0.2 L/min	0.2033	0.2036	0.2034	0.2034	±0.0002
5	ERTC30 : 3-43514	0.2 L/min	0.2076	0.2077	0.2075	0.2076	±0.0001
6	ERTC33 : 3-43524	0.2 L/min	0.2065	0.2064	0.2060	0.2063	±0.0003
7	ERTC34 : 3-43526	0.2 L/min	0.2031	0.2029	0.2034	0.2031	±0.0003
8	ERTC38 : 3-43590	0.2 L/min	0.2040	0.2040	0.2040	0.2040	±0.0000
9	ERTC54 : 11076	1.7 L/min	1.713	1.716	1.719	1.716	±0.0030
10	ERTC68 : 20051103006	2.0 L/min	2.029	2.035	2.025	2.011	±0.0050
11	ERTC78 : 17655	1.7 L/min	1.766	1.763	1.765	1.764	±0.0015
12	ERTC88 : 20080803049	2.0 L/min	2.023	2.026	2.017	2.019	±0.0046
13	ERTC99 : 20150603047	1.7 L/min	1.775	1.778	1.773	1.775	±0.0025
14	ERTC103 : 20060301018	1.0 L/min	1.017	1.020	1.023	1.020	±0.0030
15	ERTC105 : 20060301020	2.0 L/min	2.023	2.068	2.008	2.048	±0.0312
16	ERTC106 : 20060301021	1.7 L/min	1.725	1.727	1.731	1.727	±0.0031
17	ERTC114 : 11786	1.7 L/min	1.736	1.738	1.742	1.738	±0.0031
18	ERTC140 : 15513	1.7 L/min	1.740	1.742	1.753	1.746	±0.0070
19	ERTC145 : 15879	2.0 L/min	2.074	2.078	2.046	2.074	±0.0174
20	ERTC NO.161 : 20190605043	1.7 L/min	1.773	1.775	1.774	1.774	±0.0010

Checked By


Mr. Prayun Detkla
Technician

Approved By


Ms. Sutatip Im-noi
Environmental Scientist

Personal Pump Calibration Report

Equipment Type	: Personal Pump
Equipment Range	: 0.005 – 5.0 L/min
Calibration Range	: 0.01 – 3.0 L/min
Calibration Type	: DryCal Bubble Type
Volume for Calibration	: 0.2 L/min, 1.0 L/min, 1.7 L/min, 2.0 L/min
Calibrated By	: Ms.Natnalita Kotphan
Calibration Date	: November 15, 2022
Customer Name	: บริษัท โฟร์เทียร์ คอนซัลแตนต์ จำกัด : โครงการโรงงานผลิตทองแดงบริสุทธิ์และโลหะมีค่า บริษัท จูน จี แมททีเรียล เทคโนโลยี จำกัด

[illegible]

Checked By

Praym.
Mr. Prayun Detkla
Technician

envi research
ENVIRONMENT RESEARCH & TECHNOLOGY CO., LTD.
Approved By

Approved By

Suttip?

Ms.Suttip Im-noi
Environmental Scientist

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

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

Request No.23-65/0150

MTC.No.23-65/0150

Number of page(s) 2

CALIBRATION CERTIFICATE

Nomenclature : DRYCAL DC-LITE

Manufacturer : BIOS International Corporation, U.S.A.

Serial No.: 108398

Model : DCL-ML

Scale range : 50 ml/min to 2000 ml/min

Subdivision : (0.01, 0.1, 1) ml/min

Submitted by : ENVIRONMENT RESEARCH & TECHNOLOGY CO.,LTD.

25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,

Toongsonghong, Laksi, Bangkok 10210, Thailand.

Received date : 20 December 2021 **Condition of measured item :** Normal

Calibration date : 4 January 2022

Standard :

Standard	Certificate No.	Date due	Traceability
RTD Thermometer	PSL-T 336/63	6-Apr-22	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. 2013264122005238001

Issued Date 4 January 2022

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

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Thailand

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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.23-65/0150

2/2

MTC.No.23-65/0150

Calibration point : (50, 200, 2000) ml/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 (ml/min)	Standard Value (ml/min)	Temperature (°C)	Pressure (hPa)	Deviation (%)	Uncertainty (%)
53.32	52.011	22.941	1009.59	+2.52	1.07
200.2	195.55	22.770	1010.10	+2.36	1.04
2005	1948.3	22.415	1017.38	+2.93	0.86

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.

7/2

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

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FM.BL.MTC.002 Rev.4

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Fax. (66) 0 2579 8592

E-mail : sumalee@tistr.or.th



Document Type | Calibration Certificate (CC)
Description | CC for 930 Compact IC Flex
Document ID | CC.930 Version 1.0 / 8.930.3002EN

Metrohm

Compliance Service

Calibration Certificate (CC) for 930 Compact IC Flex

Instrument details

Type:	1.930.2560
Serial No.:	221307/ME (1930200024120)
Manufacturer:	Metrohm AG Ionenstrasse CH-9100 Herisau Switzerland
Customer instrument ID:	N/A
System Designation Number:	CAL220387/ME

Customer details

Name of company:	Environment Research & Technology Company Limited
Address:	25/114 Moo 6 Soi Chinaket 1, Ngamwongwan Road, Toongsonghong, Laksi, Bangkok 10210
Department:	Laboratory
Responsible person:	นายสมชาย ใจดี
Calibration place:	Laboratory Environment Research & Technology Company Limited

Date and time of calibration: 07/06/2022 - 08:45

System Designation Number: CAL220387/ME
Calibration Certificate (CC) No.: 221307/ME (1930200024120) - 07/06/2022 - 08:45

Page 1 of 4



Document Type | Calibration Certificate (CC)
Description | CC for 930 Compact IC Flex
Document ID | CC.930 Version 1.0 / 8.930.3002EN

Calibration Certificate (CC)

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 Calibration Certificate (CC) 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

Protocol

	Yes	No
Instrument had to be repaired beforehand	<input type="checkbox"/>	<input checked="" type="checkbox"/>
If yes, see Calibration Certificate (CC) No.:		
Instrument had to be readjusted beforehand	<input type="checkbox"/>	<input checked="" type="checkbox"/>
If yes, see Calibration Certificate (CC) No.:		

System Designation Number: CAL220387/ME
Calibration Certificate (CC) No.: 221307/ME (1930200024120) - 07/06/2022 - 08:45

Page 2 of 4



Document Type Calibration Certificate (CC)
Description CC for 930 Compact IC Flex
Document ID CC.930 Version 1.0 / 8.930.3002EN

Conclusion of test results

	Yes	No
Instrument satisfies the specified technical requirements	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Recommended date for next maintenance:		

Comments

Metrohm representative

	Yes	No
Metrohm representative confirms correct execution of instrument calibration	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Date	Name	Signature
07/06/2022	Mr.Prutchaya Kumparee	<i>Prutchaya K.</i>

Customer representative

	Yes	No
Customer representative accepts results of instrument calibration	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Date	Name	Signature
07/06/2022	คุณศุภชัย อรุณรัตน์	<i>ศุภชัย อรุณรัตน์</i>



Document Type Calibration Certificate (CC)
Description CC for 930 Compact IC Flex
Document ID CC.930 Version 1.0 / 8.930.3002EN

Test results

Module	Module Calibration Certificate No.	Pass		
		Yes	No	N/A
930 Basic unit	221307/ME (24120)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Professional IC pump	221307/ME (29512)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Professional Injector / Valve	221307/ME (25047)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Professional Degasser	221307/ME (24427)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Professional Peristaltic pump	221307/ME (23748)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Professional MSM	221307/ME (05503)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Professional MCS	221307/ME (24570)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CC.930 Document History

Date	Article no.	Author	Description/Changes
24.05.2013	8.930.3002EN	Stephan Wohlwender	Creation

End of CC Document



Document Type	Calibration Certificate (CC)
Description	CC for 930 Basic unit
Document ID	CC.930 Basic unit Version 1.0 / 8.930.3001EN

Metrohm

Compliance Service

Module Calibration Certificate (CC) for 930 Basic unit

Module

Assembly No.:	3.940.1200
Serial No.:	221307/ME (24120)
Firmware:	5.940.0101
Date and time of calibration:	07/06/2022 - 08:45

Instrument

Type:	1.930.2560
Serial No.:	1930200024120
System Designation Number:	CAL220387/ME

Declaration

Document

Test instructions used:	C.1 Test instructions for 930 Basic unit, Version 1.0
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Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date
Multimeter	Fluke	88490190	E1UZZ2184	25/05/2023
Temperature meas. Instr.	DTM3000	3332/119	TMU211732	16/06/2022

System Designation Number: CAL220387/ME
Calibration Certificate (CC)No.: 221307/ME (24120) - 07/06/2022 - 08:45

Page 1 of 3



Document Type	Calibration Certificate (CC)
Description	CC for 930 Basic unit
Document ID	CC.930 Basic unit Version 1.0 / 8.930.3001EN

Test results

No.	Title	Comments	Pass		N/A
			Yes	No	
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"/>

System Designation Number: CAL220387/ME
Calibration Certificate (CC)No.: 221307/ME (24120) - 07/06/2022 - 08:45

Page 2 of 3



Document Type	Calibration Certificate (CC)
Description	CC for 930 Basic unit
Document ID	CC.930 Basic unit Version 1.0 / 8.930.3001EN

No.	Title	Comments	Pass		
			Yes	No	N/A
109	Column heater (optional)				
109.1 Temperature absolute					
	Nominal value [°C]	Measured value [°C]	Tolerance [°C]		
	Set temperature 35.0	35.4	± 0.5	<input checked="" type="checkbox"/>	<input type="checkbox"/>
109.2 Temperature stability					
	Maximum t [°C]	Minimum t [°C]	Tolerance [°C]		
	35.005	34.986	<0.05	<input checked="" type="checkbox"/>	<input type="checkbox"/>

CC.930 Basic unit Document History

Date	Article no.	Author	Description/Changes
24.05.2013	8.930.3001EN	Stephan Wohlwender	Creation

End of CC Document



Document Type	Calibration Certificate (CC)
Description	CC for Professional Degasser
Document ID	CC.Professional Degasser Version 1.0 / 8.940.3004EN

Metrohm Compliance Service

Module Calibration Certificate (CC) for Professional Degasser

Module

Assembly No.:	3.850.3410
Serial No.:	221307/ME (24427)
Date and time of calibration:	07/06/2022 - 08:45

Instrument

Type:	1.930.2560
Serial No.:	1930200024120
System Designation Number:	CAL220387/ME

Declaration

Document

Test instructions used:	C.1 Test instructions for Professional Degasser, Version 1.0
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Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date



Document Type	Calibration Certificate (CC)
Description	CC for Professional Degasser
Document ID	CC.Professional Degasser Version 1.0 / 8.940.3004EN

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Communication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101	Vacuum build-up		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CC.Professional Degasser Document History

Date	Article no.	Author	Description/Changes
21.05.2013	8.940.3004EN	Stephan Wohlwender	Creation

End of CC Document



Document Type	Calibration Certificate (CC)
Description	CC for Professional Injector / Valve
Document ID	CC.Professional Injector / Valve Version 1.0 / 8.940.3003EN

Metrohm Compliance Service

Module Calibration Certificate (CC) for Professional Injector / Valve

Module

Assembly No.:	3.850.3060
Serial No.:	21307/ME (25047)
Date and time of calibration:	07/06/2022 - 08:45

Instrument

Type:	1.930.2560
Serial No.:	1930200024120
System Designation Number:	CAL220387/ME

Declaration

Document

Test instructions used:	C.1 Test instructions for Professional Injector / Valve, Version 1.0
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Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date



Document Type	Calibration Certificate (CC)
Description	CC for Professional Injector / Valve
Document ID	CC.Professional Injector / Valve Version 1.0 / 8.940.3003EN

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Communication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101	Switching operation		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CC.Professional Injector / Valve Document History

Date	Article no.	Author	Description/Changes
21.05.2013	8.940.3003EN	Stephan Wohlwender	Creation

End of CC Document



Document Type	Calibration Certificate (CC)
Description	CC for Professional MCS
Document ID	CC.Professional MCS Version 1.0 / 8.940.3005EN

Metrohm Compliance Service

Module Calibration Certificate (CC) for Professional MCS

Module

Assembly No.:	3.850.3410
Serial No.:	221307/ME (24570)
Date and time of calibration:	07/06/2022 - 08:45

Instrument

Type:	1.930.2560
Serial No.:	1930200024120
System Designation Number:	CAL220387/ME

Declaration

Document

Test instructions used:	C.1 Test instructions for Professional MCS, Version 1.0
-------------------------	---

Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date
Flow meter	ANALYT-MTC	94306	AD2201-280-0001	31/01/2023

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Communication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101	Vacuum build-up		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title	Pass			
		Yes	No	N/A	
102	Air flow without cartridge				
	Nominal value [sccm]	Measured value [sccm]			
	10.0 – 15.0	14.8	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title	Pass			
		Yes	No	N/A	
103	Air flow with cartridge				
	Nominal value [sccm]	Measured value [sccm]			
	>8.0	14.7	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CC.Professional MCS Document History

Date	Article no.	Author	Description/Changes
21.05.2013	8.940.3005EN	Stephan Wohlwender	Creation

End of CC Document

Metrohm Compliance Service

Module Calibration Certificate (CC) for Professional Peristaltic pump

Module

Assembly No.:	3.850.3200
Serial No.:	221307/ME (23748)
Date and time of calibration:	07/06/2022 - 08:45

Instrument

Type:	1.930.2560
Serial No.:	1930200024120
System Designation Number:	CAL220387/ME

Declaration

Document

Test instructions used:	C.1 Test instructions for Professional Peristaltic pump, Version 1.0
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Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date



Document Type	Calibration Certificate (CC)
Description	CC for Professional Peristaltic pump
Document ID	CC.Professional Peristaltic pump Version 1.0 / 8.940.3007EN

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Communication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101	Rotation CW		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
102	Rotation CCW		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
103	Speed control		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CC.Professional Peristaltic pump Document History

Date	Article no.	Author	Description/Changes
21.05.2013	8.940.3007EN	Stephan Wohlwender	Creation

End of CC Document



Document Type	Calibration Certificate (CC)
Description	CC for Professional IC pump
Document ID	CC.Professional IC pump Version 1.0 / 8.940.3002EN

Metrohm Compliance Service

Module Calibration Certificate (CC) for Professional IC pump

Module

Assembly No.:	3.850.3000
Serial No.:	221307/ME (29512)
Date and time of calibration:	07/06/2022 - 08:45

Instrument

Type:	1.930.2560
Serial No.:	1930200024120
System Designation Number:	CAL220387/ME

Declaration

Document

Test instructions used:	C.1 Test instructions for Professional IC pump, Version 1.0
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Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date
High pressure gauge	Metrohm	05108	CAL0252-21Q0119	22/09/2022

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Installation		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101	Communication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
102	Pump head detection		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
103	Deaerate		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
104	Pump dynamics		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title		Maximum [MPa]	Minimum [MPa]	Difference [%]	Pass		
						Yes	No	N/A
105	Pulsation							
	Standard pump head		11.02	10.74	<5.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Macro pump head		N/A	N/A	<10.0	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Pass

No.	Title		Nominal value [MPa]	Measured value [MPa]	Tolerance [%]	Pass		
						Yes	No	N/A
106	Pressure transducer							
			10.91	11	± 10.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title		Nominal value [mL]	Measured value [mL]	Tolerance [mL]	Pass		
						Yes	No	N/A
107	Flow rate							
	Standard pump head		4.0	4.1	± 0.2	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Macro pump head		20.0	N/A	± 1.0	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

No.	Title	Comments	Pass		
			Yes	No	N/A
108	Shut off at minimum pressure		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
109	Shut off at maximum pressure		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title		Maximum [MPa]	Minimum [MPa]	Difference [MPa]	Pass		
						Yes	No	N/A
110	Leak test							
			18.45	17.95	<1.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CC.Professional IC pump Document History

Date	Article no.	Author	Description/Changes
21.05.2013	8.940.3002EN	Stephan Wohlwender	Creation

End of CC Document



Document Type	Calibration Certificate (CC)
Description	CC for Professional MSM
Document ID	CC.Professional MSM Version 1.0 / 8.940.3006EN

Metrohm

Compliance Service

Module Calibration Certificate (CC) for Professional MSM

Module

Assembly No.:	3.940.3000
Serial No.:	221307/ME (05503)
Date and time of calibration:	07/06/2022 - 08:45

Instrument

Type:	1.930.2560
Serial No.:	1930200024120
System Designation Number:	CAL220387/ME

Declaration

Document

Test instructions used:	C.1 Test instructions for Professional MSM, Version 1.0
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Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date



Document Type	Calibration Certificate (CC)
Description	CC for Professional MSM
Document ID	CC.Professional MSM Version 1.0 / 8.940.3006EN

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Communication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101	Switching operation		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CC.Professional MSM Document History

Date	Article no.	Author	Description/Changes
21.05.2013	8.940.3006EN	Stephan Wohlwender	Creation

End of CC Document



Document Type	Calibration Certificate (CC)
Description	CC for 850.9010 Conductivity Detector
Document ID	CC.850 Version 1.3 / 8.850.3022EN

Metrohm Compliance Service

Calibration Certificate (CC) for 850.9010 Conductivity Detector

Instrument details

Type:	18509010
Serial No.:	221308/ME (1850901042128)
Manufacturer:	Metrohm AG, Ionenstrasse, CH-9100 Herisau Switzerland
Customer instrument ID:	N/A
System Designation Number:	CAL220387/ME

Control device details

Type:	1.930.2560
Serial No.:	1930200024120
Firmware:	5.940.0101

Customer details

Name of company:	Environment Research & Technology Company Limited
Address:	25/114 Moo 6 Soi Chinaket 1, Ngamwongwan Road, Toongsonghong, Laksi, Bangkok 10210
Department:	Laboratory
Responsible person:	ดร.วิมลรัตน์ วัฒนศิริ
Calibration place:	Laboratory Environment Research & Technology Company Limited

Date and time of calibration:	07/06/2022 - 08:45
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System Designation Number: CAL220387/ME
Calibration Certificate (CC) No.: 221308/ME (1850901042128) - 07/06/2022 - 08:45

Page 1 of 5



Document Type	Calibration Certificate (CC)
Description	CC for 850.9010 Conductivity Detector
Document ID	CC.850 Version 1.3 / 8.850.3022EN

Calibration Certificate (CC)

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 Calibration Certificate (CC) 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 850.9010 Conductivity Detector, Version 1.3
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Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date
Temperature meas. Instr.	DTM3000	3332/T19	TML211732	16/06/2022
Conductivity standard (opt.)	Metrohm	21190059	12-0187	25/08/2022

Protocol

	Yes	No
Instrument had to be repaired beforehand	<input type="checkbox"/>	<input checked="" type="checkbox"/>
If yes, see Calibration Certificate (CC) No.:		
Instrument had to be readjusted beforehand	<input type="checkbox"/>	<input checked="" type="checkbox"/>
If yes, see Calibration Certificate (CC) No.:		

System Designation Number: CAL220387/ME
Calibration Certificate (CC) No.: 221308/ME (1850901042128) - 07/06/2022 - 08:45

Page 2 of 5



Document Type Calibration Certificate (CC)
Description CC for 850.9010 Conductivity Detector
Document ID CC.850 Version 1.3 / 8.850.3022EN

Conclusion of test results

Instrument satisfies the specified technical requirements

Yes ☒ No ☐

Recommended date for next maintenance:

Comments

Metrohm representative

Metrohm representative confirms correct execution of instrument calibration

Yes ☒ No ☐

Date	Name	Signature
07/06/2022	Mr.Prutchaya Kumpaliree	<i>Prutchaya K.</i>

Customer representative

Customer representative accepts results of instrument calibration

Yes ☒ No ☐

Date	Name	Signature
07/06/2022	คุณประจักษ์ คุ้มไพรี	<i>ประจักษ์ คุ้มไพรี</i>



Document Type Calibration Certificate (CC)
Description CC for 850.9010 Conductivity Detector
Document ID CC.850 Version 1.3 / 8.850.3022EN

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Communication		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title			Nominal value [°C]	Measured value [°C]	Tolerance [°C]	Pass		
							Yes	No	N/A
101	Temperature absolute								
		Temperature 1		34.996	35.4	± 1.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Temperature 2		40.001	40.1	± 1.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title		Maximum t [°C]	Minimum t [°C]	Difference [°C]	Pass		
						Yes	No	N/A
102	Temperature stability		40.001	39.998	< 0.010	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title		Drift compensated [nS/cm]	Tolerance [nS/cm]	Pass		
					Yes	No	N/A
103	Signal noise	1 M	0.251	< 0.4	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		20 k 5	4.386	< 10.0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title	Comments	Pass		
			Yes	No	N/A
104	Conductivity dry test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

		Pass		
No.	Title	Yes	No	N/A
105	Conductivity cell (optional)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
105.1	System installation and preparation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
105.2	Write a method	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
105.3	Measurement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Nominal value [μS/cm]	Measured value [μS/cm]	Tolerance [%]	
	91.32	92.31	± 10	<input checked="" type="checkbox"/>

CC.850 Document history

Date	Article No.	Author	Description/Changes
26.04.2012	8.850.3022EN	Philipp Rüegg	Layout adapted to Metrohm Compliance Service

End of CC Document

Metrohm Compliance Service

Calibration Certificate (CC) for
863 Compact Autosampler

Instrument details

Type:	18630010
Serial No.:	221309/ME (1863001022147)
Manufacturer:	Metrohm AG Ionenstrasse CH-9100 Herisau Switzerland
Firmware:	5.863.0022
Customer instrument ID:	N/A
System Designation Number:	CAL220387/ME

Customer details

Name of company:	Environment Research & Technology Company Limited
Address:	25/114 Moo 6 Soi Chinaket 1, Ngamwongwan Road, Toongsonghong, Laksi, Bangkok 10210
Department:	Laboratory
Responsible person:	สุภากร ใจดี / Sukkhar Jaijai
Calibration place:	Laboratory Environment Research & Technology Company Limited

Date and time of calibration: 07/06/2022 - 11:15



Document Type	Calibration Certificate (CC)
Description	CC for 863 Compact Autosampler
Document ID	CC.863 Version 1.0 / 8.863.3003EN

Calibration Certificate (CC)

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 Calibration Certificate (CC) 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 863 Compact Autosampler, Version 1.0

Reference standards

Type / Model	Manufacturer	Serial No. / Batch No.	Certificate No.	Due date / Expiry date
Multimeter	Fluke	88490190	E1U222184	25/05/2023

Protocol

	Yes	No
Instrument had to be repaired beforehand	<input type="checkbox"/>	<input checked="" type="checkbox"/>
If yes, see Calibration Certificate (CC) No.:		
Instrument had to be readjusted beforehand	<input type="checkbox"/>	<input checked="" type="checkbox"/>
If yes, see Calibration Certificate (CC) No.:		



Document Type	Calibration Certificate (CC)
Description	CC for 863 Compact Autosampler
Document ID	CC.863 Version 1.0 / 8.863.3003EN

Conclusion of test results

	Yes	No
Instrument satisfies the specified technical requirements	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Recommended date for next maintenance:		

Comments

Metrohm representative

			Yes	No
Metrohm representative confirms correct execution of instrument calibration			<input checked="" type="checkbox"/>	<input type="checkbox"/>
Date	Name	Signature		
07/06/2022	Mr.Prutchaya Kumpaiee	<i>Prutchaya K.</i>		

Customer representative

			Yes	No
Customer representative accepts results of instrument calibration			<input checked="" type="checkbox"/>	<input type="checkbox"/>
Date	Name	Signature		
07/06/2022	ดร.สุวิทย์ วัฒนศิริ	<i>สุวิทย์ วัฒนศิริ</i>		

Test results

No.	Title	Comments	Pass		
			Yes	No	N/A
100	Visual check		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
101	Safety check		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
102	Getting started (system self test)		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
103	Serial number, date and time check		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
104	Prepare the instrument for diagnosis		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
105	Display test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
106	Keyboard test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
107	Prepare the instrument for service		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
108	Contrast test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
109	Remote test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
110	RS bridge test (USB-RS232-bridge)		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	RS-232/1		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	RS-232/2		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

No.	Title	Comments	Pass		
			Yes	No	N/A
111	Table test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
112	Lift test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
113	Peristaltic pump test		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
115	Test end		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

CC.863 Document history

Date	Article No.	Author	Description/Changes
03.08.2011	8.863.3003EN	Giuseppe Conte	Layout adapted to Metrohm Compliance Service

End of CC document



Certificate of Calibration

Customer
Name : Environment Research & Technology Co., Ltd.
Address : 25/114 Moo 6, Ngamwongwan 43, Ngamwongwan Road,
Toongsonghong, Laksi, Bangkok 10210

Certificate No : 22-TPM-192
Request No : Req-2022-0738
Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature
Instrument Name : Area Heat Stress Monitor
Manufacturer : Quest Technologies
Model : QT-34
Serial Number : TEG040249
Resolution : 0.1 °C
ID Number : -

Range Calibration : 30 °C to 40 °C
Type of Sensor : RTD
Sensor Diameter (mm) : 4.5
Calibration Position (mm) : 67.5
Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 15 %RH
Received Date : 19 April 2022
Calibrated Date : 26 April 2022
Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

Reference Standard : Digital Thermometer with Sensor, Manufacturer: GINGO/GINGO, Model: GT11/ RTD100, SN: 08000057, ID: 02-TPM Which was calibrated on 10 March 2022, Calibration Certificate No. : QR22-0578

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

Note

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

Approved By :
Mr. Pacit Mathavorn
Calibration Engineer Supervisor
Issue Date : 26 April 2022



Calibration Note
UUC Adjustment : Not Adjust

Certificate No : 22-TPM-192
Request No : Req-2022-0738
Page : 2/2

Result of Calibration :

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
WET	30.003	30.2	- 0.2	0.14
	35.003	35.2	- 0.2	0.14
	40.005	40.2	- 0.2	0.14
DRY	30.006	30.1	- 0.1	0.14
	35.007	35.1	- 0.1	0.14
	40.006	40.1	- 0.1	0.14
GLOBE	30.006	30.1	- 0.1	0.14
	35.004	35.1	- 0.1	0.14
	40.005	40.1	- 0.1	0.14

End of Certificate

Calibrated By :
Mr. Sittichok Jirapukdeesakun

Request No. 22-65 / 0547

MTC No. PSL-H 0260 / 65

Certificate of Calibration

Customer : Environment Research & Technology Company Limited
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Rd., Laksi, Bangkok

Equipment : Thermo-Hygrometer (Area Heat Stress Monitor)

Model /Type : hs-32

Serial Number : MCB110008

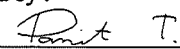
Maker : METROSONICS

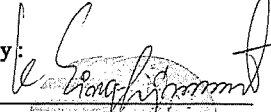
Date of Request : 23 May 2022

Date of Calibration : 7 June 2022

This certificate is traceable to International System of Units (SI Units) through Photometry and Temperature Standards Laboratory, Industrial Metrology and Testing Service Centre, Thailand Institute of Scientific and Technology Research (TISTR), NSC-ONSC accredited Calibration No. 0015.

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95 %.

Calibrated by :

(Ms. Panit Thummasri)

Approved by :

(Mr. Kamchai Singhapiwat)
Director

Photometry and Temperature Standards Laboratory

Ref. No : 2012265052302254001

Issued Date : 23 June 2022

Page 1 of 4

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.BLMTC.002 Rev.4

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

Request No. 22-65 / 0547

MTC No. PSL-H 0260 / 65

Description of Unit Under Calibration :

Customer : Environment Research & Technology Company Limited

Address : 25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Rd., Laksi, Bangkok

Equipment : Thermo-Hygrometer (Area Heat Stress Monitor)

Serial Number : MCB110008

Calibration Required : Temperature at (30, 35, 40) °C

Ambient Condition : Ambient temperature (23 ± 3) °C
Relative humidity (55 ± 20) %

Laboratory Address : Photometry and Temperature Standards Laboratory
Soi 1, Bangpoo Industrial Estate, Sukhumvit Rd., Samutprakan

Reference Standard :

Digital Thermometer with Sensor, Model : F250H, S/N : 9345 008 2331, Sensor RTD Probe No. RTD-01 and RTD-02 which was calibrated by Industrial Metrology and Testing Service Centre, Certificate No. PSL-T 1081/64.

The temperature scale in use of this laboratory is the International Temperature Scale of 1990.

Calibration Procedure :

The certifies the above equipment was calibrated according to procedure no. WI.CP.18.

Support Equipment :

Temperature & Humidity Controlled Chamber, Model : 9145-5116-00AA, S/N : 1403041

Adjustments : NONE

Page 2 of 4

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P.T.

FM.BLMTC.002 Rev.4

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

Request No. 22-65 / 0547

MTC No. PSL-H 0260 / 65

Results of Calibration :-

Table : Temperature Measurement @ Wet Bulb

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
29.9	30.3	-0.4	0.50
35.1	35.4	-0.3	0.50
40.0	40.1	-0.1	0.50

Table : Temperature Measurement @ Dry Bulb

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
29.9	30.4	-0.5	0.50
35.1	35.5	-0.4	0.50
40.0	40.3	-0.3	0.50

Request No. 22-65 / 0547

MTC No. PSL-H 0260 / 65

Results of Calibration :-

Table : Temperature Measurement @ Globe Bulb

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
29.9	30.4	-0.5	0.50
35.1	35.4	-0.3	0.50
40.0	40.1	-0.1	0.50

- Note :
1. This calibration was done without removing reservoir cover, white plates and blackened copper sphere of the instrument.
 2. The calibration data for instrument in this report is reported within the condition existing at the time of measurement only.

...end of certificate...



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484



Certificate of Calibration

Certificate No. : 22PH284

Page : 1 of 2

Cert. No.: 22PH284

Page.: 2 of 2

Equipment : Lux Meter

Manufacturer: Exttech

Model : 407026

Serial No.: 048593

ID No.: -

Condition As-Received: Used Item

Received Date: 27 May 2022

Calibration Date: 02 June 2022

Reference: 2205-0924WN

Submitted by: Environment Research & Technology Company Limited.

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,
Toongsonghong, Laksi, Bangkok 10210

Procedure used: Calibration were conducted using In-house calibration procedure CP-PH01 by measuring against luminous-intensity standard lamp (source-based method) According to the inverse square law measurement method.

Condition of this result of calibration

1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Photometry & Encoder	LMguide 9,6 m	120RC003	61-140006-1	30 Apr 2023
2) High-accuracy Irradiance Standard	OL FEL-U	F-1470	TP-1036-21	21 Aug 2022

2. This result of calibration was made on requested at the point specified by customer.

3. Test Equipment : Programmable Voltage/Current Source (Model : OL83A, S/N : 09220284).

4. Test Equipment : Illuminance Meter (Model : 51002, S/N : 080129).

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

6. This Certification is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Nivat Nitas
Issue Date : 08 June 2022

Approved Signatory :
[✓] Phalinee Prabpaipal
[] Nuntawat Khamchai

Result of calibration:-

(*) Without adjustment () After adjustment

Function : Illuminance Measurement

Range : 2000 lx

Standard Value	UUC* Reading	Error	Uncertainty
(lx)	(lx)	(lx)	(± lx)
0	0	0	0.60
15	4	-11	0.62
100	90	-10	1.5
500	495	-5	6.8
1000	1000	0	14
1500	1501	1	21
1900	1901	1	26

Function : Illuminance Measurement

Range : 20000 lx

Standard Value	UUC* Reading	Error	Uncertainty
(lx)	(lx)	(lx)	(± lx)
2000	1990	-10	28
3000	2910	-90	42
4000	3820	-180	55
5000	4750	-250	69

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 %

Light source factor setting mode : L

UUC* = Unit Under Calibration.

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Sound Level Meter Calibration Report


Support Equipment Type : Sound Level Calibrator
Manufacture : BSWA TECH
Model : CA115
Serial No. : 470205
Range of Calibrator
- **Sound Pressure Level** : 114.0 dB.
- **Frequency** : 1,000 Hz.
Calibrated By : Ms.Natnalita Kotphan
Calibration Date : November 15, 2022
Customer Name : บริษัท โฟร์เทียร์ คอนซัลแตนต์ จำกัด : โครงการโรงงานผลิตทองแดงบริสุทธิ์และโลหะมีค่า
บริษัท จูน จี แมททีเรียล เทคโนโลยี จำกัด

Item	Equipment			Actual Reading (dB(A))		Status
	Brand	Model	Serial Number	Before Adjustment	After Adjustment	
1	ACO	6236	222107	114.1	114.0	Pass
2	ACO	6236	222112	114.0	114.0	Pass
3	ACO	6236	222113	114.1	114.0	Pass
4	ACO	6236	222114	114.0	114.0	Pass
5	ACO	6236	222116	114.0	114.0	Pass
6	ACO	6236	222120	113.9	114.0	Pass
7	ACO	6236	222122	113.9	114.0	Pass
8	ACO	6236	222123	113.8	114.0	Pass
9	ACO	6236	222125	113.7	114.0	Pass
10	Larson Davis	706RC	17861	114.0	114.0	Pass
11	Larson Davis	706RC	17862	113.9	114.0	Pass
12	EXTECH	SL400	170400043	113.8	114.0	Pass
13	EXTECH	SL400	180200304	113.8	114.0	Pass
14	EXTECH	SL400	180200311	114.0	114.0	Pass
15	EXTECH	SL400	190600222	114.0	114.0	Pass
16	EXTECH	SL400	190600236	114.0	114.0	Pass
17	EXTECH	SL400	190800173	114.1	114.0	Pass
18	EXTECH	SL400	190800276	114.0	114.0	Pass

Checked By


Mr. Prayun Detkla
Technician


Approved By


Ms. Sutatip Im-noi
Environmental Scientist



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0209

MTC No. EEL. BP. 131/1264

CALIBRATION CERTIFICATE

Submitted by : Environment Research & Technology Co.,Ltd.

Address : 25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road, Toongsonghong, Laksi, Bangkok 10210.

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

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

Instrument Calibrated :

Description : Acoustic Calibrator

Manufacturer : BSWA TECH

Model : CA115

Serial No. : 470205

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

2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.

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

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

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

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

7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871.

Calibration Procedure: CP-102-04 based on IEC 60942-2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 29 Dec. 2021

Date of Calibration : 10 Jan. 2022

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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.BLMTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0209

MTC No. EEL. BP. 131/1264

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

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

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	114.02	0.02	± 0.10	± 0.75 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	999.9	-0.1	± 1.5	$\pm 2.0\%$

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	0.80	± 0.50	$\pm 4.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

(Mr. Weerachai Deechaiyae)

Approved by :

(Mr. Prawate Kluaypa)
Acting Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 10 Jan. 2022

Date of Issue : 11 Jan. 2022

Ref : 2011264122905422004

End of Certificate

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