



ภาคผนวก จ

เอกสารสอบเทียบเครื่องมือวิเคราะห์

TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	May 17, 2022
บ้านคลองสมบูรณ์ หมู่ที่ 13 ตำบลหัวท้าว				Start Time	12:15 PM
Sampler Number	TSP No.A10	Transfer Standard Type	Orifice	Stop Time	12:25 PM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Woradech Rungprasert
Motor Serial Number	2012-04	Calibrator Serial Number	3883		
Recorder Serial Number	1504				

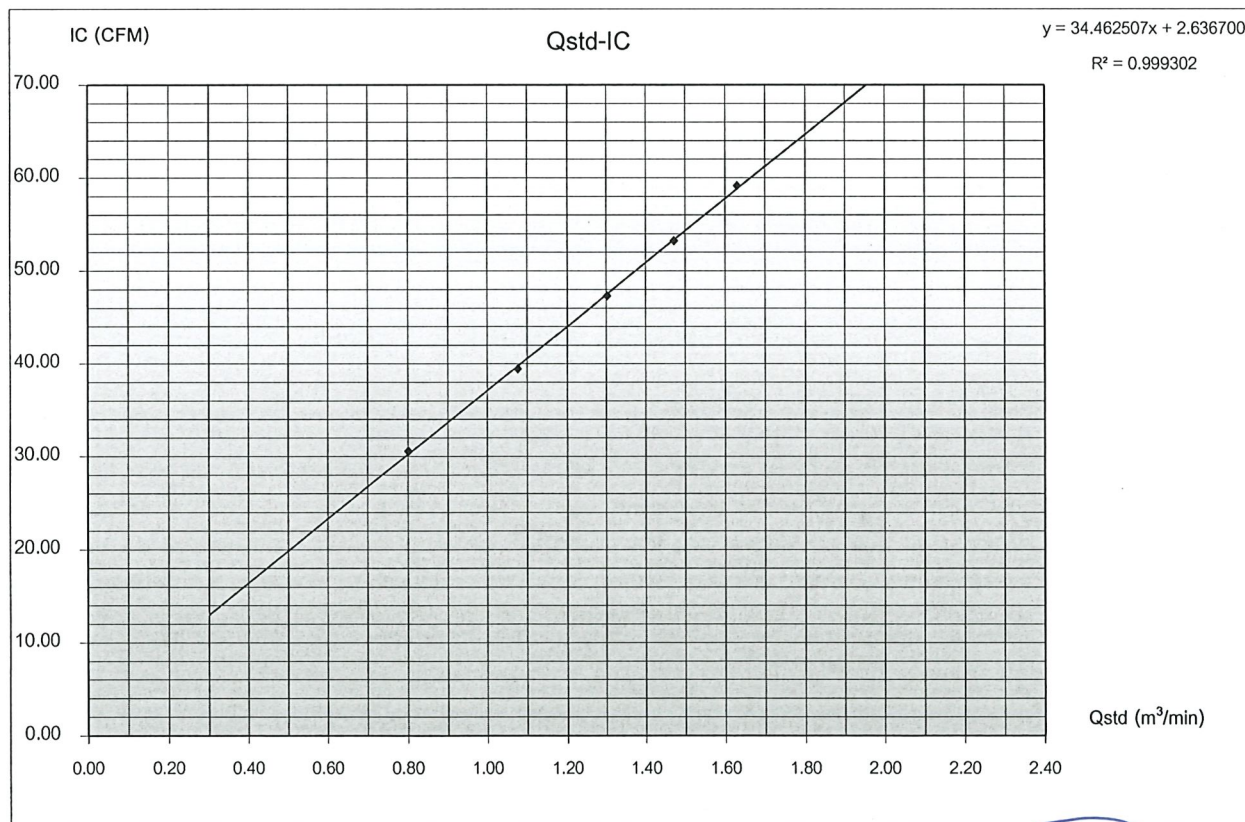
Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH ₂ O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ (m ³ /min)	ample Flow Rate Indication (ft ³ /min)	$IC = I[(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	(°K = °C+273)	(mmHg)		
	Positive	Negative	ΔH ₂ O								
5	1.4	1.4	2.8	1.64965	0.80131	31.0	30.56	305.0	756.0		
7	2.5	2.6	5.1	2.22637	1.07660	40.0	39.43	305.0	756.0		
10	3.7	3.8	7.5	2.69987	1.30261	48.0	47.32	305.0	756.0		
13	4.8	4.8	9.6	3.05455	1.47190	54.0	53.24	305.0	756.0		
18	5.9	5.9	11.8	3.38652	1.63036	60.0	59.15	305.0	756.0		

Linear Regression Y ON X : Y= mX + b

1	Slope (m)	2.09503	Linear Equation		Average	305.0	756.0	
2	Intercept (b)	-0.02913	Set Point Flow Rate (X) (m ³ /min)	1.133	r ²	0.999302	Pstd(mmHg)	760.0
3	Correlation Coefficient (r)	0.99999	Final Set Flow Rate = (I)	0	r	0.9996509	T _{NTP}	298.0
Result						(Pa/Pstd)*(Tstd/Ta)		0.971906816
						C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.985853344

COMMENT

Andersen Instruments, Inc.



Checked By

(Mr. Prayun Detkla)

Technician

Approved By

(Mr.Panupon Podang)

Environmental Scientist

PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

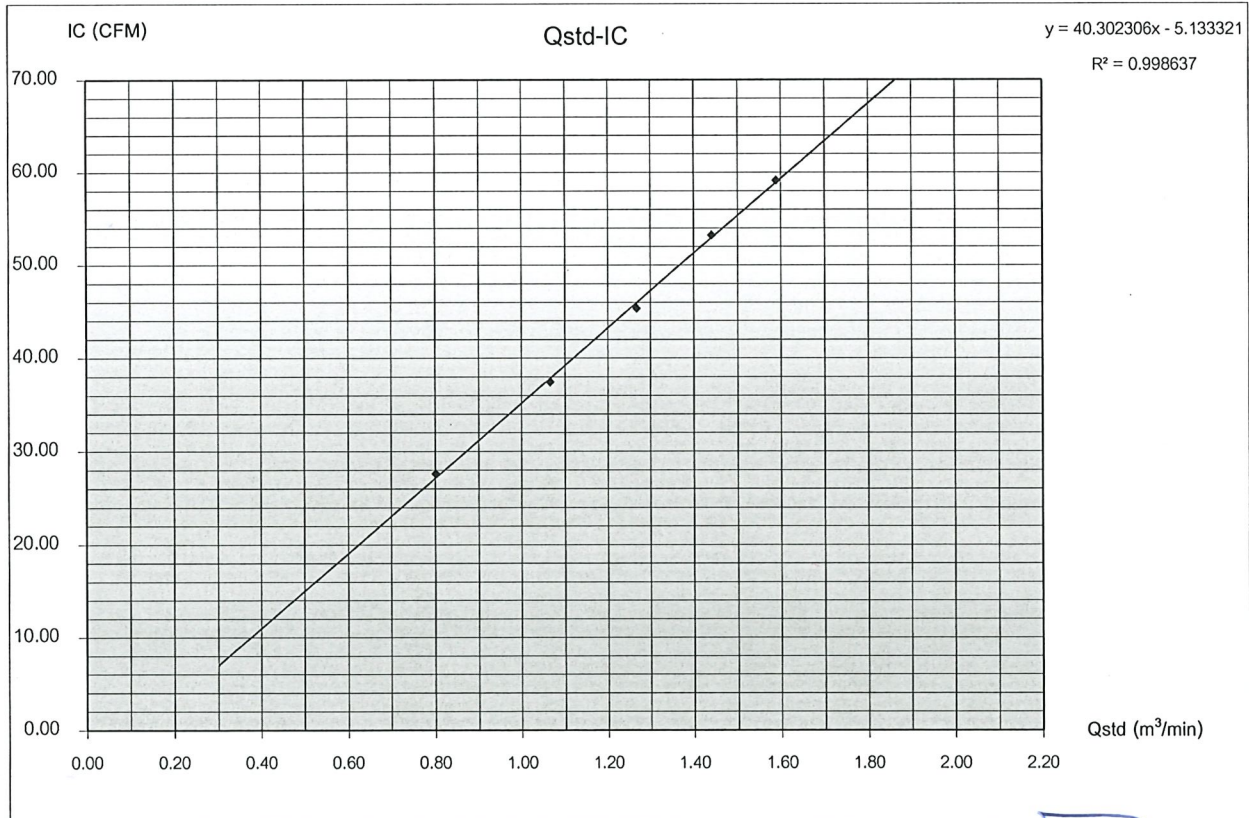
Sampler Location				Date	May 17, 2022
บ้านคลองสมบุญ หมู่ที่ 13 ตำบลหัวน้ำ				Start Time	12:25: PM
Sampler Number	PM-10 No.10	Transfer Standard Type	Orifice	Stop Time	12:35 PM
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Woradech Rungprasert
Motor Serial Number	610-047	Calibrator Serial Number	3883		
Recorder Serial Number	102940701				

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH ₂ O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$	sample Flow Rate Indication	$IC = I[(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	(°K = °C+273)	(mmHg)		
	Positive	Negative	ΔH ₂ O		(m ³ /min)	(ft ³ /min)					
5	1.4	1.4	2.8	1.64965	0.80131	28.0	27.60	305.0	756.0		
7	2.5	2.5	5.0	2.20444	1.06613	38.0	37.46	305.0	756.0		
10	3.5	3.6	7.1	2.62689	1.26777	46.0	45.35	305.0	756.0		
13	4.6	4.6	9.2	2.99024	1.44121	54.0	53.24	305.0	756.0		
18	5.6	5.6	11.2	3.29930	1.58872	60.0	59.15	305.0	756.0		
Linear Regression Y ON X : Y= mX + b							Average	305.0	756.0		

1	Slope (m)	2.09503	Linear Equation			r^2	0.998637	Pstd(mmHg)	760.0
2	Intercept (b)	-0.02913	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9993183	T _{NTP}	298.0
3	Correlation Coefficient (r)	0.99999	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.971906816	
Result						C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.985853344	

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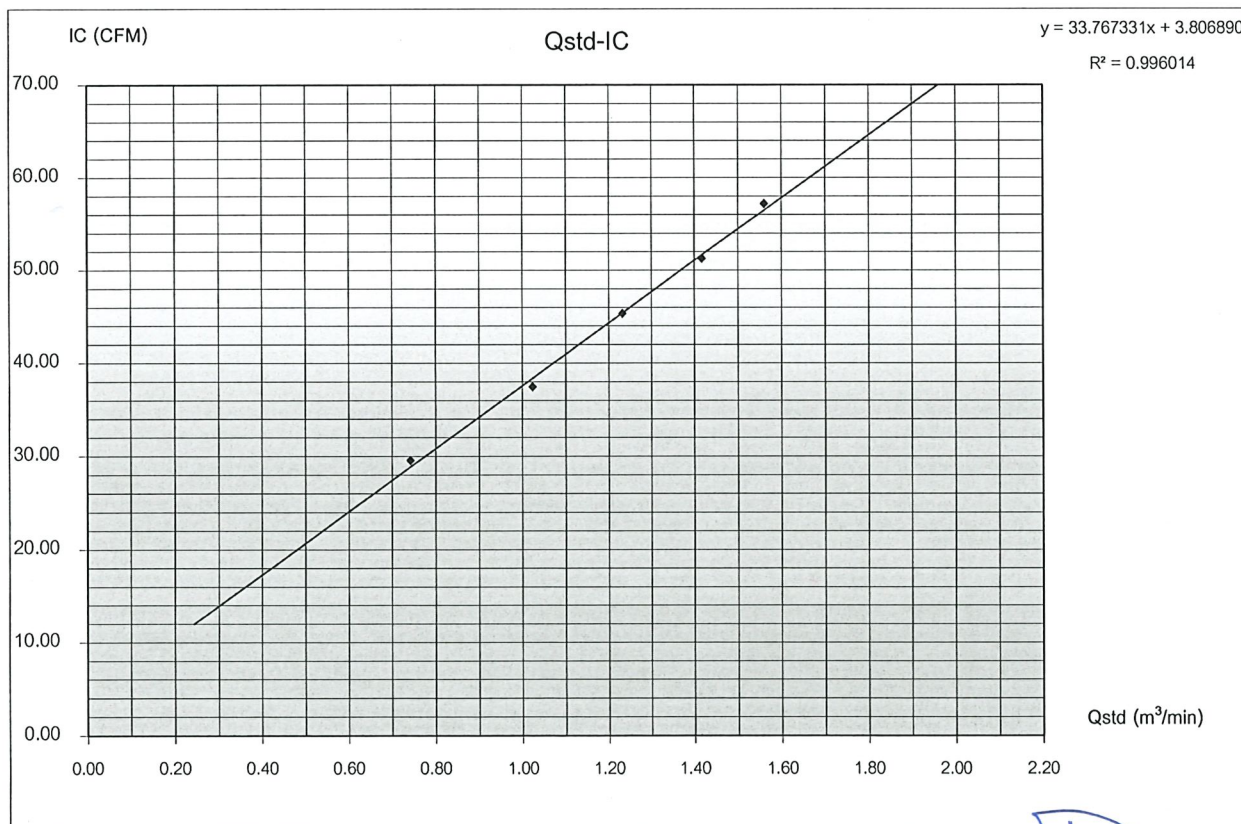
TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	May 17, 2022
บ้านโป่งกระทู้ หมู่ที่ 9 ตำบลหนองโพรง				Start Time	14:30:00 PM
Sampler Number	TSP No.A1	Transfer Standard Type	Orifice	Stop Time	14:40:00 PM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Woradech Rungprasert
Motor Serial Number	3680	Calibrator Serial Number	3883		
Recorder Serial Number	954				

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH ₂ O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$	Sample Flow Rate Indication	$IC = I[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$				
	Positive	Negative	ΔH_2O		(m ³ /min)	(ft ³ /min)		(°K = °C+273)	(mmHg)		
5	1.2	1.2	2.4	1.52728	0.74290	30.0	29.58	305.0	756.0		
7	2.3	2.3	4.6	2.11442	1.02316	38.0	37.46	305.0	756.0		
10	3.3	3.4	6.7	2.55182	1.23194	46.0	45.35	305.0	756.0		
13	4.4	4.5	8.9	2.94108	1.41774	52.0	51.26	305.0	756.0		
18	5.4	5.4	10.8	3.23984	1.56035	58.0	57.18	305.0	756.0		
Linear Regression Y ON X : Y= mX + b							Average	305.0	756.0		
1	Slope (m)			2.09503	Linear Equation			r ²	0.996014	Pstd(mmHg)	760.0
2	Intercept (b)			-0.02913	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.998005	T _{NTP}	298.0
3	Correlation Coefficient (r)			0.99999	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)			0.971906816
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5			0.985853344

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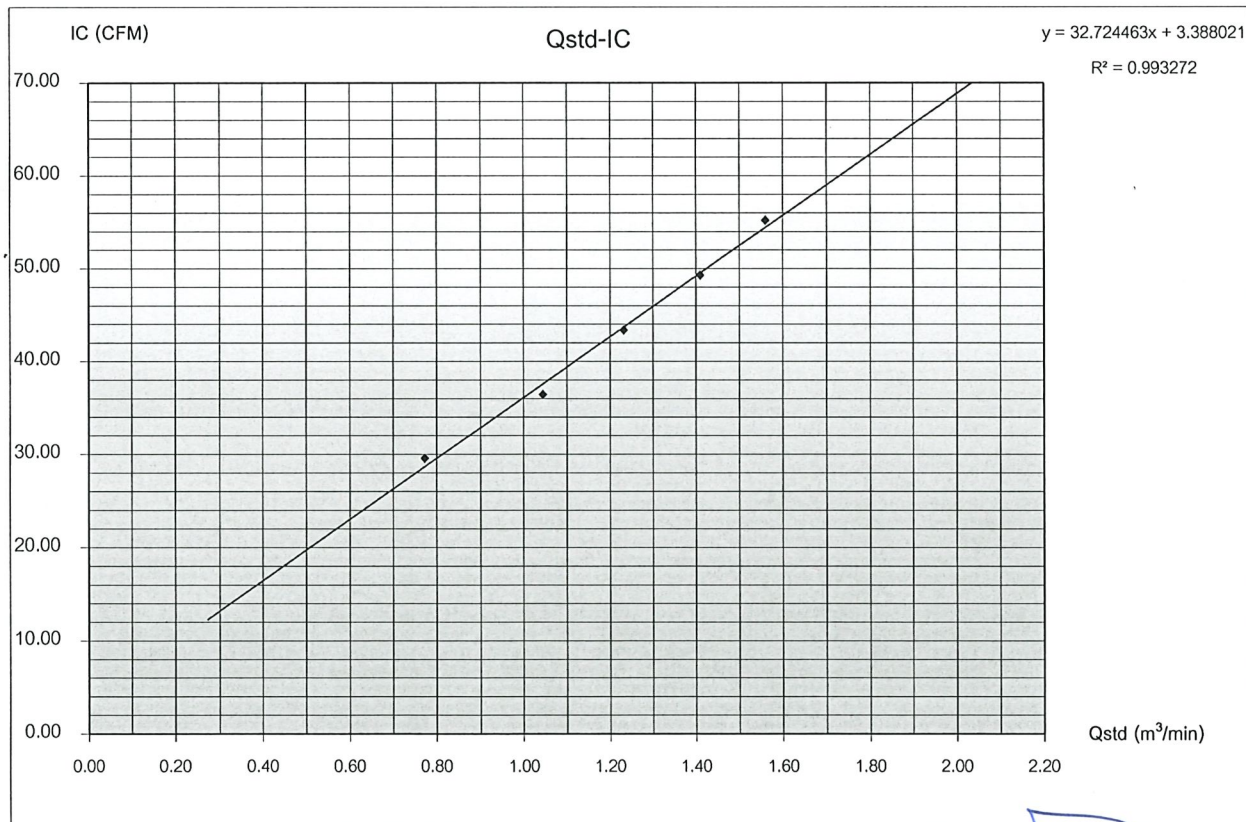
PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	May 17, 2022
บ้านโป่งกระพ้อ หมู่ที่ 9 ตำบลหนองโพรง				Start Time	14:20:00 PM
Sampler Number	PM-10 No.2	Transfer Standard Type	Orifice	Stop Time	14:30:00 PM
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Woradech Rungprasert
Motor Serial Number	610-644	Calibrator Serial Number	3883		
Recorder Serial Number	7139				

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)] (m ³ /min)	sample Flow Rate Indicato (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	1.3	1.3	2.6	1.58964	0.77267	30.0	29.58	305.0	756.0		
7	2.4	2.4	4.8	2.15990	1.04487	37.0	36.48	305.0	756.0		
10	3.3	3.4	6.7	2.55182	1.23194	44.0	43.38	305.0	756.0		
13	4.4	4.4	8.8	2.92451	1.40983	50.0	49.29	305.0	756.0		
18	5.4	5.4	10.8	3.23984	1.56035	56.0	55.21	305.0	756.0		
Linear Regression Y ON X : Y= mX + b							Average	305.0	756.0		
1	Slope (m)			2.09503	Linear Equation			r ²	0.993272	Pstd(mmHg)	760.0
2	Intercept (b)			-0.02913	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9966303	T _{NTP}	298.0
3	Correlation Coefficient (r)			0.99999	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.971906816	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.985853344	

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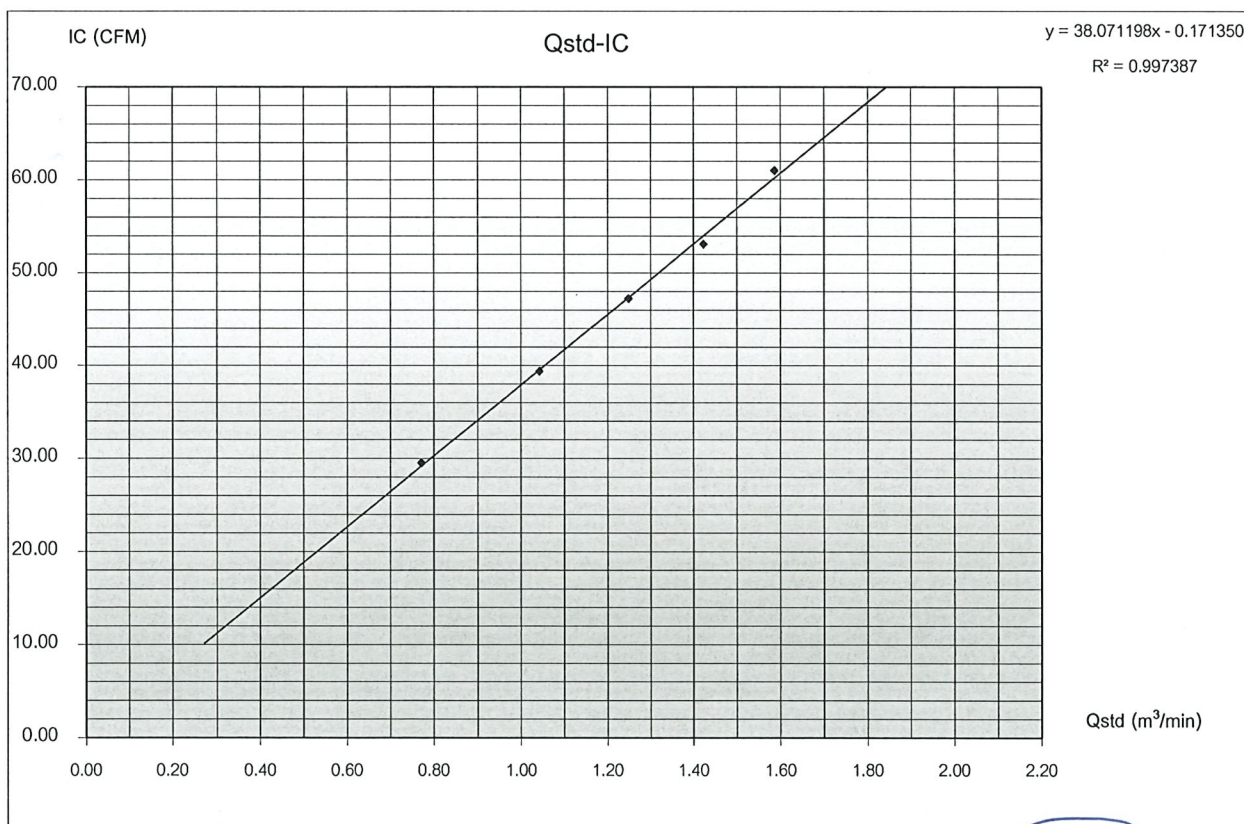
TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	May 17, 2022
บ้านโคกอุดมดี หมู่ที่ 12 ตำบลหัวหว้า				Start Time	13:20:00 PM
Sampler Number	TSP No.A8	Transfer Standard Type	Orifice	Stop Time	13:30:00 PM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Woradech Rungprasert
Motor Serial Number	BLA0902	Calibrator Serial Number	3883		
Recorder Serial Number	11452				

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)] (m ³ /min)	sample Flow Rate Indication (ft ³ /min)	IC = I[(Pa/P _{std})(T _{std} /Ta)] ^{1/2}	(*K = °C+273)	(mmHg)			
	Positive	Negative	ΔH ₂ O									
5	1.3	1.3	2.6	1.58704	0.77143	30.0	29.53	306.0	756.0			
7	2.4	2.4	4.8	2.15636	1.04318	40.0	39.37	306.0	756.0			
10	3.4	3.5	6.9	2.58539	1.24796	48.0	47.24	306.0	756.0			
13	4.5	4.5	9.0	2.95272	1.42330	54.0	53.15	306.0	756.0			
18	5.6	5.6	11.2	3.29390	1.58615	62.0	61.02	306.0	756.0			
Linear Regression Y ON X : Y= mX + b							Average	306.0	756.0			
1	Slope (m)			2.09503	Linear Equation			r ²	0.997387	Pstd(mmHg)	760.0	
2	Intercept (b)			-0.02913	Set Point Flow Rate (X) (m ³ /min)			1.133	r	0.9986926	T _{NTP}	298.0
3	Correlation Coefficient (r)			0.99999	Final Set Flow Rate = (I)			0	(Pa/Pstd)*(Tstd/Ta)		0.96873065	
Result									C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.984241154	

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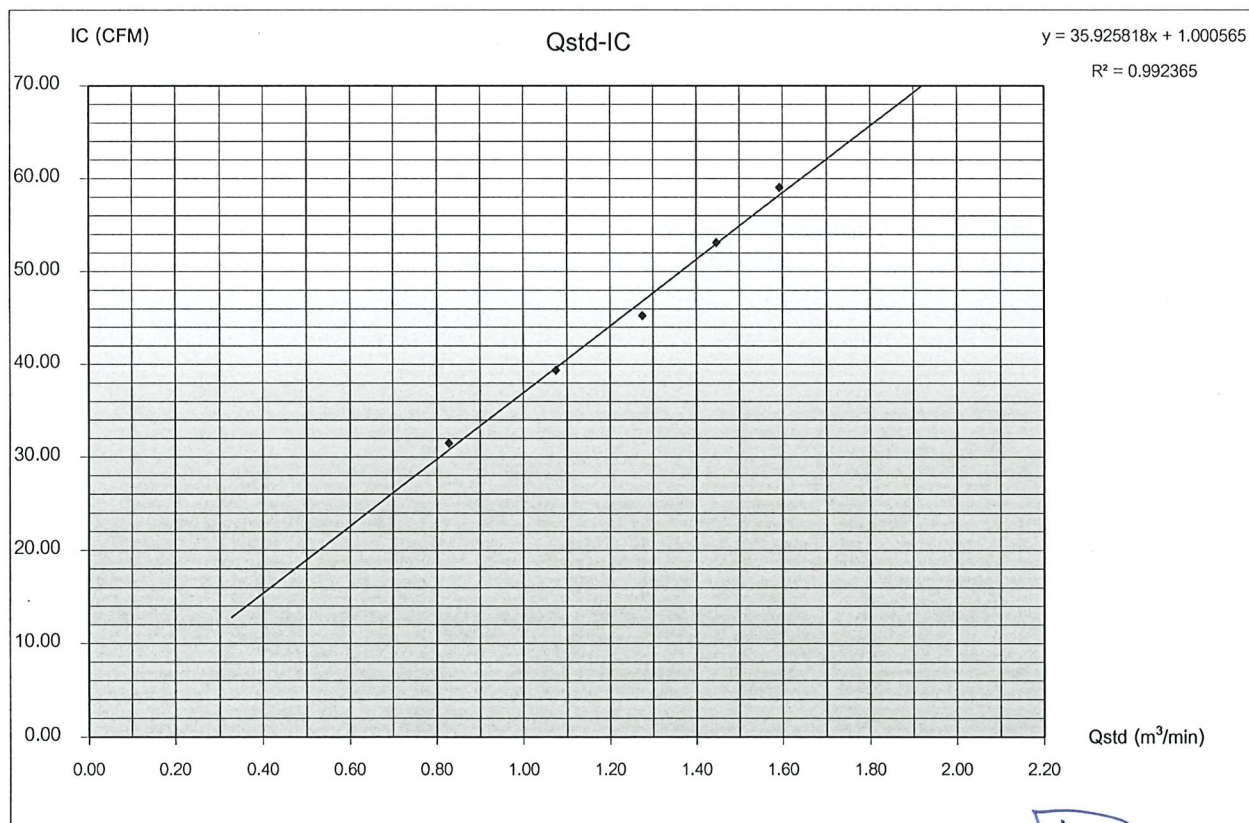
PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	May 17, 2022
บ้านโคกจุดมด หมู่ที่ 12 ตำบลหัววัว				Start Time	13:30:00 PM
Sampler Number	PM-10 No.28	Transfer Standard Type	Orifice	Stop Time	13:40:00 PM
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Woradech Rungprasert
Motor Serial Number	2206	Calibrator Serial Number	3883		
Recorder Serial Number	7281				

Plate No.	(Delta H)			(A) [ΔH ₂ O(Pa/P _{std})(T _{std} /Ta)] ^{1/2}	(X) Qstd = (1/m)[(A-b)] (m ³ /min)	(I) ample Flow Rate Indicato (ft ³ /min)	(Y) IC = I[(Pa/P _{std})(T _{std} /Ta)] ^{1/2}	Temperature	Barometric	Start	Stop
	Pressure Drop Across Orifice (inH ₂ O)							Pressure (mmHg)	Meter	Meter	
	Positive	Negative	ΔH ₂ O								
5	1.5	1.5	3.0	1.70476	0.82762	32.0	31.50	306.0	756.0		
7	2.6	2.5	5.1	2.22273	1.07486	40.0	39.37	306.0	756.0		
10	3.6	3.6	7.2	2.64100	1.27450	46.0	45.28	306.0	756.0		
13	4.6	4.7	9.3	3.00153	1.44660	54.0	53.15	306.0	756.0		
18	5.6	5.7	11.3	3.30857	1.59315	60.0	59.05	306.0	756.0		
Linear Regression Y ON X : Y= mX + b							Average	306.0	756.0		
1	Slope (m)			2.09503	Linear Equation			r ²	0.992365	Pstd(mmHg)	760.0
2	Intercept (b)			-0.02913	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9961752	T _{NTP}	298.0
3	Correlation Coefficient (r)			0.99999	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)			0.96873065
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5			0.984241154

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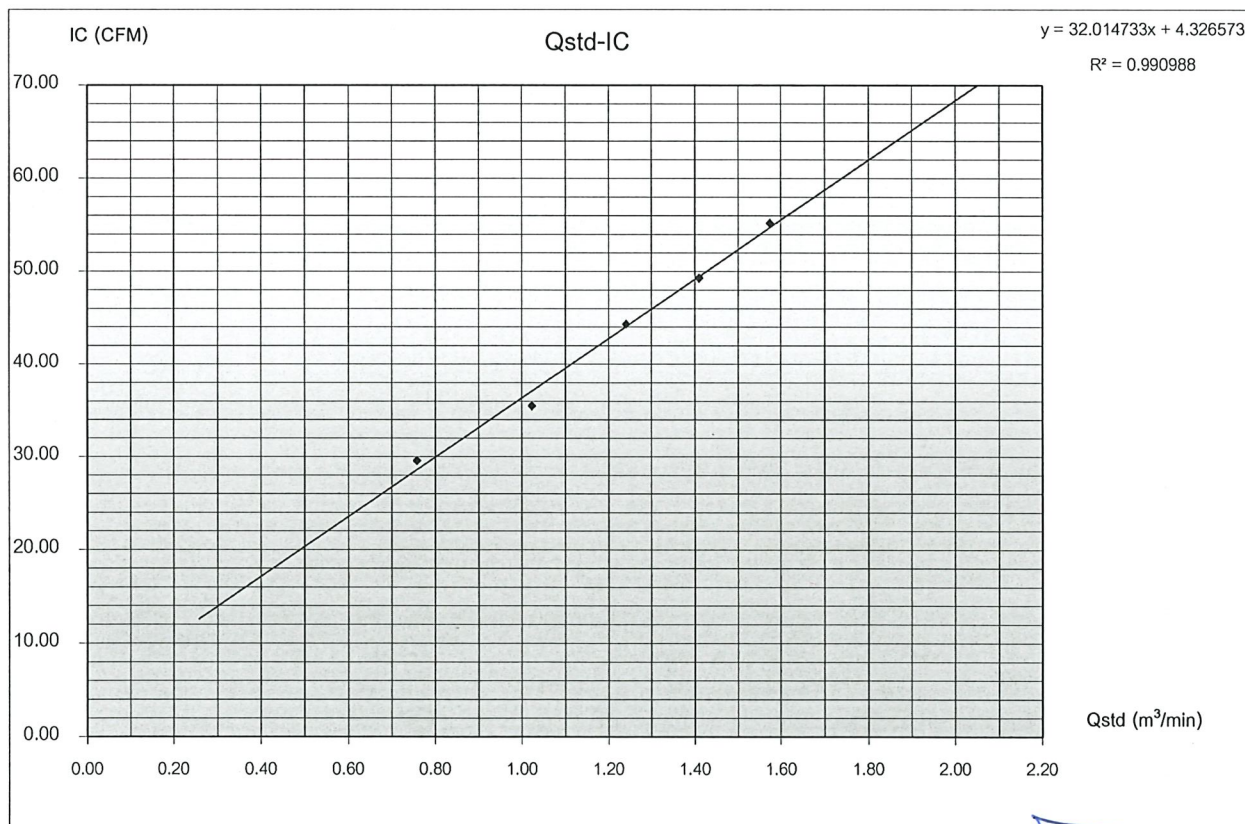
TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	May 17, 2022
วัดใหม่ประจวบ บ้านวังตะพาน หมู่ที่ 11				Start Time	15:20:00 PM
Sampler Number	TSP No.A19	Transfer Standard Type	Orifice	Stop Time	15:30:00 PM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Woradech Rungprasert
Motor Serial Number	2014-04	Calibrator Serial Number	3883		
Recorder Serial Number	7372				

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric	Start	Stop
No.	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 Indicato (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	1.2	1.3	2.5	1.55877	0.75794	30.0	29.58	305.0	756.0		
7	2.3	2.3	4.6	2.11442	1.02316	36.0	35.49	305.0	756.0		
10	3.4	3.4	6.8	2.57079	1.24099	45.0	44.36	305.0	756.0		
13	4.4	4.4	8.8	2.92451	1.40983	50.0	49.29	305.0	756.0		
18	5.5	5.5	11.0	3.26971	1.57460	56.0	55.21	305.0	756.0		
Linear Regression Y ON X : Y= mX + b							Average	305.0	756.0		
1	Slope (m)			2.09503	Linear Equation			r ²	0.990988	Pstd(mmHg)	760.0
2	Intercept (b)			-0.02913	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9954838	T _{NTP}	298.0
3	Correlation Coefficient (r)			0.99999	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.971906816	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.985853344	

COMMENT

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Technician



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Environmental Scientist

PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	May 17, 2022
วัดใหม่ประชุมชน บ้านวังตะพาน หมู่ที่ 11				Start Time	15:30: PM
Sampler Number	PM-10 No.19	Transfer Standard Type	Orifice	Stop Time	15:40:00 PM
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Woradech Rungprasert
Motor Serial Number	2133	Calibrator Serial Number	3883		
Recorder Serial Number	2396				

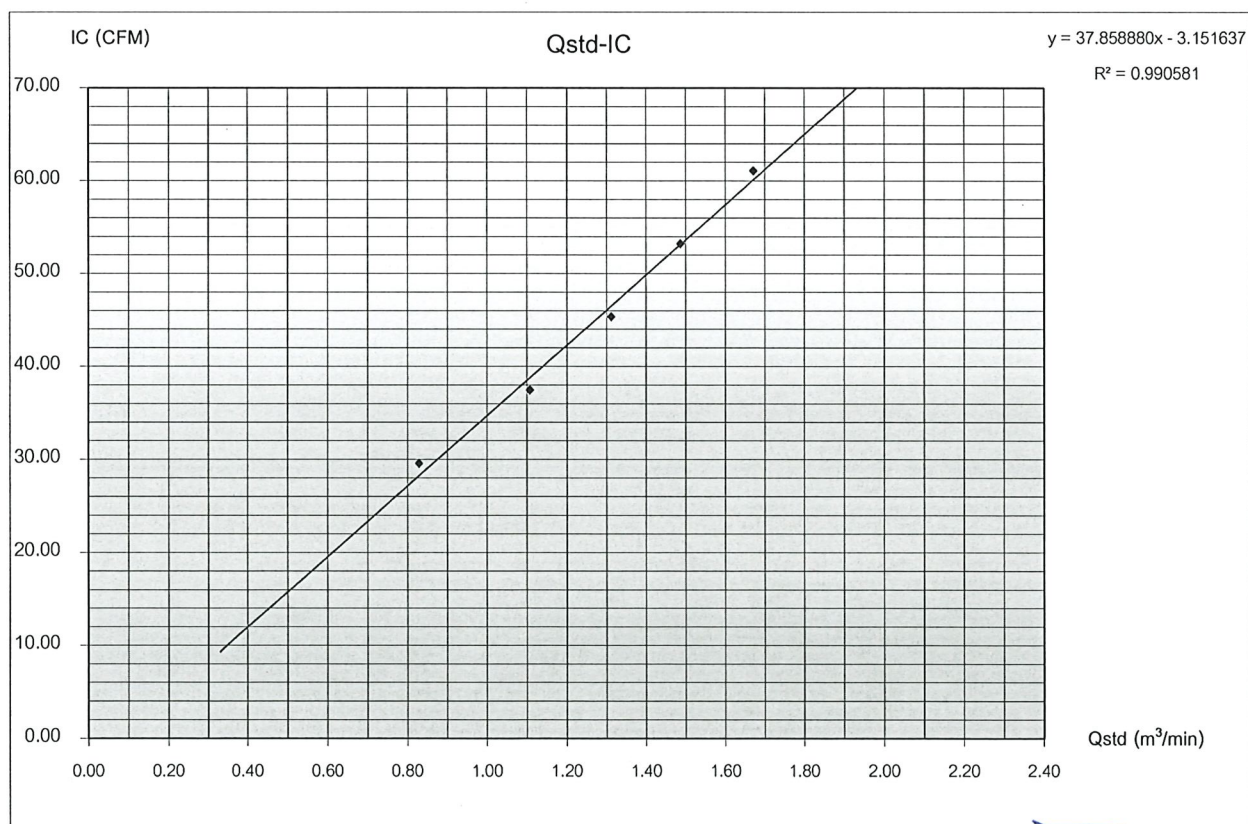
Plate No.	(Delta H) Pressure Drop Across Orifice (inH ₂ O)			(A) $[\Delta H_2O(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	(X) Qstd = (1/m)[(A-b)] (m ³ /min)	(I) sample Flow Rate Indication (ft ³ /min)	(Y) $IC = I[(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	Temperature (°K = °C+273)	Barometric Pressure (mmHg)	Start Meter	Stop Meter
	Positive	Negative	ΔH ₂ O								
5	1.5	1.5	3.0	1.70755	0.82895	30.0	29.58	305.0	756.0		
7	2.7	2.7	5.4	2.29092	1.10740	38.0	37.46	305.0	756.0		
10	3.8	3.8	7.6	2.71781	1.31117	46.0	45.35	305.0	756.0		
13	4.9	4.9	9.8	3.08621	1.48701	54.0	53.24	305.0	756.0		
18	6.2	6.2	12.4	3.47155	1.67094	62.0	61.12	305.0	756.0		

Linear Regression Y ON X : Y= mX + b

1		Slope (m)	2.09503	Linear Equation		Average	r^2	0.990581	Pstd(mmHg)	760.0
2		Intercept (b)	-0.02913	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9952794	T _{NTP}	298.0
3		Correlation Coefficient (r)	0.99999	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.971906816	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.985853344

COMMENT

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Technician

Approved By

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Environmental Scientist

Certificate of Calibration

Calibration Certification Information

Cal. Date: February 24, 2021 Roots-meter S/N: 438320 Ta: 294 °K
 Operator: Jim Tisch Pa: 750.1 mm Hg
 Calibration Model #: TE-5025A Calibrator S/N: **3883**

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4470	3.2	2.00
2	3	4	1	1.0230	6.4	4.00
3	5	6	1	0.9140	8.0	5.00
4	7	8	1	0.8730	8.8	5.50
5	9	10	1	0.7210	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)
0.9961	0.6884	1.4145	0.9957	0.6881	0.8854
0.9918	0.9695	2.0004	0.9915	0.9692	1.2521
0.9897	1.0828	2.2365	0.9893	1.0824	1.3999
0.9886	1.1324	2.3456	0.9883	1.1320	1.4683
0.9833	1.3638	2.8289	0.9829	1.3633	1.7708
QSTD	m=	2.09503	QA	m=	1.31187
	b=	-0.02913		b=	-0.01823
	r=	0.99999		r=	0.99999

Calculations

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



PLAY SOLUTION TECHNOLOGY COMPANY LIMITED
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

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%



PLAY SOLUTION TECHNOLOGY COMPANY LIMITED
179/75 Nawong Pracha Pattana Road, Sikan, Donmuang, Bangkok 10210
Tel.:+66 2 011 0505, Fax:+66 2 010 7700
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CERTIFICATE OF CALIBRATION

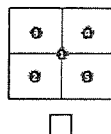
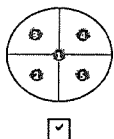
Result of Calibration

Certificate no. PST-0001-22

Page no. 3 of 3

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

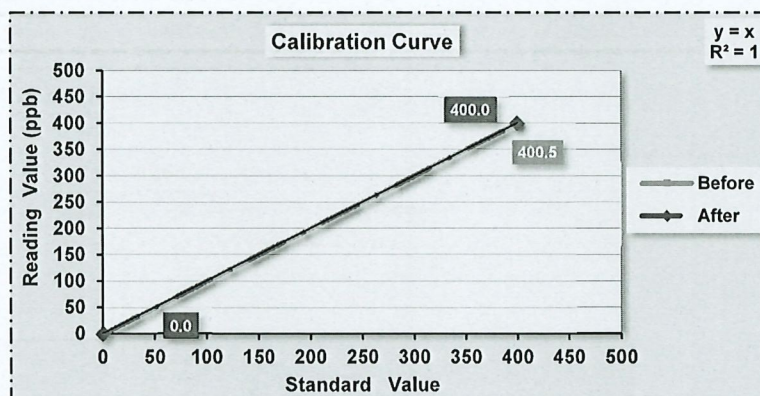
Equipment	Gas Analyzer (NOx)	Customer Name	โพธิ์เพชร คอนซัลแตนต์
Manufacture	HORIBA	Location	Envi Research
Model	APNA-370	Scientist	Panupon
Serial No.	PA6WVAJ9	Calibration Date	April 21, 2022
Analyzer Unit	ppb	Time	2:30 PM

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	-0.3	0.0	-0.3	0.0	0.0	0.0	-	-	-
Span	400	400.2	400.0	400.5	400.0	-0.3	0.0	-	-	0.1



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	0.6	Voltage of the measured NO value
Signal NOx	mV	15.9	16.9	Voltage of the measured NOx value
Detector	°C	41.2	41.2	43 °C ± 5 °C
Ambient	kPa	100.2	100.2	Current atmospheric pressure
DC 24V	V	23.6	23.6	24V ±0.5
DC 5V	V	5.0	5.0	5V ±0.5
NO Slope	-	0.85210	0.84930	0.50000 - 2.0000
NOx Slope	-	0.83140	0.82900	0.50000 - 2.0000

Calibrate By :

(MR.PANUPON PODANG)
April 21, 2022



Checked By :

(MS.SUTATIP IM-NOI)
April 21, 2022

Calibration Data of NOx Analyzer

Analyzer Performance Test

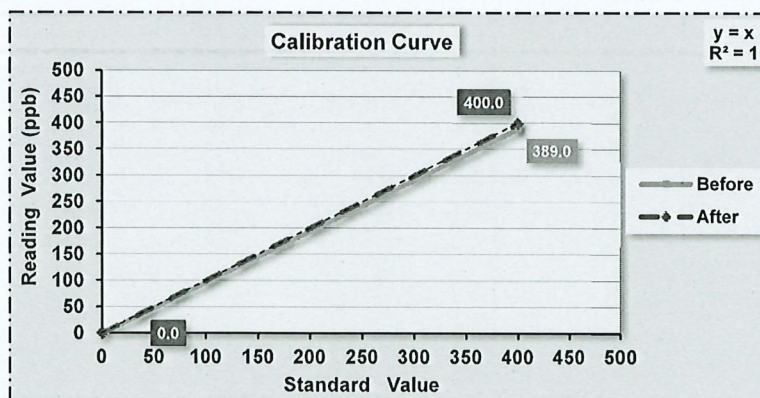
Equipment	Gas Analyzer (NOx)	Customer Name	โพรเพียร์ คอนซัลแตนต์
Manufacture	HORIBA	Location	Envi Research
Model	APNA-370	Scientist	Panupon
Serial No.	AX7HSME0	Calibration Date	April 12, 2022
Analyzer Unit	ppb	Time	11:49 AM

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	-5.0	0.0	-0.9	0.0	-4.1	0.0	-	-	-
Span	400	376.7	400.0	389.0	400.0	-12.3	0.0	-	-	2.8



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	0.2	0.3	Voltage of the measured NO value
Signal NOx	mV	11.1	11.2	Voltage of the measured NOx value
Detector	°C	40.6	40.6	43 °C ± 5 °C
Ambient	kPa	101.0	100.9	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	-	0.77960	0.97730	0.50000 - 2.0000
NOx Slope	-	0.75770	0.98700	0.50000 - 2.0000

Calibrate By :

(MR.PANUPON PODANG)

April 12, 2022



Checked By :

(MS.SUTATIP IM-NOI)

April 12, 2022

Calibration Data of NOx Analyzer

Analyzer Performance Test

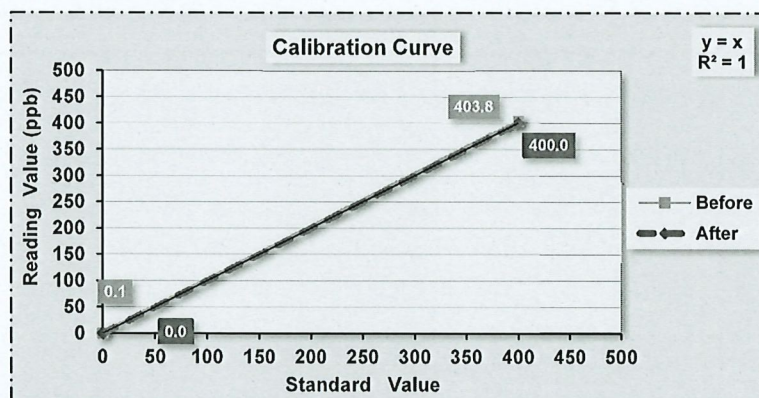
Equipment	Gas Analyzer (NOx)	Customer Name	โพธิ์เทพย์ คอนซิลแดนด์
Manufacture	HORIBA	Location	Envi Research
Model	APNA-370	Scientist	Panupon
Serial No.	A4LUUFHB	Calibration Date	May 13, 2022
Analyzer Unit	ppb	Time	10:11 AM

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	0.1	0.0	-0.3	0.0	-	-	-
Span	400	405.0	400.0	403.8	400.0	1.2	0.0	-	-	1.0



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	3.3	3.1	Voltage of the measured NO value
Signal NOx	mV	18.8	19.1	Voltage of the measured NOx value
Detector	°C	41.6	41.6	43 °C ± 5 °C
Ambient	kPa	100.6	100.6	Current atmospheric pressure
DC 24V	V	23.8	23.6	24V ±0.5
DC 5V	V	5.0	5.0	5V ±0.5
NO Slope	-	0.98970	0.98220	0.50000 - 2.0000
NOx Slope	-	0.98260	0.97540	0.50000 - 2.0000

Calibrate By :

(MR.PANUPON PODANG)
May 13, 2022



Checked By :

(MS.SUTATIP IM-NOI)
May 13, 2022

Calibration Data of NOx Analyzer

Analyzer Performance Test

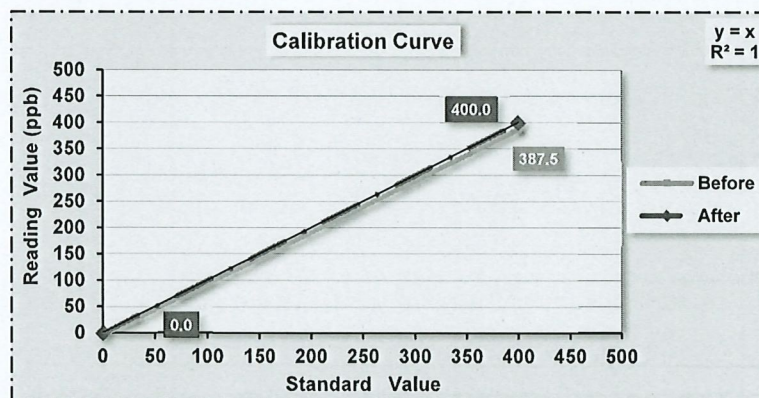
Equipment	Gas Analyzer (NOx)	Customer Name	โพธิ์เพียร คอนซัลแตนต์
Manufacture	HORIBA	Location	Envi Research
Model	APNA-370	Scientist	Panupon
Serial No.	4VWFEBUK	Calibration Date	April 18, 2022
Analyzer Unit	ppb	Time	1:29 PM

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	-12.3	0.0	-3.4	0.0	-8.9	0.0	-	-	-
Span	400	385.8	400.0	387.5	400.0	-1.7	0.0	-	-	3.1



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	1.3	1.9	Voltage of the measured NO value
Signal NOx	mV	5.5	9.1	Voltage of the measured NOx value
Detector	°C	41.4	41.3	43 °C ± 5 °C
Ambient	kPa	100.6	100.5	Current atmospheric pressure
DC 24V	V	23.8	23.8	24V ±0.5
DC 5V	V	5.0	5.0	5V ±0.5
NO Slope	-	1.42100	1.54130	0.50000 - 2.0000
NOx Slope	-	1.33000	1.42210	0.50000 - 2.0000

Calibrate By :

(MR.PANUPON PODANG)
April 18, 2022



Checked By :

(MS.SUTATIP IM-NOI)
April 18, 2022

Calibration Data of SO₂ Analyzer

Analyzer Performance Test

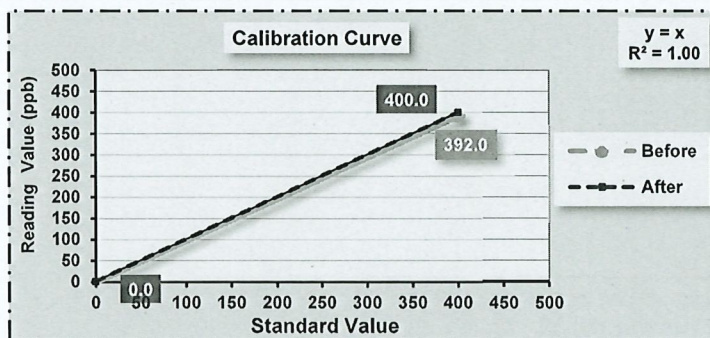
Equipment	Gas Analyzer (SO ₂)	Customer Name	โพธิ์เพชร คอนซัลแตนต์
Manufacture	Horiba	Location	Envi Research
Model	APSA-370	Scientist	Panupon
Serial No.	E5KBWB08	Calibration Date	April 10, 2022
Analyzer Unit	ppb	Time	12:55 PM

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	-0.1	0.0	-	-	-
Span	400	392.0	400.0	-	-	2.0



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	7.4	7.6	Voltage of the measured SO ₂ value
LAMP	mV	503.5	54.1	200 mV - 1200 mV
CELL	°C	35.4	33.7	Ambient temperature + 5 °C - 15 °C
PUMP	Kpa	44.9	44.8	65 kPa or less
AMBIENT	kPa	100.7	100.7	Current atmospheric pressure
DC 24V	V	23.9	23.9	24 V ±0.5 V
DC 5V	V	5.0	5.0	5 V ±0.5 V

Calibrate By :

(MR.PANUPON PODANG)

April 10, 2022

Checked By :

(MS.SUTATIP IM-NOI)

April 10, 2022

Calibration Data of SO₂ Analyzer

Analyzer Performance Test

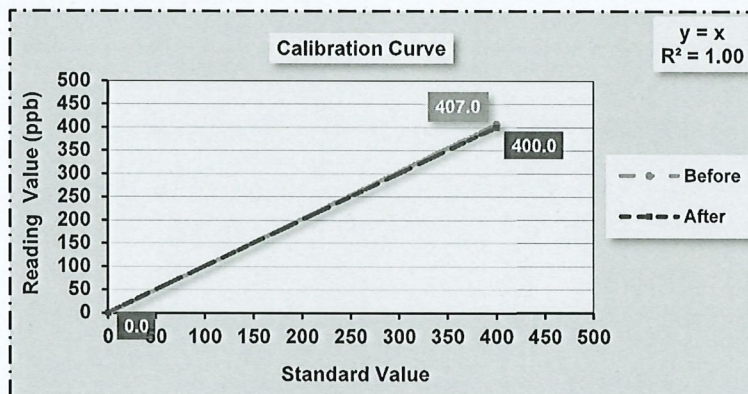
Equipment	Gas Analyzer (SO ₂)	Customer Name	โพธิ์เกียรติ์ คอนซัลแตนต์
Manufacture	Thermo	Location	Envi Research
Model	43C	Scientist	Panupon
Serial No.	60772-328/2	Calibration Date	April 20, 2022
Analyzer Unit	ppb	Time	2:15 PM

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	407.0	400.0	-	-	1.8



STATUS TEST AND VALIDATION OF SO₂ ANALYZER MODEL 43C

Parameter	Display As	Unit	Observed Value		Nominal Range
			Before Adjust	After Adjust	
Range	RANGE	ppb	500	500	0 - 500 standard
Internal Temperature	INTERNAL	°C	32.2	32.5	8.0 °C to 47.0 °C
Chamber Temp	CHAMBER	°C	45.3	45.4	43.0 °C to 47.0 °C
Pressure	PRESSURE	mmHg	693.6	693.7	400.0 to 1,000
Sample Flow	SAMP FLOW	LPM	0.477	0.477	0.350 to 1.000
Lamp Intensity	INTENSITY	Hz	33,604	33,423	20,000 to 50,000
Lamp Voltage	LAMP VOLTAGE	V	898	898	750 to 1,200
SO ₂ Concentration	SO ₂ CONCENTRATION	ppb	1.6	1.4	0 to 10,000
Motherboard Status	MOTHERBOARD STATUS	-	OK	OK	OK
Interface Status	INTERFACE STATUS	-	OK	OK	OK

Calibrate By :

(MR.PANUPON PODANG)
April 20, 2022

Checked By :

(MS.SUTATIP IM-NOI)
April 20, 2022

Calibration Data of SO₂ Analyzer

Analyzer Performance Test

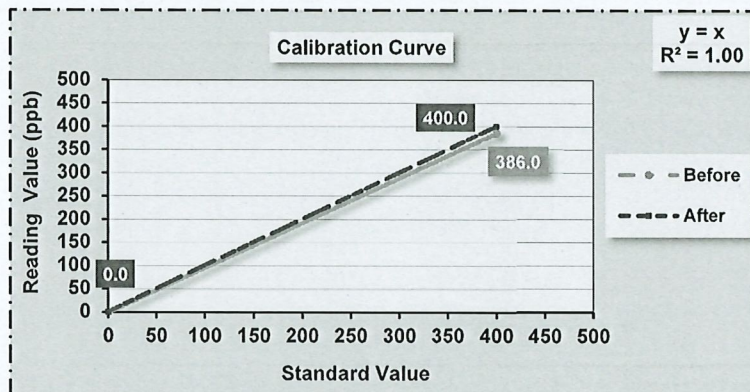
Equipment	Gas Analyzer (SO ₂)	Customer Name	โพธิ์เทพย์ คอนซัลแตนต์
Manufacture	Thermo	Location	Envi Research
Model	43C	Scientist	Panupon
Serial No.	0607415768	Calibration Date	April 20, 2022
Analyzer Unit	ppb	Time	7:39 PM

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	-0.1	0.0	-	-	-
Span	400	386.0	400.0	-	-	3.5



STATUS TEST AND VALIDATION OF SO₂ ANALYZER MODEL 43C

Parameter	Display As	Unit	Observed Value		Nominal Range
			Before Adjust	After Adjust	
Range	RANGE	ppb	500	500	0 - 500 standard
Internal Temperature	INTERNAL	°C	30.8	30.7	8.0 °C to 47.0 °C
Chamber Temp	CHAMBER	°C	44.8	44.7	43.0 °C to 47.0 °C
Pressure	PRESSURE	mmHg	734.7	734.7	400.0 to 1,000
Sample Flow	SAMP FLOW	LPM	1.416	1.417	0.350 to 1.000
Lamp Intensity	INTENSITY	Hz	23,696	23,656	20,000 to 50,000
Lamp Voltage	LAMP VOLTAGE	V	851	851	750 to 1,200
SO ₂ Concentration	SO ₂ CONCENTRATION	ppb	0.8	1.1	0 to 10,000
Motherboard Status	MOTHERBOARD STATUS	-	OK	OK	OK
Interface Status	INTERFACE STATUS	-	OK	OK	OK

Calibrate By :

(MR.PANUPON PODANG)
April 20, 2022

Checked By :

(MS.SUTATIP IM-NOI)
April 20, 2022



Calibration Data of SO₂ Analyzer

Analyzer Performance Test

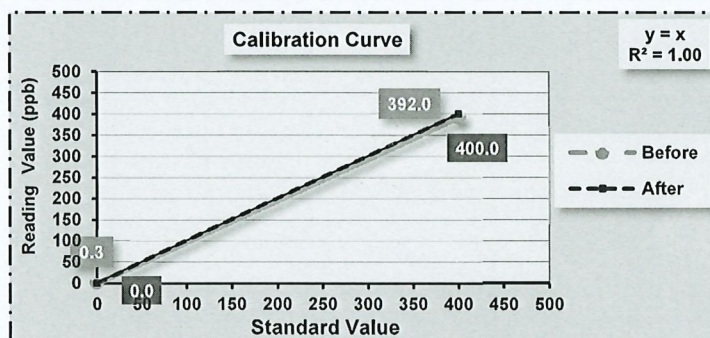
Equipment	Gas Analyzer (SO ₂)	Customer Name	โพธิ์เกียรติ์ คอนซัลแตนต์
Manufacture	Horiba	Location	Envi Research
Model	APSA-370	Scientist	Panupon
Serial No.	V4HC9062	Calibration Date	April 11, 2022
Analyzer Unit	ppb	Time	11:07 AM

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	392.0	400.0	-	-	2.0



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	16.3	16.2	Voltage of the measured SO ₂ value
LAMP	mV	409.4	407.8	200 mV - 1200 mV
CELL	°C	37.7	38.0	Ambient temperature + 5 °C - 15 °C
PUMP	Kpa	46.5	46.0	65 kPa or less
AMBIENT	kPa	101.5	101.4	Current atmospheric pressure
DC 24V	V	23.9	23.9	24 V ±0.5 V
DC 5V	V	4.9	4.9	5 V ±0.5 V

Calibrate By :

(MR.PANUPON PODANG)

April 11, 2022



Checked By :

(MS.SUTATIP IM-NOI)

April 11, 2022

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04NI99E15A0292 Reference Number: 160-401604495-1
Cylinder Number: EB0123013 Cylinder Volume: 144.4 Cubic Feet
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG
PGVP Number: A12019 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Oct 22, 2019

Expiration Date: Oct 22, 2027

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	55.00 PPM	55.27 PPM	G1	+/- 0.8% NIST Traceable	10/14/2019, 10/22/2019
NITRIC OXIDE	55.00 PPM	55.27 PPM	G1	+/- 0.8% NIST Traceable	10/14/2019, 10/22/2019
SULFUR DIOXIDE	55.00 PPM	54.93 PPM	G1	+/- 0.9% NIST Traceable	10/14/2019, 10/22/2019
CARBON MONOXIDE	4500 PPM	4516 PPM	G1	+/- 0.6% NIST Traceable	10/14/2019
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	13010429	KAL004123	97.6 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Jul 23, 2025
NTRM	13010429	KAL004123	97.6 PPM NOx/NITROGEN	+/- 0.8%	Jul 23, 2025
NTRM	16010235	KAL004419	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021
NTRM	08012318	KAL004620	4857 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 07, 2024

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
MKS FTIR - CO - 000928781	FTIR	Sep 26, 2019
MKS FTIR - NO - 000928781	FTIR	Oct 18, 2019
MKS FTIR - NOx - 000928781	FTIR	Oct 18, 2019
MKS FTIR - SO2 - 000928781	FTIR	Oct 03, 2019

Triad Data Available Upon Request

NOTES: Gross Weight: 28.0 Kg, Net Weight: 4.6 Kg.



[Signature]
Approved for Release



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 9 February, 2022

Certification No. 040/22

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : Davis Instruments Inc.

Type : Weather Wizard III Product No. 7425

Serial No. : WC20516A58 ID No. : No.13

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 1012.9 hPa

NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91563

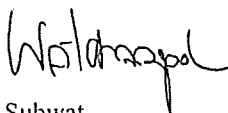
: HOOK GAGE NO 1425 Pitot Tube Theodor Friedrichs Type 0800.0000 serial 9023

N.I.S.T. Test Reference Number 731/241460

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)

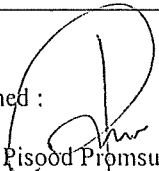
Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

Calibrated by : 

Mr. Watcharapol Subwat

Mechanical Engineer

Signed : 

Mr. Pisood Promsut





THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 040/22

9 February, 2022

Page : 2 of 2

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H2O	Vacumm inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.5	0.50
7.04	-	-	-	6.7	0.34
9.02	-	-	-	8.5	0.52
11.01	-	-	-	10.7	0.31
13.01	-	-	-	12.1	0.91
15.01	-	-	-	14.7	0.31
17.02	-	-	-	16.1	0.92
20.02	-	-	-	19.7	0.32

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

Calibrated by :

Watchapol

Mr. Watchapol Subwat

Mechanical Engineer



Meteorological Instruments Bureau

Sound Level Meter Calibration Report

Support Equipment Type : Sound Level Calibrator

Manufacture : Larson Davis

Model : CAL200

Serial No. : 3605

Range of Calibrator

- Sound Pressure Level : 94.0 dB.

- **Frequency** : 1,000 Hz.

Calibrated By : Mr.Romsea Kateh

Calibration Date : May 17, 2022

Customer Name : บริษัท โพรเทียร์ คอนซัลแตนต์ จำกัด : โครงการ โรงงานผลิตเหล็กแท่งและผลิตภัณฑ์เหล็ก
ที่ผลิตจากเหล็กถวด ของบริษัท หยงซิง สตีล (ไทยแลนด์) 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. 21-65/0141

MTC No. EEL. BP. 109/1164

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 : Precision Acoustic Calibrator
Manufacturer : Larson Davis
Model : CAL200
Serial No. : 3605

Ambient Environment
Temperature : $(23 \pm 3) ^\circ\text{C}$
Relative Humidity : $(50 \pm 15) \%$
Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$

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 of instrument was measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 26 Nov. 2021

Date of Calibration : 7 Dec. 2021

1 / 3

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

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

FM.BLMTC.002 Rev.4

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

Office/Laboratory
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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

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 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. 21-65/0141

MTC No. EEL. BP. 109/1164

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

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

Acoustic Output in dB re 20 μ Pa, Corrected to Reference Conditions : 101.325 kPa, 23.0 $^\circ\text{C}$ 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&Kjaer4180	93.63	-0.37	± 0.10	$\pm 0.40 \text{ dB}$

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer4180	1000.0	0.0	± 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&Kjaer4180	2.15	± 0.50	$\pm 3.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was included at level of 0.26 dB from manual.

Date of Calibration : 7 Dec. 2021

2 / 3

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FM.BLMTC.002 Rev.4

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



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0141

MTC No. EEL. BP. 109/1164

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

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	113.62	-0.38	± 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	1000.0	0.0	± 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	0.37	± 0.50	$\pm 3.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was included at level of 0.26 dB from manual.

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 : 7 Dec. 2021

Date of Issue : 8 Dec. 2021

Ref : 2011264112604951001

End of Certificate

3 / 3

The results relate only to the items tested/calibrated or value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FM.BLMTC.002 Rev.4

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Office/Laboratory
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Office
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Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

METHOD 5 PRE-TEST CONSOLE CALIBRATION
USING REFERENCE METER # WET TEST METER W-NK5A No. 540961



Preventive Maintenance & Check

5-POINT METRIC UNIT

Meter Console Information	
Console Model Number	XC-572-V
Console Serial Number	1602011
DGM Model Number	SK25EX
DGM Serial Number	0006265

Calibration Conditions			
Date	Time	05-Apr-21	9:00 AM
Calibration Reference No.	GC64APE0033		
Barometric Pressure	768	mm Hg	
Calibration Meter Gamma	0.9980	unitless	

Factors/Conversions		
Std Temp	298	K
Std Press	760	mm Hg
K ₁	0.392	

Run Time		Metering Console				Calibration Meter			
Elapsed	DGM Orifice ΔH	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final
(S)	(P _m)	(V _i)	(V _f)	(T _i)	(T _f)	(V _i)	(V _f)	(T _i)	(T _f)
min	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C	°C
15.00	13.0	0.1039	0.2761	25	26	195.21714	195.38645	25	25
10.00	25.0	0.2948	0.4562	26	27	195.40476	195.56304	25	25
8.00	50.0	0.4660	0.6493	27	27	195.57280	195.75249	25	25
7.00	80.0	0.6642	0.8691	27	28	195.76713	195.96814	25	25
5.00	120.0	0.8825	1.0618	28	29	195.98115	196.15714	25	25

Standardized Data				Results				
Dry Gas Meter		Calibration Meter		Calibration Factor		Dry Gas Meter		
(V _{std})	(Q _m)	(V _{std})	(Q _m)	Value	Variation	Flowrate	ΔH @	Variation
m ³	m ³ /min	m ³	m ³ /min	(Y)	(ΔY)	Std & Corr (Q _{std})	(ΔH@)	(ΔΔH@)
						m ³ /min	mm H ₂ O	
0.172	0.011	0.168	0.011	0.982	0.001	0.011	47.170	1.259
0.160	0.016	0.157	0.016	0.981	0.001	0.016	46.084	0.173
0.182	0.023	0.179	0.022	0.980	0.000	0.022	45.914	0.003
0.204	0.029	0.200	0.029	0.980	-0.001	0.029	45.132	-0.780
0.179	0.036	0.175	0.035	0.980	-0.001	0.035	45.255	-0.656
				0.980	Y Average		45.911	ΔH@ Average

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ± 0.02 .

Note: For ΔH_g, orifice pressure differential that equates to 0.75cm (0.0212m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 0.2 inches (5.1mm) H₂O.

Signature

(Surachai Chaisana)
Service Engineer

บริษัท สิทธีพรแอสโซซิเอต จำกัด

SITHIPORN ASSOCIATES COMPANY LIMITED

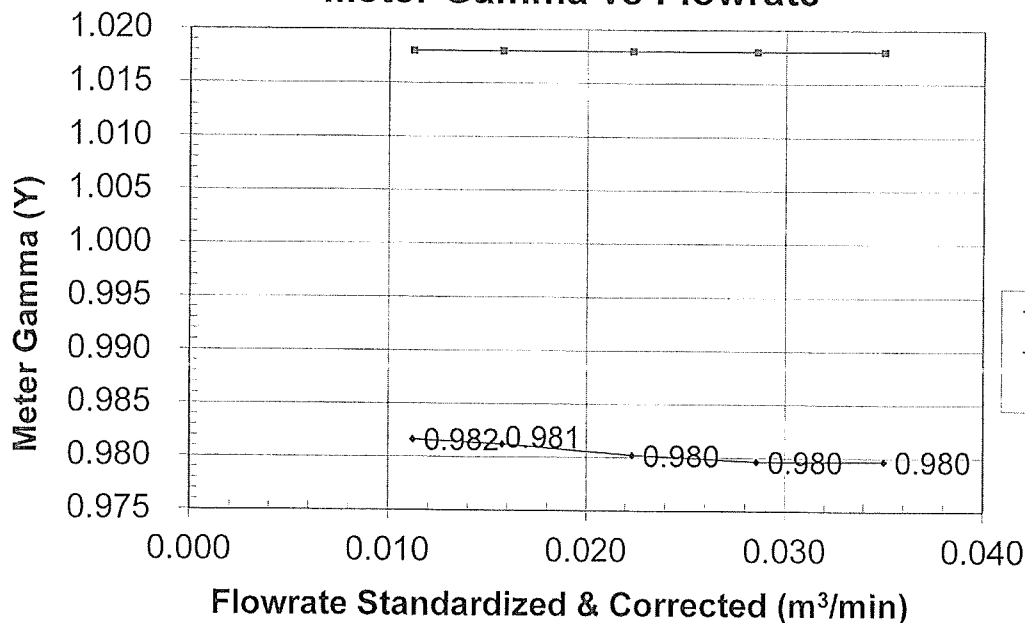
Date

05/04/2021

Calibration Date: 4-5-2021

Calibration Reference No: GC64APE0033

Meter Gamma vs Flowrate

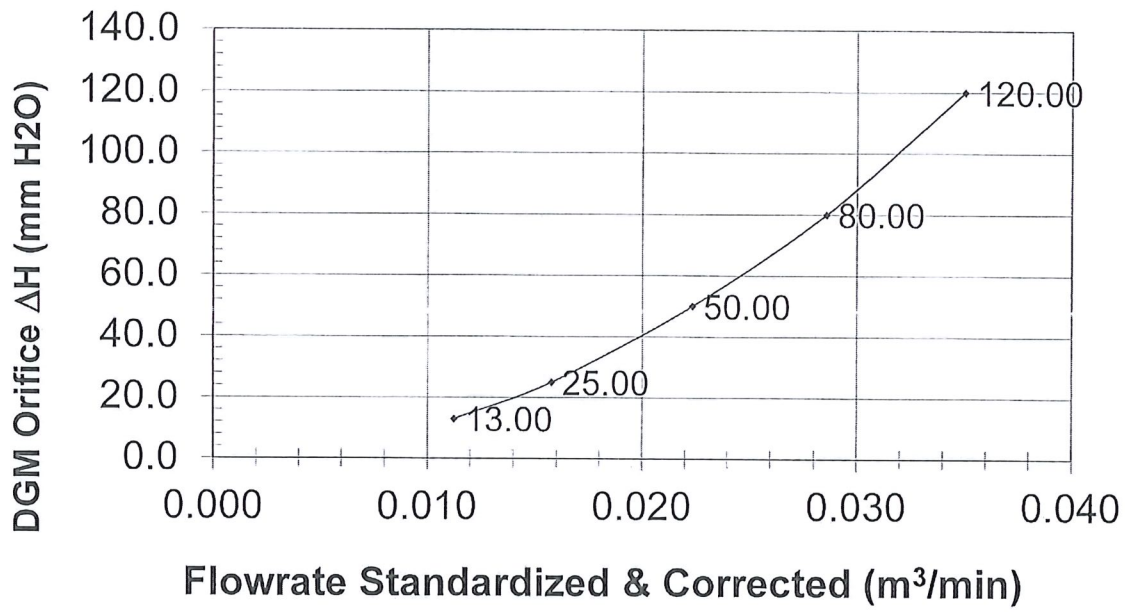


บริษัท สิทธีพรแอสโซซิเอต จำกัด
SITHIPORN ASSOCIATES COMPANY LIMITED

Console Serial: 1602011

Console Model: XC-572-V

Meter Pressure vs Flowrate



Console Serial: 1602011

บริษัท สิทธีพรแอสโซซิเอต จำกัด
SITHIPORN ASSOCIATES COMPANY LIMITED

Console Model: XC-572-V

METHOD 5 PRE-TEST CONSOLE CALIBRATION
USING REFERENCE METER # WET TEST METER W-NK5A No. 540961
5-POINT METRIC UNIT

Meter Console Information	
Console Model Number	XC-572V
Console Serial Number	0306016
DGM Model Number	SK25EX
DGM Serial Number	0005305

Calibration Conditions			
Date	Time	23-Aug-21	1:00 PM
Calibration Reference No.	GC64APE0039		
Barometric Pressure	756	mm Hg	
Calibration Meter Gamma	0.9980	unitless	

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K ₁	0.386	

Calibration Data									
Run Time		Metering Console				Calibration Meter			
Elapsed (h)	DGM Orifice ΔH (P _{sc})	Volume Initial (V _{sc})	Volume Final (V _{sc})	Outlet Temp Initial (t _{sc})	Outlet Temp Final (t _{sc})	Volume Initial (V _{sc})	Volume Final (V _{sc})	Outlet Temp Initial (t _{sc})	Outlet Temp Final (t _{sc})
min	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C	°C
15.00	13.0	0.1394	0.3486	27	27	220.39268	220.60147	27	27
10.00	25.0	0.3569	0.5658	27	27	220.61981	220.81869	27	27
8.00	50.0	0.6002	0.8191	27	27	220.85357	221.07311	27	27
7.00	80.0	0.8472	1.0854	27	27	221.10196	221.34195	27	27
5.00	120.0	1.1244	1.3330	27	27	221.38124	221.59250	27	27

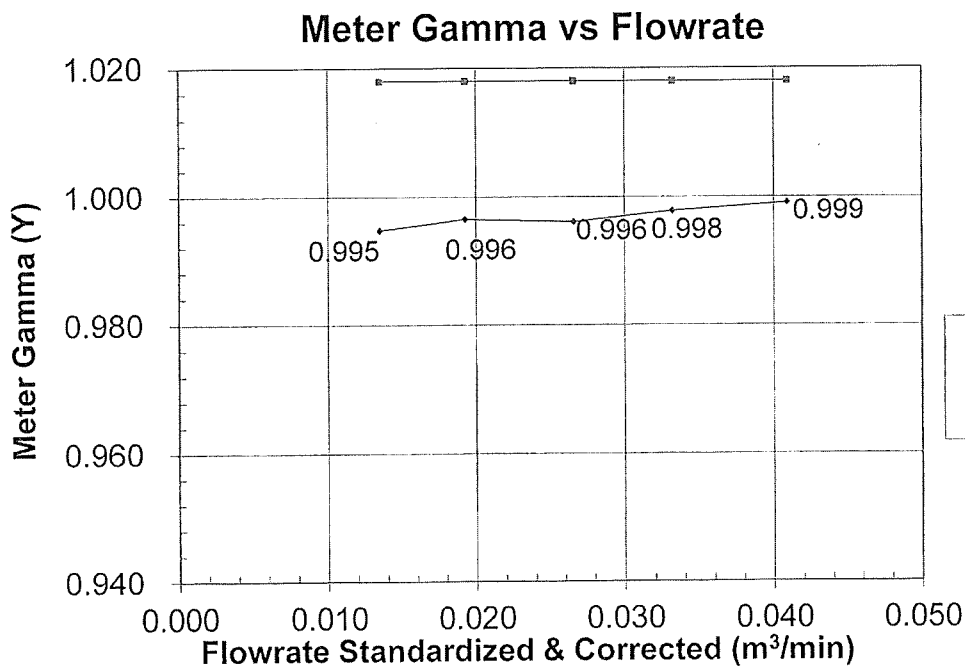
Standardized Data				Results			
Dry Gas Meter		Calibration Meter		Calibration Factor		Dry Gas Meter	
(V _{sc})	(Q _{sc})	(V _{sc})	(Q _{sc})	Value	Variation	Flowrate	ΔH @
m ³	m ³ /min	m ³	m ³ /min	(Y)	(ΔY)	Std & Corr (Q _{sc})	(ΔH@)
0.203	0.014	0.202	0.013	0.995	-0.002	0.013	31.362
0.194	0.019	0.193	0.019	0.996	0.000	0.019	29.552
0.214	0.027	0.213	0.027	0.996	-0.001	0.027	31.256
0.233	0.033	0.233	0.033	0.999	0.001	0.033	32.227
0.205	0.041	0.205	0.041	0.999	0.002	0.041	32.074
				0.997	Y Average		31.294
							ΔH@ Average

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ± 0.02 .
Note: For ΔH_{sc}, orifice pressure differential that equates to 0.75cfm (0.0212m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 0.2 inches (5.1mm) H₂O.

Signature: Surachai Chaisana (Surachai Chaisana) Service Engineer
บริษัท สิทธีพรแอสโซซิเอตส์ จำกัด
SITHIPORN ASSOCIATES COMPANY
Date: 23/8/2021

Calibration Date: 23-8-2021

Calibration Reference No: GC64APE0039



Console Serial: 0306016

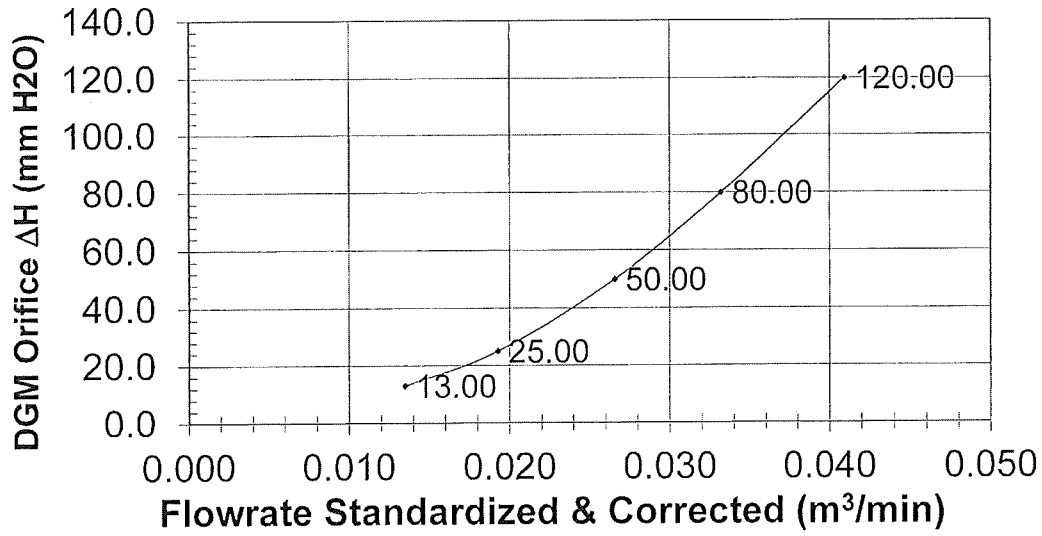
บริษัท สิทธีพรแอสโซซิเอตส์ จำกัด
SITHIPORN ASSOCIATES COMPANY

Console Model: XC-572V

Calibration Date: 23-8-2021

Calibration Reference No: GC64APE0039

Meter Pressure vs Flowrate



Console Serial: 0306016

Console Model: XC-572V


บริษัท สิทธีพรแอสโซซิเอต จำกัด
SITHIPORN ASSOCIATES COMPANY LIMITED

Certificate No: G 640273
Date of issue : 05-May-21

Instrument description : Flue gas Analyzer
Instrument model : Testo 350 NEW
Instrument serial no. : 60534802
ID no. or control no. : -
Manufacturer : testo AG
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 : 3 Pages
Receiving no. : L-211079
Receiving date. : 27-Apr-21
Parameter of calibration : Gas Calibration(Oxygen 2.501,10.00,21.00 %vol, Carbon Monoxide 80.23,301.4,1002 ppm, Nitric Oxide 10.04,150.2,320.9 ppm, Sulphur Dioxide 50.28,100.9,600.0 ppm, Nitrogen Dioxide 10.20,80.37,200.8 ppm)
Condition of UUC. : Used
Ambient condition : All of the Measurement were carried out the stabilized laboratory
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 measurement 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 reproduced 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 traceability to national standards, which realize measurement according to the International System of Units (SI).*

Date of calibration : 05-May-21


Mr. Kwanchai Khamdoun
Calibration Technician


Mrs. Nongluck Wongsettee
Technical Manager

Certificate No.: G 640273

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) 80.23 ppm	2396/19	Linde	15-Jul-21
Carbon monoxide (CO) 301.4 ppm	2397/19	Linde	16-Jul-21
Carbon monoxide (CO) 1002 ppm	2424/19	Linde	17-Jul-21
Nitric Oxide (NO) 10.04 ppm	2448/19	Linde	17-Jul-21
Nitric Oxide (NO) 150.2 ppm	2309/19	Linde	07-Jul-21
Nitric Oxide (NO) 320.9 ppm	2433/19	Linde	16-Jul-21
Sulphur Dioxide (SO2) 50.28 ppm	2410/19	Linde	21-Jul-21
Sulphur Dioxide (SO2) 100.9 ppm	4942/20	Linde	20-Nov-22
Sulphur Dioxide (SO2) 600.0 ppm	2398/19	Linde	16 Jul 21
Nitrogen Dioxide (NO2) 10.20 ppm	2929/19	Linde	27-Aug-21
Nitrogen Dioxide (NO2) 80.37 ppm	2379/19	Linde	14-Jul-21
Nitrogen Dioxide (NO2) 200.8 ppm	2347/19	Linde	10-Jul-21

Measured room conditions

Temperature : 24.9 °C Humidity : 49.9 %RH Pressure : 1016.3 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,200 ml/min Gas pressure : 1021.6 mbar

Calibration Results Before Adjustment (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.501	2.49	-0.011	0.20
O2 (%Vol)	10.00	9.88	-0.12	0.40
O2 (%Vol)	21.00	21.14	0.14	0.80
CO (ppm)	80.23	82	1.77	2.8
CO (ppm)	301.4	302	0.6	11
CO (ppm)	1002	996	-6	34
NO (ppm)	10.04	4	-6.04	3.0
NO (ppm)	150.2	148	-2.2	5.0
NO (ppm)	320.9	303	-17.9	10
SO2 (ppm)	50.28	50	-0.28	5.0
SO2 (ppm)	100.9	102	1.1	5.0
SO2 (ppm)	600.0	602	2.0	14
NO2 (ppm)	10.20	10.6	0.40	1.5
NO2 (ppm)	80.37	81.4	1.03	5.0
NO2 (ppm)	200.8	202.5	1.7	5.0

Calibration Results After Adjustment (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (\pm)
O ₂ (%Vol)	2.501	2.49	-0.011	0.20
O ₂ (%Vol)	10.00	9.88	-0.12	0.40
O ₂ (%Vol)	21.00	21.14	0.14	0.80
CO (ppm)	80.23	82	1.77	2.8
CO (ppm)	301.4	302	0.6	11
CO (ppm)	1002	996	-6	34
NO (ppm)	10.04	7	-3.04	3.0
NO (ppm)	150.2	153	2.8	5.0
NO (ppm)	320.9	324	3.1	10
SO ₂ (ppm)	50.28	50	-0.28	5.0
SO ₂ (ppm)	100.9	102	1.1	5.0
SO ₂ (ppm)	600.0	602	2.0	14
NO ₂ (ppm)	10.20	10.6	0.40	1.5
NO ₂ (ppm)	80.37	81.4	1.03	5.0
NO ₂ (ppm)	200.8	202.5	1.7	5.0

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

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

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.501 % Vol	2431/19	Linde	16-Jul-23
Oxygen (O ₂) 10.00 % Vol	2453/19	Linde	18-Jul-23
Oxygen (O ₂) 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 (NO ₂) 80.62 ppm	3240/21	Linde	25-Jul-23
Nitric Oxide (NO) 150.9 ppm	2857/21	Linde	27-Jun-23
Sulphur Dioxide (SO ₂) 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 (±)
O ₂ (%Vol)	2.501	2.47	-0.031	0.20
O ₂ (%Vol)	10.00	9.88	-0.12	0.40
O ₂ (%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
*NO ₂ (ppm)	80.62	81.3	0.68	5.0
*NO (ppm)	150.9	152	1.1	5.0
*SO ₂ (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

Date of issue : 07-Feb-22

Certificate no. : T 650050

Standard references

Standard	Reference no.	Vendor	Due date
Dry Block ATC-650B	Performance	ENTECH	21-Sep-22
Digital Thermometer with probe	PSL-T 0138/65	TISTR	11-Jan-23
Digital Thermometer with probe	SG-T-00213/64	Success Gateway	11-Feb-22
Dry Block EIUk PTB150	Performance Test	ENTECH	18-Mar-22

Measured room conditions

Temperature : 22.3 °C

Humidity : 53.6 %RH

Pressure : 1012.8 mbar

Calibration conditions

Immersion Depth : 140 mm.

Calibration results (without adjustment)

Parameter of standard	Standard values	Mean of UUC.	Error	Uncertainty (±)
Temperature (°C)	30.03	30.8	0.77	0.33
Temperature (°C)	150.04	151.3	1.26	0.75
Temperature (°C)	400.02	403	2.98	1.8

Remark : -

End of report

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., Tuangsongkhro
City: Laksl Contact: Ramita Taongthai
Zip / Postal: 10210
State / Province: Bangkok
Order Number:



Weighing Device

Manufacturer: Mettler Toledo Instrument Type: Weighing Instrument
Model: MS204S/01 Asset Number: ERTC-LIN-107
Serial No.: B445239184 Terminal Model: N/A
Building: N/A Terminal Serial No.: N/A
Floor: 4 Terminal Asset No.: N/A
Room: 411

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: 18.5 °C End: 18.7 °C	Start: 49.7 % End: 50.0 %

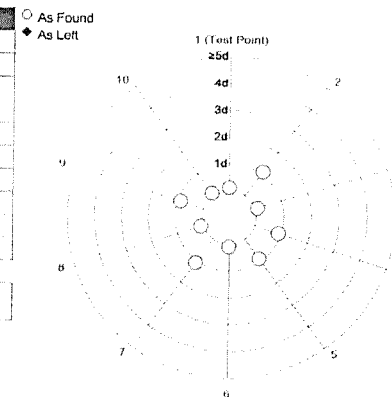
As Found Calibration Date: 19-Jan-2022 Calibrator: Suwicha Choykamachu
As Left Calibration Date: N/A
Issue Date: 20-Jan-2022 Approved Signatory: Kassakorn Tassanachalsakul
☒ Kassakorn Tassanachalsakul
☐ Santi Jitriyom
☐ Surachet Sukkato

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Measurement Results

Repeatability

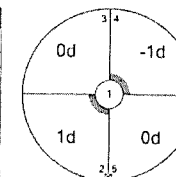
Test Load: 100 g		
	As Found	As Left
1	100.0000 g	N/A
2	99.9999 g	N/A
3	100.0000 g	N/A
4	100.0001 g	N/A
5	100.0001 g	N/A
6	100.0000 g	N/A
7	99.9999 g	N/A
8	100.0000 g	N/A
9	100.0001 g	N/A
10	100.0000 g	N/A
Standard Deviation	0.00007 g	N/A



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	100.0000 g	N/A
2	100.0001 g	N/A
3	100.0000 g	N/A
4	99.9999 g	N/A
5	100.0000 g	N/A
Maximum Deviation	0.0001 g	N/A



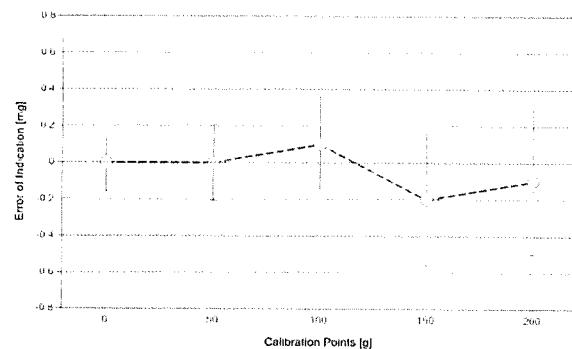
As Found
The "d" in the graph represents the readability of the range/interval in which the test was performed.

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Error of Indication

As Found

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.0000 g	0.16 mg	2
2	0.0500 g	0.0500 g	0.0000 g	0.17 mg	2
3	0.1000 g	0.1000 g	0.0000 g	0.17 mg	2
4	0.5000 g	0.5000 g	0.0000 g	0.17 mg	2
5	1.0000 g	1.0000 g	0.0000 g	0.17 mg	2
6	5.0000 g	5.0000 g	0.0000 g	0.17 mg	2
7	10.0000 g	10.0000 g	0.0000 g	0.18 mg	2
8	50.0000 g	50.0000 g	0.0000 g	0.21 mg	2
9	99.9999 g	100.0000 g	0.0001 g	0.26 mg	2
10	149.9999 g	149.9997 g	-0.0002 g	0.36 mg	2
11	199.9999 g	199.9998 g	-0.0001 g	0.40 mg	2



○ As Found

◆ As Left

For improved legibility of the graphics only increasing measurement points are shown and measurement points close to zero are not displayed.

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.

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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

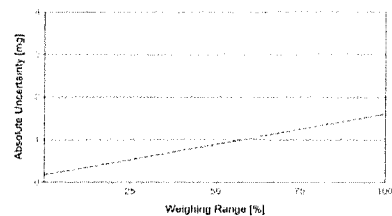
Linearization of Uncertainty Equation

1	Range		As Found	As Left
	d	Max		
1	0.0001 g	220 g	$U_1 = 0.17 \text{ mg} + 0.00653 \text{ mg/g} \cdot R$	N/A

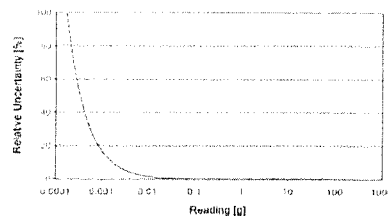
To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

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

Net Indication	As Found		As Left	
0.0220 g	0.17 mg	0.77%	N/A	N/A
0.2200 g	0.17 mg	0.078%	N/A	N/A
2.2000 g	0.18 mg	0.0084%	N/A	N/A
22.0000 g	0.31 mg	0.0014%	N/A	N/A
220.0000 g	1.6 mg	0.00073%	N/A	N/A



As Found



As Left

26-1-65

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.

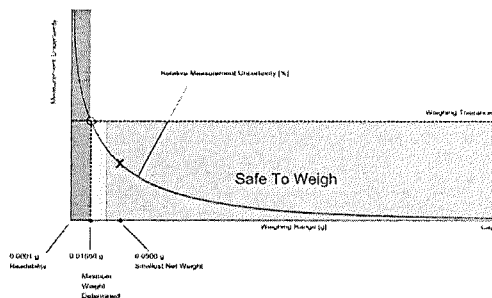
Process Requirements

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

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%	0.16976 g	0.34177 g	0.51607 g	0.87172 g	1.80429 g
0.2%	0.08460 g	0.16976 g	0.25548 g	0.42863 g	0.87172 g
0.5%	0.03378 g	0.06764 g	0.10159 g	0.16976 g	0.34177 g
1%	0.01688 g	0.03378 g	0.05070 g	0.08460 g	0.16976 g
2%	0.00844 g	0.01688 g	0.02532 g	0.04223 g	0.08460 g
5%	0.00337 g	0.00675 g	0.01012 g	0.01688 g	0.03378 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%	0.16976 g	0.34177 g	0.51607 g	0.87172 g	1.80429 g
0.2%	0.08460 g	0.16976 g	0.25548 g	0.42863 g	0.87172 g
0.5%	0.03378 g	0.06764 g	0.10159 g	0.16976 g	0.34177 g
1%	0.01688 g	0.03378 g	0.05070 g	0.08460 g	0.16976 g
2%	0.00844 g	0.01688 g	0.02532 g	0.04223 g	0.08460 g
5%	0.00337 g	0.00675 g	0.01012 g	0.01688 g	0.03378 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.

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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	0.00007 g*	N/A	0.00007 g*	N/A
0.2%	0.00005 g		✗		✗
0.5%	0.00013 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	0.0001 g	✓	0.0001 g	✓
0.2%	0.1000 g		✓		✓
0.5%	0.2500 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.

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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	0.0000 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	-0.0002 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	0.0000 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	-0.0002 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: TH2065-163-011922-LABBalanceHR
ENVIRONMENT RESEARCH&TECHNOLOGY CO., LTD
25/114 Moo 6, Soi Chinnak 1, Ngamwongwan Rd., Toongsongho 6, ลาดพร้าว 6, Lakki, Bangkok 10210
Ramita Taengthai

METTLER TOLEDO

Balance Health Report

Device Details

System Details			
Manufacturer:	Mettler Toledo	Accessory 1:	
Model:	MS204S/01	Accessory 2:	
Serial number:	B445239164	Weight set for routine testing:	Yes /
Firmware:	2.22		

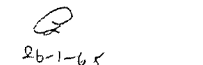
History

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:	0.0500g		

Check List

Environmental Conditions		General & Functional Checks	
Room temperature fluctuation	✓	Leveling	✓
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: 086-6334490
			Email: ramita@envresearch.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

26-1-65

26-1-65

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	: 1.7 L/min
Calibrated By	: Mr.Satitkoon Maitreejit
Calibration Date	: May 18, 2022
Customer Name	: บริษัท โพรเทียร์ คอนซัลแตนต์ จำกัด : โครงการ โรงงานผลิตเหล็กแท่งและผลิตภัณฑ์เหล็ก ที่ผลิตจากเหล็กถลุง ของบริษัท หยงซิง สตีล (ไทยแลนด์) จำกัด

[illegible]

.....
Mr. Prayun Detkla
Technician

Ms.Sutatip 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.23-64/0644

MTC.No.23-64/0644

Number of page(s) 2

CALIBRATION CERTIFICATE

Nomenclature : DRYCAL

Manufacturer : BIOS International Corporation, USA.

Serial No.: 4492

Model : DCL-M Rev.1.08

Scale range : 0.1 l/min to 7 l/min

Subdivision : (0.0001, 0.001) l/min

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

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

Toongsonghong, Laksi, Bangkok 10210, Thailand.

Received date : 21 July 2021

Condition of measured item : Normal

Calibration date : 1 August 2021

Standard :

Standard	Certificate No.	Date due	Traceability
Digital Thermometer with RTD Sensor	PSL-T 336/63	6-Apr-22	TISTR
MassFlowTerminal/PressureTransducer	MP-0013-21	25-Jan-23	NIMT
Bios Met Lab ML-800 S/N 117982	MW-0011-21	8-Apr-23	NIMT
Bios Met Lab ML-800 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. 2013264072103161001

Issued Date 6 August 2021

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

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

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

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

Request No.23-64/0644

2/2

MTC.No.23-64/0644

Calibration point : (0.2, 1.0, 2.5) l/min

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

Atmospheric pressure (1010 ± 13) mbar

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

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

Measurement data :

UUC Value (l/min)	Standard Value (l/min)	Temperature (°C)	Pressure (hPa)	Deviation (%)	Uncertainty (%)
0.2011	0.21103	24.298	1002.91	-4.72	0.99
1.006	1.0250	24.592	1004.84	-1.89	0.87
2.500	2.5314	24.618	1007.67	-1.24	0.87

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.

Ts.

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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

Certificate of Calibration

Model Number : CP225D
Description : Semi-micro Balance
Serial Number : 19308255
Manufacturer : Sartorius

Certificate No. : 22BNA0013
Issued Date : Thursday, January 27, 2022
Reference No. : 178333
Page No. : 1 of 3

Customer Name : Environment Research & Technology Co., Ltd.
25/114 Moo 6, Soi Chinnaket 1, Ngamwongwan Rd., Tungsohong, Laksi, Bangkok 10210.

Calibrated Place : Weighing Room.

Calibrated By : Mr. Nathapol Aejimjangpun
Calibration Date : Wednesday, January 26, 2022

Calibration Procedure No. : This calibration was conducted by
Using in-house calibration procedure number (WI-003)
Based on UKAS LAB 14

Metrological data :
Capacity : 80 / 220 g Readability : 0.01/0.1 mg

Ambients Conditions:
Temperature : 20.0 °C ± 5.0 °C
Humidity : 55.5 % RH ± 10.0 % RH
Pressure : ±

Reasons for calibration
☐ New Installation ☐ Service / Repaired ☒ Re-calibration/ Maintenance

Equipment Condition: ☒ Good Operate ☐ Fair

Measurement Method : UKAS Publication Ref: Lab 14

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came from list of Sartorius Metrological Specifications.

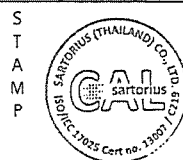
Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-612-00	Sartorius weight set 1mg - 1kg E2, YCS011-612-00	SPC-RT	C02203547	21-Sep-2022
608H1	Thermo-Hygrometer, Testo 608-H1	SPC-RT	C19210657	14-Dec-2022

This certificate relate and apply this equipment only.
This certificate may not be reproduced other than in full except with the prior written approval of the Verification Operation Division Sartorius (Thailand) Co., Ltd.

ISO17025-RF-15 26/03/2020 R2

Mr. Chonchai Inthana (Technical Manager)




Certificate of Calibration

Model Number : CP225D
Description : Semi-micro Balance
Serial Number : 19308255
Manufacturer : Sartorius

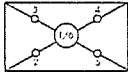
Certificate No. : 22BNA0013
Issued Date : Thursday, January 27, 2022
Reference No. : 178333
Page No. : 2 of 3

Calibration Results : Without Adjustment

Repeatability			Eccentricity (Off-center loading error)	
<p>The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.</p>			<p>The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R76).</p>	
Nominal Value : (Low Load)	5.00000	49.99998	Nominal value :	50 g
5 g	5.00001	49.99998	Tolerance	0.00015 g
Tolerance	5.00000	49.99996		
0.0001 g	4.99998	49.99998		
	4.99997	49.99999		
Nominal Value : (High Load)	4.99997	50.00000		
50 g	4.99998	49.99997		
Tolerance	4.99999	49.99996		
0.0001 g	5.00001	49.99997		
	4.99998	49.99997		
Standard Deviation	0.000015	0.000013		



Difference	
1	-
2	0.00001
3	0.00002
4	-0.00002
5	-0.00005
6	-



Linearity

The linearity, also called linearity error. Describes the deviation of the characteristic curve of a weighing instrument from the linear slope.

Tolerance 0.0001 g

Nominal Value	Conventional Mass Value	Displayed Value	Deviation	Uncertainty
(g)	(g)	(g)	(g)	(g)
0.01	0.01000	0.01002	0.00002	0.000066
0.1	0.10000	0.10000	0.00000	0.000066
1	1.00001	1.00000	-0.00001	0.000067
2	2.00001	1.99998	-0.00003	0.000067
5	4.99999	4.99997	-0.00002	0.000068
10	10.00000	9.99998	-0.00002	0.000070
20	19.99997	20.00000	0.00003	0.000074
50	49.99999	49.99999	0.00000	0.000093
60	59.99998	60.00000	0.00002	0.00015
70	69.99996	69.99998	0.00002	0.00015

ISO17025-RF-15 26/03/2020 R2

5-1-65

Certificate of Calibration

Model Number : CP225D
Description : Semi-micro Balance
Serial Number : 193082255
Manufacturer : Sartorius

Certificate No. : 22BNA0013
Issued Date : Thursday, January 27, 2022
Reference No. : 178333
Page No. : 3 of 3

Calibration Results : Without Adjustment

Repeatability		Eccentricity (Off-center loading error)	
<i>The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.</i>		<i>The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R76).</i>	
Nominal Value : (Low Load)		Nominal value :	50 g
g		Tolerance	0.00015 g
Tolerance			
0.0001 g			
Nominal Value : (High Load)			
200 g			
Tolerance			
0.0001 g			

Linearity <i>The linearity, also called linearity error. Describes the deviation of the characteristic curve of a weighing instrument from the linear slope.</i>				
Tolerance 0.0002 g				
Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
90	90.0000	90.0001	0.0001	0.00018
100	100.0000	100.0000	0.0001	0.00018
110	109.9999	110.0000	0.0001	0.00026
120	119.9999	119.9999	0.0000	0.00026
150	149.9999	149.9999	0.0000	0.00026
160	159.9999	159.9999	0.0000	0.00026
170	169.9999	169.9999	0.0000	0.00026
180	179.9999	179.9999	0.0000	0.00027
190	189.9999	189.9998	-0.0001	0.00028
200	199.9999	199.9999	0.0000	0.00031
End of Report.				

Certificate of Calibration

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

Certificate No : 21-TPM-252
Request No : Req-2021-0975
Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature
Instrument Name : Area Heat Stress Monitor
Manufacturer : METROSONICS
Model : hs - 32
Serial Number : MCD050029
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 : 20 July 2021
Calibrated Date : 1 September 2021
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: 12000077, ID: AR-TPM Which was calibrated on 30 March 2021, Calibration Certificate No.: QR21-0719

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 : 1 September 2021



Calibration Note

UUC Adjustment : Not Adjust

Certificate No : 21-TPM-252

Request No : Req-2021-0975

Page : 2/2

Result of Calibration :

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
WET	30.003	30.3	- 0.3	0.14
	35.004	35.3	- 0.3	0.14
	40.005	40.3	- 0.3	0.14
DRY	30.006	30.3	- 0.3	0.14
	35.007	35.3	- 0.3	0.14
	40.007	40.3	- 0.3	0.14
GLOBE	30.003	30.2	- 0.2	0.14
	35.003	35.2	- 0.2	0.14
	40.003	40.2	- 0.2	0.14

End of Certificate

Calibrated By :
 Mr. Sittichok Jirapukdeesakun



Request No. 22-65 / 0316

MTC No. PSL-H 0147 / 65

Certificate of Calibration

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

Equipment : Thermo-Hygrometer (Thermal Environment Monitor)

Model /Type : hs-32

Serial Number : MCF010006

Maker : METROSONICS

Date of Request : 9 February 2022

Date of Calibration : 1 March 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), NSG-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 :

Panit T.

(Ms. Panit Thummasri)

Approved by :

Mr. Kamchai Singhapiwat

Director

Photometry and Temperature Standards Laboratory

Ref. No : 2012265020900609003

Issued Date : 10 March 2022

Page 1 of 4

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Request No. 22-65 / 0316

MTC No. PSL-H 0147 / 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 (Thermal Environment Monitor)

Serial Number : MCF010006

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

P.T.

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Request No. 22-65 / 0316

MTC No. PSL-H 0147 / 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)
30.0	29.9	0.1	0.50
35.0	34.8	0.2	0.50
40.0	39.7	0.3	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)
30.0	30.0	0.0	0.50
35.0	35.0	0.0	0.50
40.0	39.9	0.1	0.50

Request No. 22-65 / 0316

MTC No. PSL-H 0147 / 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)
30.0	29.9	0.1	0.50
35.0	34.7	0.3	0.50
40.0	39.6	0.4	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...



Request No. 22-64 / 0779

MTC No. PSL-H 300 / 64

Certificate of Calibration

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

Equipment : Thermo-Hygrometer (Thermal Environment Monitor)

Model /Type : hs-32

Serial Number : MCH110038

Maker : METROSONICS

Date of Request : 21 July 2021

Date of Calibration : 20 August 2021

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 :

Panit T.

(Ms. Panit Thummasri)

Approved by :

Karnchar Singhapiwat

(Mr. Karnchar Singhapiwat)

Director

Photometry and Temperature Standards Laboratory

Ref. No : 2022264072103157003

Issued Date : 26 August 2021

Page 1 of 4

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



Request No. 22-64 / 0779

MTC No. PSL-H 300 / 64

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 (Thermal Environment Monitor)

Serial Number : MCH110038

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 1114 / 63.

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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E-mail : sumalee@tistr.or.th

Request No. 22-64 / 0779

MTC No. PSL-H 300 / 64

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	30.5	-0.6	0.50
35.0	35.4	-0.4	0.50
39.9	40.2	-0.3	0.53

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
35.0	35.3	-0.3	0.50
39.9	40.2	-0.3	0.50

Request No. 22-64 / 0779

MTC No. PSL-H 300 / 64

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)
30.0	30.3	-0.3	0.50
35.0	35.2	-0.2	0.50
39.9	40.0	-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...



Request No. 22-64 / 0821

MTC No. PSL-H 306 / 64

Certificate of Calibration

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

Equipment : Thermo-Hygrometer (Thermal Environment Monitor)

Model /Type : QUESTemp[®]34

Serial Number : TED050028

Maker : QUEST Technologies

Date of Request : 24 August 2021

Date of Calibration : 15 September 2021

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 :

Panit T.
(Ms. Panit Thummasri)

Approved by :

Mr. Kamchai Singhapiwat
(Mr. Kamchai Singhapiwat)

Director

Photometry and Temperature Standards Laboratory

Ref. No : 2012264082403482001

Issued Date : 17 September 2021

Page 1 of 4

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FM.BLMTC.002 Rev.4

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E-mail : sumalee@tistr.or.th



Request No. 22-64 / 0821

MTC No. PSL-H 306 / 64

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 (Thermal Environment Monitor)

Serial Number : TED050028

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. WLCP.18.

Support Equipment :

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

Adjustments : NONE

Page 2 of 4

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Amphoe Muang, Changwat Samutprakan 10280, Thailand
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Thailand
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Fax. (66) 0 2579 8592
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Request No. 22-64 / 0821

MTC No. PSL-H 306 / 64

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)
30.0	29.8	0.2	0.50
35.0	34.7	0.3	0.50
39.9	39.5	0.4	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)
30.0	29.8	0.2	0.50
35.0	34.7	0.3	0.53
39.9	39.6	0.3	0.50



Request No. 22-64 / 0821

MTC No. PSL-H 306 / 64

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)
30.0	29.7	0.3	0.50
35.0	34.6	0.4	0.50
39.9	39.4	0.5	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...

Support Equipment Type	:	Sound Level Calibrator
Manufacture	:	Quest Technologies
Model	:	QC-10
Serial No.	:	QE2080089
Range of Calibrator		
- Sound Pressure Level	:	114.0 dB.
- Frequency	:	1,000 Hz.
Calibrated By	:	Mr.Satitkoon Maitreejit
Calibration Date	:	May 18, 2022
Customer Name	:	บริษัท โฟร์เพียร์ คอนซัลแตนต์ จำกัด : โครงการ โรงงานผลิตเหล็กแท่งและผลิตภัณฑ์เหล็ก ที่ผลิตจากเหล็กถลุง ของบริษัท หยงซิง สตีล (ไทยแลนด์) จำกัด

Checked By

envi research
a
ENVIRONMENT RESEARCH & TECHNOLOGY CO., LTD.

Approved By

Page 2/2



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0733

MTC No. EEL. BP. 90/0764

CALIBRATION CERTIFICATE

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

Address : 25/114 Moo 6, Soi Chinnaket 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 : Calibrator

Manufacturer : Quest Electronics

Model : QC-10

Serial No. : QE2080089

Ambient Environment

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

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

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

- 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 Panasonic VP-7722A S/N 041477D122.
 7. Condenser Microphone B&K 4180 S/N 2633526.

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 : 21 Jul. 2020

Date of Calibration : 28 Jul. 2021

1 / 2 ✓

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0733

MTC No. EEL. BP. 90/0764

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 1
1/2 inch Brüel&Kjaer 4180	113.99	-0.01	± 0.10	± 0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	998.3	-1.7	± 1.5	$\pm 1.0\%$

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	1.01	± 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 Kluaypa)
TISTR
Acting Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 28 Jul. 2021

Date of Issue : 30 Jul. 2021

Ref : 2011264072103155002

End of Certificate

2 / 2

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



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
53-14 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 22CH13
Page.: 1 of 3

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Eutech
Model : pHTestr 30
Serial No. : 3011826
ID No. : NO.23
Condition As-Received: Used Item
Received Date : 29 December 2021
Calibration Date : 05 January 2022
Reference : 2112-0752WN-9
Submitted by : Environment Research & Technology Company Limited.
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,
Toongsonghong, Laksi, Bangkok 10210
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with standard
voltage calibrator and direct measurement with
certified reference material (CRM)
- CP-CH8 by comparison with standard thermometer

Calibrated by : Walalak Sirithean

Approved by : Malee Butkruea
Approved Signatory

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

Issue Date : 7 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.



Cert.No.: 22CH13
Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument : -

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Ref. Standard Thermometer	4982054	110RC044	2111201	26 Oct 2022

This certification is traceable to the International System of Unit maintained at:-

- Traceable to National Institute of Metrology (Thailand), NIMT

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
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

3. 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 (±)	Coverage factor k
pH Electrode S/N.: 3011826	4.008	4.00	N/A	0.0085	2.05
	6.982	6.97	N/A	0.011	2.00
	10.015	10.02	N/A	0.0096	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

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Cert.No.: 22CH13

Page.: 3 of 3

Calibration Results

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : _____
- Serial No. : 3011826

Dimension of probe;

- Length : 36 mm.
- Diameter : 6 mm.
- Immersion Depth : 33 mm.

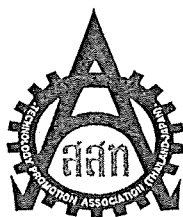
Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °C)	Coverage factor <i>k</i>
25.0	24.998	25.3	0.302	0.13	2.00
30.0	29.998	30.3	0.302	0.13	2.00
35.0	35.002	35.3	0.298	0.13	2.00

Remark : - UUC* = Unit Under Calibration

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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Md.



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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Cert.No.: 22TW2

Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : YSI
Model : Pro20
Serial No. : 14L101229
ID No. : NO.4
Received Date : 29 December 2021
Test Date : 04 January 2022
Reference : 2112-0752WN-2
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 Lerngagtrakul

Issue Date :

7 January 2022



Cert.No.: 22TW2

Page.: 2 of 2

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 14L100144

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.12	8.12	0.0084

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

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Salathammassop, Thawewatthana, Bangkok 10170 Thailand

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



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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 \pm 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.

45/48 Salathammassop 31, Salathammassop Rd., Salathammassop, Thawewatthana, Bangkok 10170

Phone : 0-2408-8474 Fax : 0-2408-8477 http://www.crystalcal.com Email : info@crystalcal.com



PAGE 1/3
15-1-65

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

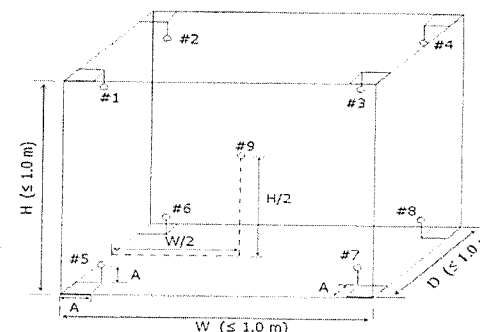


Diagram of Chamber

15-1-65 PAGE 2/3



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 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%.

--END--

13-1-b5 PAGE 3/3



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Cert.No.: 22TW15

Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : YSI
Model : 5000-115V
Serial No. : 03C1280 AC
ID No. : ERTC-L-In-021
Received Date : 19 January 2022
Test Date : 21 January 2022
Reference : 2201-0594WN-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 Lerngagtrakul

Issue Date :

1 February 2022

23-2-65

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Cert.No.: 22TW15

Page.: 2 of 2

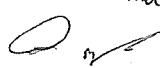
Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 07H100306

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.16	8.15	0.0071

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Fax: +662 632 4334
Email: ccc-smrt@agilent.com
Website: www.agilent.com/chem

Service Confirmation Number: 6903908836

Service Confirmation Date: 18.11.2021

Customer Contact:

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Co Ltd
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Ngamwongwan Rd
25/114 Moo 6 Soi Chinnakhet 1
TAX ID : 0105542064981
Raiwin@envresearch.co.th
0895030467

Invoice To:

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Co Ltd
Head Office
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Chinnakhet 1 Thungsohong Luksi

Payer:

World Siam Group Co Ltd Head
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Klong San
BANGKOK 10600
Delivery Site:
Environment Research & Technology
Co Ltd
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Location:

Room
Bldg
Lab
Dept

SERVICE REPORT

Customer Purchase Order Number:	Customer Number: 70472666
Service Request:	Service Request Date:
Service Order: 6004983683	Service Confirmation: 6903908836

Direct Inquiries to:

Contact Name: Customer Contact Center
Contact E-mail: ccc-smrt@agilent.com
Contact Telephone: +662 637 6363
Contact Fax: +662 632 4334

Service Instrument:

Model Number	Model Description	Serial Number	System Handle	Parent Asset
SYS-IO-5100	ICP-OES 5100/5110 System			
G8481A	Water chiller	1A1560387		SYS-IO-5100
G8011A	Agilent 5100 VDV ICP-OES Spectrometer	MY15330001		SYS-IO-5100
G8410A	SPS 4 Autosampler	AU15220240		SYS-IO-5100

Service Items:

Item	Service/Part #	Description	Qty	Entitlement	Service Start	Service End
2000	PM	Preventive Maintenance	1.00	Agreement Entitlement - 100 % covered	18.11.2021	18.11.2021
2040	G8010-G8015	Spare pre-optic window rad,5100 ICP 1/pk	1.00	Agreement Entitlement - 100 % covered		
2030	G8010-G8014	Spare pre-optic window ax,5100 ICP 1/pk	1.00	Agreement Entitlement - 100 % covered		
2020	G8010-60136	Filter Argon ICP-OES 5100 Series	1.00	Agreement Entitlement - 100 % covered		
2010	G8000-G8002	Inlet cooling air filter for MP-AES	1.00	Agreement Entitlement - 100 % covered		

Additional Information:

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Acc. No: 012-4452-007,
THB:Krungh Thai Bank PCL
Siam Square Br.,416/1-2 Rama 1 Rd.,Pathumwan, BKK 10330
Thailand

ORIGINAL


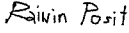
Service Confirmation Number: 6903908836

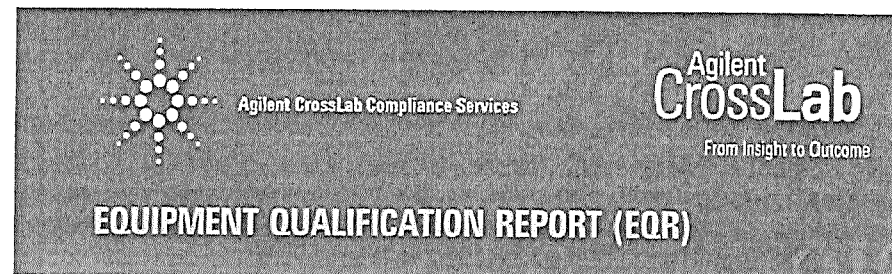
Service Confirmation Date: 18.11.2021

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Agilent CrossLab Compliance Services

Service Information:

Problem Description: T-WM-S-PM00-105100-5000961745		
Service Provided: Discuss any issues with the customer prior to starting/ perform to preventive maintenance checklist and replace parts		
Service Overview Code: Reason Code: Scheduled Service Diagnosis Code: Scheduled Service Resolution Code: Scheduled Service		
Reported Hours: 4.0	Travel Hours: 2.0	
Customer Field Service Representative Name: Piyawit Sompanithan	Customer Field Service Representative Signature: 	Date: 18 Nov 2021
Customer Name: RAIWIN POSIT	Customer Signature: 	Date: 18 Nov 2021
Additional Comments:		



Agilent CrossLab Compliance

Qualification Type:	ES-OQ
System ID:	MY15330001
EQP Name:	AgilentRecommended
EQP Revision:	ES.02.50
EQP Publish Date:	March 2020
Date:	November 29, 2021 3:20:41 PM
Report Type:	Report
Org. Name:	Environment Research & Technology Co., Ltd
Org. Location:	25/114 Moo 6 Soi Chinaket, Ngamwongwan Rd., Bangkok 10210

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Test Summary

Purpose

This section includes a status for each scheduled test and the overall qualification. For each test that is run, (1) the status is automatically determined based on pre-defined limits, and (2) the total number of times the test was run is displayed. For detailed results and specifications for a test, refer to the test results in this EQR.

Details

Test	Status	Runs
Preparation : 5100 VDV	Pass	1
Instrument Tests : 5100 VDV	Pass	1
Autosampler Operation : Autosampler 1 - SPS4	Pass	1

Overall Qualification Status

Pass

Service Details

Purpose

This section includes local contact and delivery details for this service.

General Details

Service Order No./Request: 6004983683
EQP Name: AgilentRecommended
EQP Revision: ES.02.50
Report Type: Report

Organization Details

Name: Environment Research & Technology Co., Ltd
Location: 25/114 Moo 6 Soi Chinaket, Ngamwongwan Rd., Bangkok 10210

Local Contact Details

Name: Khun Raiwin Posit
Job Title: Supervisor Scientist
Qualification Location: ICPOES Room

Operator Details

Name: Kanyakorn Sukpathrajareem
Job Title: Field Service Engineer

Data Acquisition Details

Acquisition Software Name: ICP Expert
Acquisition Software Revision: 7.1.0.6821

Customer Data System (CDS): Es: ICP Expert

Date: November 29, 2021 3:20:41 PM
System ID: MY15330001

Instrument Details

Purpose

This section describes the as found system configuration.

Details

Spectrometer 1

Manufacturer: Agilent Technologies
Name: 5100 VDV
Model Number: G8011A
Sample Introduction: Double pass glass cyclonic spraychamber and seaspray nebulizer
Serial Number: MY15330001
Firmware Revision: 2994

Chiller 1

Manufacturer: Agilent Technologies
Name: Chiller
Model Number: G8481A
Serial Number: 1A1560387

Autosampler 1

Manufacturer: Agilent Technologies
Name: SPS4
Model Number: G8410A
Serial Number: AU15220240

Date: November 29, 2021 3:20:41 PM
System ID: MY15330001

Protocol Details

Purpose

This section lists the revisions for all test units used in this report. For complete test-specific and high-level change details, refer to the Revision History document.

Test Revision	Test
ES.02.50	Autosampler Operation
ES.02.50	Instrument Tests
ES.02.50	Preparation

Preparation

Purpose

This test records a status for each preparation task for the Agilent ICP-OES.

Configuration Details

Model/Serial No.:	G8011A	MY15330001
-------------------	--------	------------

Results

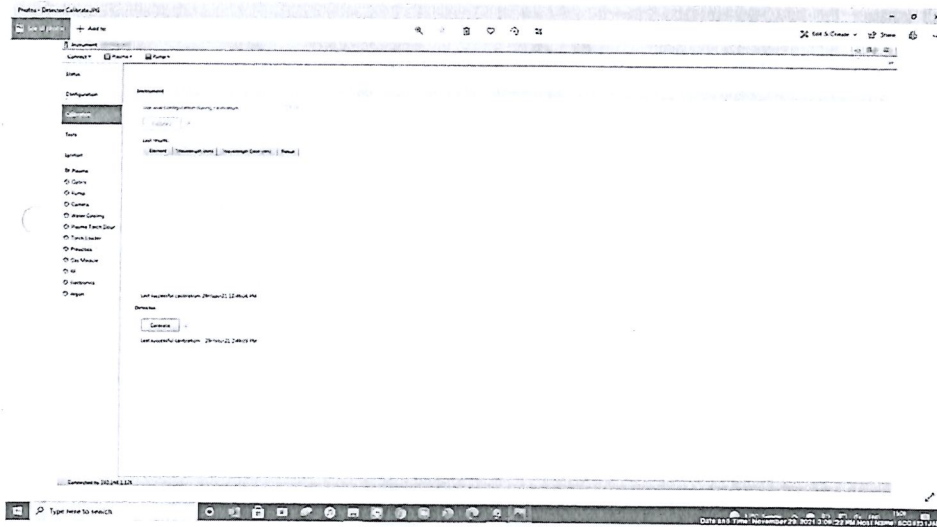
Criteria	Observed Result	Expected Result	Status
Does the plasma ignite successfully in the first three attempts?	Yes	Yes	Pass
Was the detector calibration performed and completed successfully?	Yes	Yes	Pass
Was the instrument calibration performed and completed successfully?	Yes	Yes	Pass

Test Evidence

Image Details: Was the detector calibration performed and completed successfully?

Date and Time: November 29, 2021 3:09:22 PM

Host Name: 5CG9231J5L

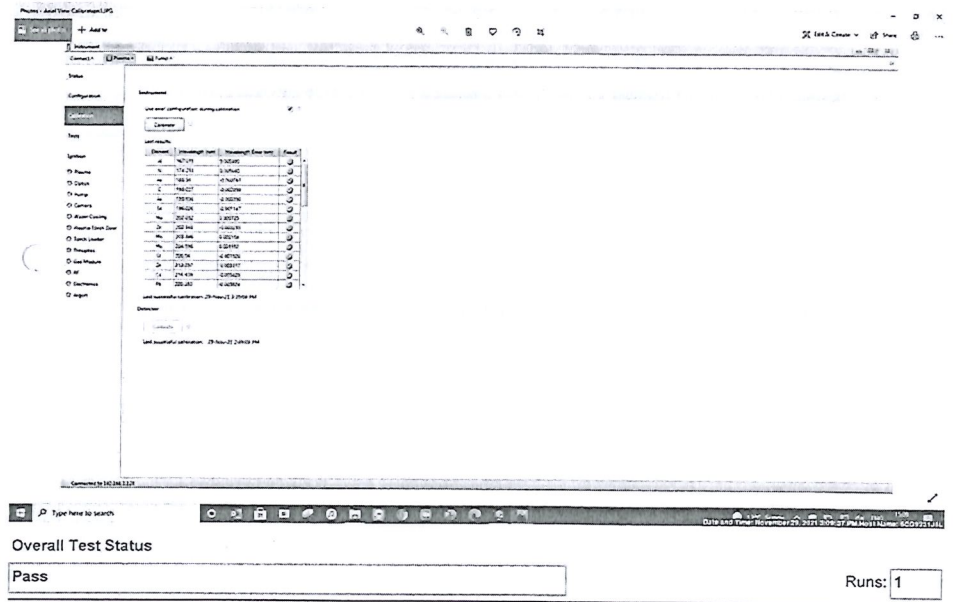


Date: November 29, 2021 3:20:41 PM
System ID: MY15330001

Image Details: Was the instrument calibration performed and completed successfully?

Date and Time: November 29, 2021 3:09:37 PM

Host Name: 5CG9231J5L



Date: November 29, 2021 3:20:41 PM
System ID: MY15330001

Instrument Tests

Purpose

This test records a status for each of the automated tests within the Agilent ICP-OES CDS. For detailed test criteria, refer to the attached report.

Configuration Details

Model/Serial No.: G8011A MY15330001

Results	Observed Result	Expected Result	Status
---------	-----------------	-----------------	--------

Are the Functional Tests results within acceptance criteria?

Subsystem Communications

Yes	Yes	Pass
-----	-----	------

Air Flow

Yes	Yes	Pass
-----	-----	------

Water Flow

Yes	Yes	Pass
-----	-----	------

Gas Flows

Yes	Yes	Pass
-----	-----	------

RF Generator

Yes	Yes	Pass
-----	-----	------

Camera

Yes	Yes	Pass
-----	-----	------

Optics

Yes	Yes	Pass
-----	-----	------

Are the Instrument Performance Tests results within acceptance criteria?

Resolution

Yes	Yes	Pass
-----	-----	------

Sensitivity

Yes	Yes	Pass
-----	-----	------

Precision

Yes	Yes	Pass
-----	-----	------

Overall Test Status

Pass Runs: 1

Autosampler Operation

Purpose

This test verifies that the autosampler operates properly.

Configuration Details

Model/Serial No.: G8410A AU15220240

Results

Criteria	Observed Result	Expected Result	Status
----------	-----------------	-----------------	--------

Does the autosampler successfully move to the specified location(s)?

Yes	Yes	Pass
-----	-----	------

Overall Test Status

Pass Runs: 1

Declaration of Change Control

This document is under change control. Revision history is maintained and printed on each document. Access to the master documents is limited to process owners. Documents receive periodic review and cannot be assigned an evergreen status. The qualification performed according to this document refers only to the hardware/software configuration in place at the time of the qualification. Agilent Technologies recommends that instrument configuration change management procedures be in place in order to maintain the validation process. Any changes to the analytical or computer hardware or software must be clearly specified. A change management system provides a means for determining the degree of requalification required according to the extent of the changes made. All details of the changes must be thoroughly recorded and documented, together with details of completed tests and their results. Note: Hardware/software configuration management is the customer's responsibility.

Attachments

Training requirements note: The delivery engineer attaches an ACE technique-specific training certificate to the Equipment Qualification Report (EQR). Obtaining ACE technique-specific certification includes pre-requisite trainings for Data Integrity, General Compliance topics (GMP, GLP, ALCOA, etc.), instrument hardware and software components, and the ACE technique itself. The one certificate encompasses all pre-requisite trainings as documented in the Agilent Learning Management System called Success Factors.

Location	Category	Document Name	Page
EQR	General	Certificate of Qualification for ACE	14
EQR	General	Certificate of Qualification for ACE	15
EQR	General	Operator's training certificate and qualifications	16
EQR	General	Certificate of Qualification for ACE	17
EQR	Material	Certificate of Analysis Wavelength calibration solution	18
EQR	General	Instrument's Test Report	22
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EQR	General	Instrument's Test Report	27
EQR	General	Instrument's Test Report	28

General

Document Name:

Certificate of Qualification for ACE



Agilent Technologies

Agilent Compliance Engine Self Qualification

Date: November 29, 2021 3:10:26 PM

Drive Serial #: EAF04672

Platform Revision: ACE 3.11

Individual self-qualification reports for each specific technique installed are also available upon request. They provide additional details on the general report from the concise summary and are structured by the actual algorithms challenged during the process. There is not a one-to-one relationship between algorithms and OQ program tests because some algorithms are used by several tests and across multiple similar hardware components of the qualified systems.

Technique Type	Tests Completed	Result
Emission Spectroscopy	3	Conforms
Software	6	Conforms

Overall Qualification Status

Conforms

Date: November 29, 2021 3:20:41 PM
System ID: MY15330001

General

Document Name:

Certificate of Qualification for ACE



Agilent Technologies

Certificate of Completion

Learner Name: Kanyakorn Sukpathrajareem

Title Of Course: AN-CE-SS-II-030-A: ACE 3.X User Update Training

Completion Date: June 25, 2020

Certified By Company: Learning at Agilent

All Service and Support training certificates have the following specific limitations.

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

Date: November 29, 2021 3:20:41 PM
System ID: MY15330001

General

Document Name: Operator's training certificate and qualifications



Certificate of Completion

Learner Name: Kanyakorn Sukpathrajareem

Title Of Course: ANV-CE-ICPOES-2-008-A: Agilent 5100 ICP-OES Support Neophyte Training

Completion Date: November 2, 2017

Certified By Company: Learning at Agilent

All Service and Support training certificates have the following specific limitations.

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

Date: November 29, 2021 3:20:41 PM
System ID: MY15330001

General

Document Name: Certificate of Qualification for ACE



Certificate of Completion

Learner Name: Kanyakorn Sukpathrajareem

Title Of Course: ANV-CE-ICPOES-2-007-C: CrossLab Compliance Hardware Specific Delivery for Agilent ICP-OES Systems

Completion Date: October 30, 2020

Certified By Company: Learning at Agilent

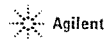
All Service and Support training certificates have the following specific limitations.

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

Date: November 29, 2021 3:20:41 PM
System ID: MY15330001

Materials

Document Name: Certificate of Analysis Wavelength calibration solution



CERTIFICATE OF ANALYSIS

Agilent Product Name: Wavelength Calibration Solution for ICP-OES & MP-AES, 5 mg/L, 500mL

Agilent Part No: 0610030100

Lot No: 0010898002

Product Specifications

Analyte	Starting Material	CAS #	Certified Conc.	Analyte	Starting Material	CAS #	Certified Conc.
Al	Al(NO ₃) ₃	1784-27-2	5.000 ± 0.025 mg/L	Mn	Mn	7439-96-5	5.003 ± 0.025 mg/L
As	As	7440-38-2	5.002 ± 0.025 mg/L	Mo	(NH ₄) ₂ MoO ₄	13109-76-8	5.001 ± 0.025 mg/L
Ba	Ba(NO ₃) ₂	10077-31-9	4.999 ± 0.025 mg/L	Ni	Ni	7440-02-0	5.001 ± 0.025 mg/L
Cd	Cd	7440-43-9	5.002 ± 0.025 mg/L	Pb	Pb	7439-92-1	4.998 ± 0.025 mg/L
Co	Co	7440-48-4	5.000 ± 0.025 mg/L	Se	Se	7782-49-2	5.003 ± 0.025 mg/L
Cr	Cr(NO ₃) ₃	13548-36-4	5.001 ± 0.025 mg/L	Sr	Si(NO ₃) ₂	10042-76-8	5.021 ± 0.025 mg/L
Cu	Cu	7440-50-6	5.003 ± 0.025 mg/L	Zn	Zn	7440-66-6	5.002 ± 0.025 mg/L
K	KNO ₃	7757-79-1	50.00 ± 0.25 mg/L				

Matrix: 5% HNO₃

Intended Use: This solution is intended for use as a certified reference material or calibration standard for inductively coupled plasma optical emission spectrometry (ICP-OES), inductively coupled plasma mass spectrometry (ICP-MS), atomic absorption spectroscopy (flame AAS or GFAAS), microwave plasma atomic emission spectrometry (MP-AES), x-ray fluorescence spectroscopy (XRF), and other techniques for elemental analysis.

Certification & Traceability: This CRM was manufactured under a quality management system that is registered to ISO 9001, ISO 17024 and ISO/IEC 17025. This CRM was prepared to the certified concentrations shown above by gravimetric methods using single-element concentrates that were certified using the "High Performance ICP-OES" protocol developed by NIST and are directly traceable to the NIST SRMs listed below. This solution was stabilized using high purity nitric acid (HNO₃) and diluted with filtered (0.22µm), 18 M-ohm deionized water. The balances used in the preparation of this CRM are calibrated regularly with traceability to NIST. All volumetric dilutions are performed in Class A calibrated glassware. The certified concentrations were determined based upon gravimetric procedures. Secondary verification of the certified concentrations was performed using ICP-OES that was calibrated and/or referenced against NIST SRMs: 3101a, 3103a, 3104a, 3108, 3112, 3112a, 3114, 3141a, 3132, 3134, 3136, 3128, 3144, 3153a, and 3168a. The uncertainty associated with each certified concentration represents the expanded uncertainty at the 95% confidence level using a coverage factor of k=2.

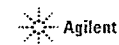
Instructions for Use: Agilent recommends that the solution be thoroughly mixed by repeated shaking or swirling of the bottle immediately prior to use. To achieve the highest accuracy the analyst should: (1) use only pre-cleaned containers and transferware, (2) avoid pipetting directly from the CRM's original container, (3) use a minimum sub-sample size of 500µL, (4) make dilutions using calibrated balances or certified volumetric class A flasks and pipettes, (5) dilute to volume using the same matrix as the original CRM, and (6) never pour used product back into the original container. The solution should be kept tightly capped and stored under normal laboratory conditions. Do not freeze, heat, or expose to direct sunlight. Minimize exposure to moisture or high humidity.

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Date: November 29, 2021 3:20:41 PM
System ID: MY15330001

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Document Name: Certificate of Analysis Wavelength calibration solution



Period of Validity: Agilent ensures the accuracy of this solution until the expiration date shown below, provided the instructions for use are followed. During the period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution.

Sample lot approval:

Chuck Gaudreau, Certifying OfficerDate of release: 17 October 2020
Date of expiration: 17 April 2022

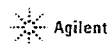
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Date: November 29, 2021 3:20:41 PM
System ID: MY15330001

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Document Name:

Certificate of Analysis Wavelength calibration solution



Hazard Information: Refer to the Safety Data Sheet (SDS), which can be obtained at www.agilent.com/chem/cls.

Homogeneity: This solution was determined to be homogeneous by procedures consistent with the requirements of ISO 17024 and ISO Guide 25. Replicate samples of the finished solution were analyzed to confirm its homogeneity, in accordance with QSP 6-13 **Assessment of Homogeneity and Stability.** To ensure homogeneity, users should not take a smaller sub-sample than specified in the Instructions for Use, as doing so will invalidate the certified values and uncertainties.

Further Information: Please contact Agilent for further information about this CRM.

Quality Certifications: This CRM was prepared under a quality management system that is:

- Registered to ISO 9001 – Quality Management Systems – Requirements (TUV NORD Cert. Reg. No. 44 100 16500231)
- Accredited to ISO 17024 – General Requirements for the Competence of Reference Material Producers (A2LA Cert. No. 2846.02)
 - ISO 17024 references additional requirements specified in ISO Guide 31 and ISO Guide 25
- Accredited to ISO/IEC 17025 – General Requirements for the Competence of Testing and Calibration Laboratories (A2LA Cert. No. 2846.01)
- ISO Standard, 216 Alder Road, Murfreesboro, TN 37132

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System ID: MY15330001

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Document Name:

Certificate of Analysis Wavelength calibration solution

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General

Document Name: Instrument's Test Report

Report Summary

Instrument Model Agilent 5100 VDV ICP-OES
Instrument ID G8011A
Instrument Serial Number MY15330001
Software Version 7.1.0.6921
Firmware Version 2994
Tested By Kanyakorn S.
Test Completed On 29-Nov-21 3:18:24 PM

Result Summary

Resolution Test Pass
Sensitivity Test Pass
Precision Test Pass

Resolution Test Pass

Element Wavelength	Specification	Width
N (174.213 nm)	≤ 0.40	7.54
As (188.980 nm)	≤ 8.20	6.72
C (193.027 nm)	≤ 11.50	8.01
Mo (202.032 nm)	≤ 8.20	6.80
Cr (206.158 nm)	≤ 13.40	10.24
Zn (213.857 nm)	≤ 8.70	7.54
Pb (220.353 nm)	≤ 0.50	7.71
Co (228.615 nm)	≤ 17.20	11.30
Ba (230.424 nm)	≤ 0.40	8.19
Mn (257.610 nm)	≤ 13.30	9.60
Mn (260.568 nm)	≤ 20.30	16.52
Cr (267.716 nm)	≤ 11.00	9.08
Cu (324.754 nm)	≤ 25.00	18.23
Cu (327.395 nm)	≤ 14.20	12.53
Sr (338.071 nm)	≤ 33.50	27.38
Ba (455.403 nm)	≤ 44.00	34.14
Sr (460.733 nm)	≤ 36.00	21.93
Ba (493.408 nm)	≤ 36.00	29.13
Ba (614.171 nm)	≤ 42.00	27.47
Ar (675.283 nm)	≤ 74.00	67.94
K (766.491 nm)	≤ 80.00	63.70

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Document Name: Instrument's Test Report

Sensitivity Test Pass

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	122.4	1199.1	83.2
Se (196.026 nm)	≥ 41.0	SRBR	79.1	935.2	100.1
Zn (213.857 nm)	≥ 1421.0	SRBR	3206.2	52338.5	263.8
Pb (220.353 nm)	≥ 46.0	SRBR	170.7	2838.4	233.0
Mn (257.610 nm)	≥ 3519.0	SRBR	10484.0	285474.0	737.6
Al (396.152 nm)	≥ 3.4	SBR	5.7	37125.2	5560.4
Ba (493.408 nm)	≥ 34.0	SBR	84.3	1024562.6	12016.8
K (766.491 nm)	≥ 1.8	SBR	3.9	104539.1	21328.3

Axial

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	276.1	4320.0	220.4
Se (196.026 nm)	≥ 159.0	SRBR	179.5	3290.1	281.0
Zn (206.200 nm)	≥ 234.0	SRBR	1432.3	22017.4	231.4
Zn (213.857 nm)	≥ 1743.0	SRBR	6972.3	204965.9	857.0
Cd (214.439 nm)	≥ 4227.0	SRBR	7810.0	163528.6	436.1
Pb (220.353 nm)	≥ 320.0	SRBR	600.5	16920.2	727.3
Mn (257.610 nm)	≥ 10625.0	SRBR	31358.8	1574284.8	2512.2
Cr (267.716 nm)	≥ 1048.0	SRBR	4587.3	186346.2	1621.6
Cu (324.754 nm)	≥ 19.0	SBR	51.8	253941.6	4813.6
Al (396.152 nm)	≥ 6.0	SBR	12.4	263070.7	10621.4
Ba (493.408 nm)	≥ 60.0	SBR	190.6	6858283.6	35799.9
K (766.491 nm)	≥ 24.0	SBR	63.4	3363913.7	52206.8

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Document Name: Instrument's Test Report

Precision Test Pass

Radial

Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 2.60	1.19
Se (196.026 nm)	≤ 2.60	1.14
Zn (213.857 nm)	≤ 1.50	0.47
Pb (220.353 nm)	≤ 2.60	0.84
Mn (257.610 nm)	≤ 1.50	0.42
Al (396.152 nm)	≤ 1.50	0.37
Ba (493.408 nm)	≤ 1.50	0.77
K (766.491 nm)	≤ 1.50	0.29

Axial

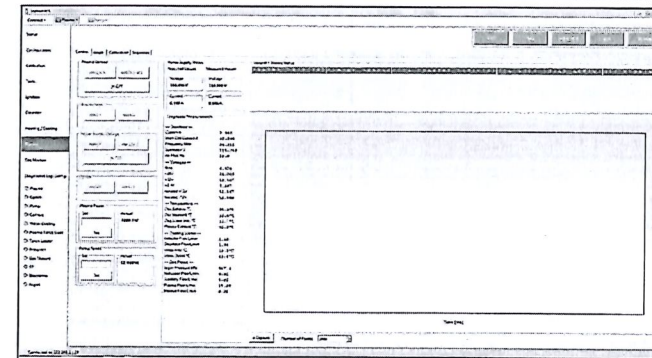
Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 1.50	0.68
Se (196.026 nm)	≤ 1.50	0.64
Zn (206.200 nm)	≤ 1.50	0.29
Zn (213.857 nm)	≤ 1.50	0.37
Cd (214.439 nm)	≤ 1.50	0.34
Pb (220.353 nm)	≤ 1.50	0.33
Mn (257.610 nm)	≤ 1.50	0.74
Cr (267.716 nm)	≤ 1.50	0.29
Cu (324.754 nm)	≤ 1.50	0.37
Al (396.152 nm)	≤ 1.50	0.35
Ba (493.408 nm)	≤ 1.50	0.55
K (766.491 nm)	≤ 1.50	0.60

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Date: November 29, 2021 3:20:41 PM
System ID: MY15330001

General

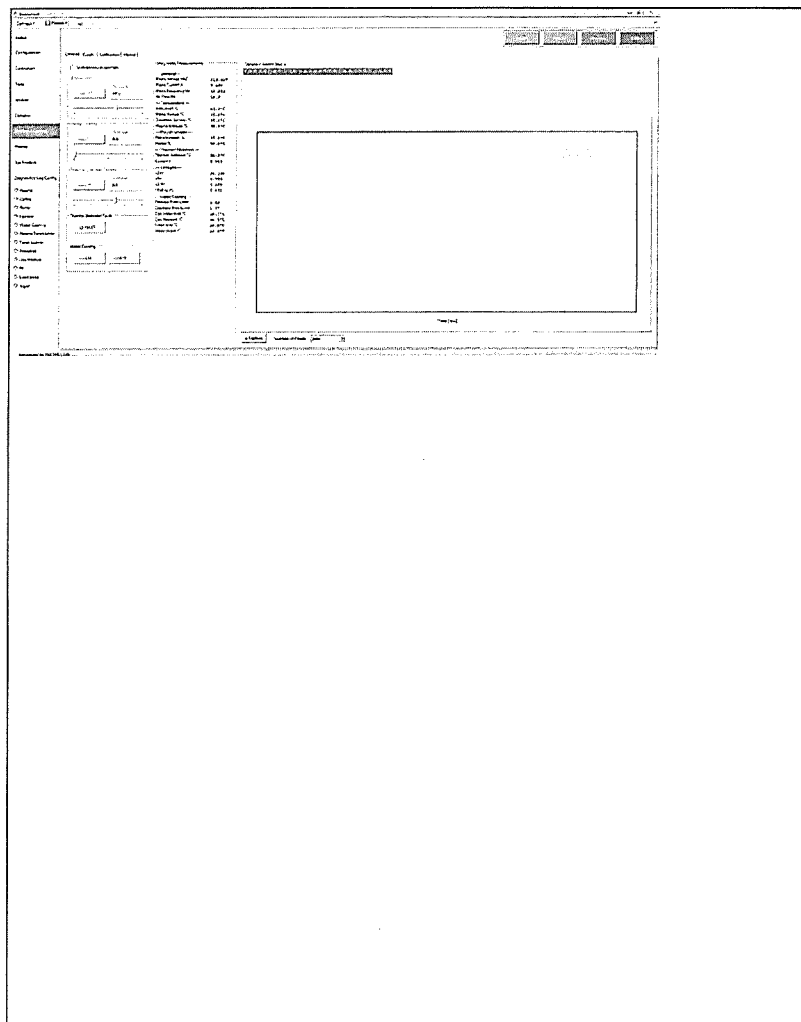
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Date: November 29, 2021 3:20:41 PM
System ID: MY15330001

General

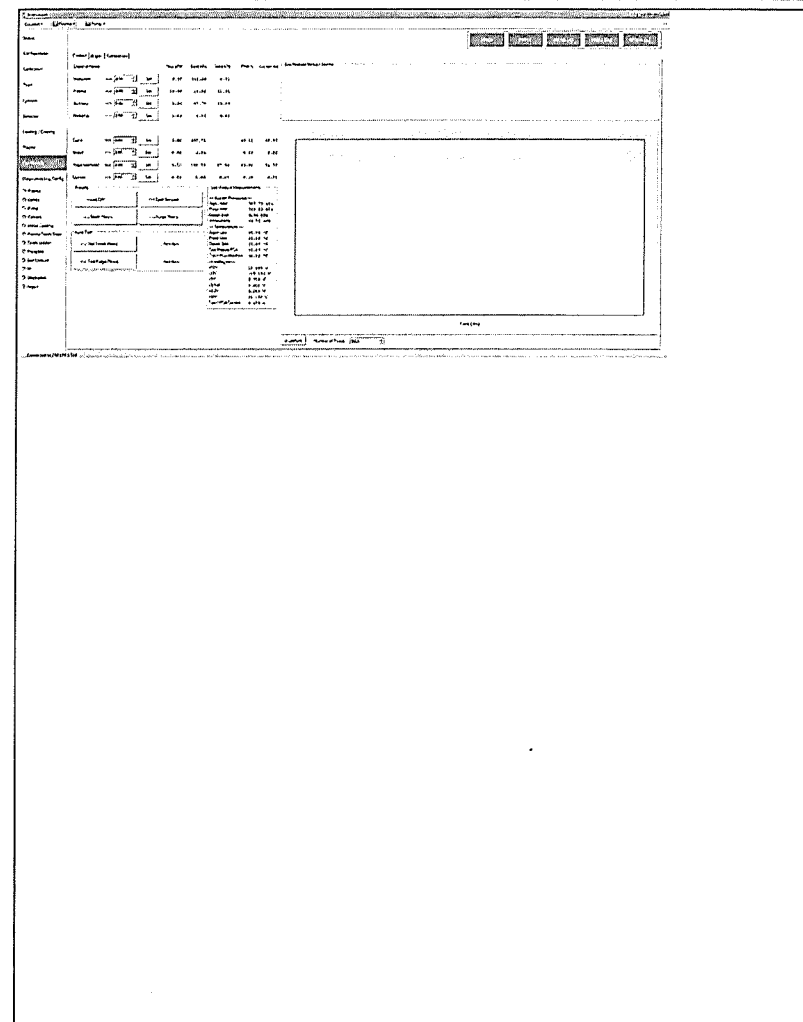
Document Name: Instrument's Test Report



Date: November 29, 2021 3:20:41 PM
System ID: MY15330001

General

Document Name: Instrument's Test Report

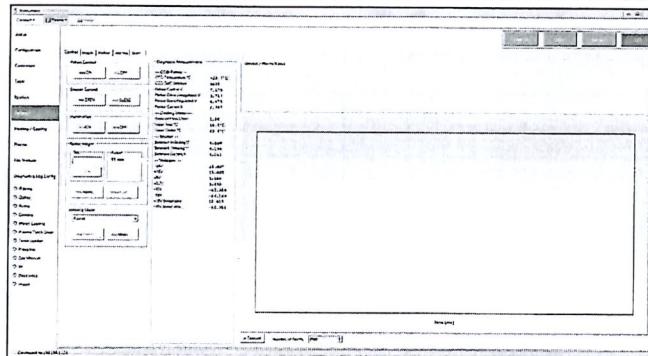


Date: November 29, 2021 3:20:41 PM
System ID: MY15330001

General

Document Name:

Instrument's Test Report





PinAAcle 900Z Preventive Maintenance Report

Company Name: ENVIRONMENT RESEARCH

Instrument Location: 25/114 M.6 ,THANON NGAM WONG WAN ,
THUNG SONG HONG, LAK SI, BANGKOK, 10210

Instrument Serial No.: PZAS19031401

Date: 14-Jun-2021

PinAAcle 900Z Preventive Maintenance (PM)

Company Name:	ENVIRONMENT RESEARCH		
Address (Instrument Location):	25/114 M.6 ,THANON NGAM WONG WAN, LAK SI, BANGKOK, 10210		
Serial Number:	PZAS19031401	PM Number:	1/2
Customer Name (if applicable):	K. RAIWIN	Telephone Number:	099-182-9241
Customer Support Engineer Name:	K.DUANG	Service Order Number:	WO-01301953
Date PM Performed: (DD-MMM-YYYY)	14-Jun-2021	Next PM Due Date: (DD-MMM-YYYY)	14-Dec-2021
Standard Labor Hours to Complete PM :		5 hours	

Part Number	Release	Publication Date	
09370144 Rev.9	A	January 2018	

Scope

The purpose of this PM is to ensure the continued functionality of the PinAAcle 900Z by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer.

The customer should save their method before the PM begins.

General Instructions:

The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM.

Always check with the customer before making any changes that may affect the customer's analysis or calibration, including a current back-up of system software and/or data files.

The completed document should be signed by an authorized PerkinElmer and customer representative and left with the customer.

Update the PM sticker and instrument logbook as required.

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Component List

Component / Specific Model	Serial #	Configuration Notes

Parts Lists

Parts Included with the PM		
Part Number (if applicable)	Description	Quantity
B0501696	Fan Filters	2
B3002013	THGA Contact Cylinders	1
B3141064	Glycerol for THGA Cooling	N/A

Additional Reagents and Standards Required for PM				
Part Number (if applicable)	Description	Quality	Batch/Lot #	Expired Date (MM/YY)
N9300244	GFAAS Mixed Standard	AR	53-255CRY1	30-Sep-2021

Additional Reagents and Standards Required for PM (Customer Support Solution)				
Part Number (if applicable)	Description	Quantity	Batch/Lot #	Expiration Date (MM/YY)
N/A	DI Water	250 ml.	AR	AR
N/A	0.5% HNO ₃	250 ml.	AR	AR

Additional Tools Required for PM			
Part Number (if applicable)	Description	Quantity	Serial #
B3100652 Or N9307029	Electronic Flow Meter	1	PE200767
B0505495	Test Jig	1	NA
03030997	System 2 EDL Driver	1	03030997
N3050605	As System 2 EDL	1	16148
N3050121	Cu Lumina HCL	1	092216-010130
N3050109	Ba Lumina HCL	1	102416-040160
N3050139	K Lumina HCL	1	110716-010060
N3050152	Ni Lumina HCL	1	100516-030190
N3050119	Cr Lumina HCL	1	091911-020150

Procedure Checklist

Use (✓) to check off those steps in the checklist that have been completed.

1. General:

- ☒ Review the instrument performance with the customer and document any recent problems.
- ☒ Inspect the customer log book and make any appropriate PM entries.
- ☒ Perform general inspection of system for cleanliness.

2. PC Instrument Software:

- ☒ Instrument Software user files/databases archived, packed, and/or deleted as needed.

3. Mechanical:

- ☒ Inspect and clean all fans and filters. Replace filters if necessary
- ☒ Inspect all gas and water lines for leaks and/or wear. Replace if needed. Thoroughly inspect all quick connects. Replace the Y connector, P/N 09921079, if needed.
- ☒ Clean exterior of the instrument.
- ☒ Check the drain system for signs of wear. Replace worn or damaged parts.
- ☒ Inspect the pole pieces and clean where the pole pieces contact the furnace. Replace the pole piece p-rings as needed, P/N's B0501018 & B0501250. Grease the O-rings as needed with Apiezon L grease, P/N 09905148
- ☒ Inspect the four insulation pads on the front contact housing of the THGA in furnace. If the pads are missing replace the THGA furnace or replace the insulator pads on the furnace.
- ☒ Inspect the graphite tube and clean the contact cylinders. Replace if necessary.
- ☒ Check internal and external gas flows with the Electronic Gas Flow Meter and the Gas Flow Test Probe as described in the Service Manual. Correct if necessary.
- ☒ Check furnace open/close function.
- ☒ Verify the operation of the GFTV Camera for proper operation and viewing alignment in the furnace camera Tube View window. Align if needed.
- ☒ Check the operation of the Halogen Light ASSY for the GFTV Camera. Replace if needed.
- ☒ Check the water level/quality in the recirculation (if applicable). Add distilled water if necessary.
- ☒ Check the cooling system fluid flow rate with the FCS In-Line Flow Meter for proper levels if needed. Refer to SDB# COSY008.STN
- ☒ Perform Cooling System maintenance if needed per SDB# COSY005.STN.
- ☒ Check auto sampler operation.
- ☒ Perform an auto sampler check valve test as described in the Service Manual.
- ☒ Lubricate the spindles of the auto sampler pumps and all moving parts of the tray mechanics as described in the Service Manual.
- ☒ Inspect the auto sampler sampling capillary as described in the Service Manual. Replace if necessary.
- ☒ Inspect the four insulation pads on the front contact housing of the THGA in furnace. If the pads are missing replace the THGA furnace or replace the insulator pads on the furnace.
- ☒ Inspect the graphite tube and clean the contact cylinders. Replace if necessary.
- ☒ Check internal and external gas flows with the Electronic Gas Flow Meter and the Gas Flow Test Probe as described in the Service Manual. Correct if necessary.
- ☒ Check furnace open/close function

4. Electrical:

- ☒ Inspect PC boards. Clean if necessary.
- ☒ Check instrument firmware revisions upgrade to current levels (if necessary)
- ☒ Run Diagnostics Test within the Advanced function of the Spectrometer page. Check the results in the service log folder in the Spectrometer BM Log Viewer.

5. Optics:

- ☒ Inspect and clean the sample compartment windows, if needed.
- ☒ Inspect and clean the furnace windows, if needed.
- ☒ Inspect and clean the GFTV camera lens, if needed.
- ☒ Inspect optics. Clean or replace if necessary,

6. Gasses:

- ☒ Verify that the Gasses supplied to the instrument are within the pressure and purity specifications found in the PinAAcle 900 Series Pre-installation Checklist SDB.
- ☒ Verify that the air filter element is dry. Replace if necessary.

7. After PM Performance tests [THGA]:

7.1 Furnace Gas Flows

Description: Ensures the flow rates are within specification.

Parameter	Specification	Test Results	Pass/Fail
Internal Flow Rate	250 mL/min ± 25 mL/min	255	Passed
External Flow Rate	100 mL/min ± 10 mL/min	100	Passed

7.2 Chromium Baseline Noise

Description: Signal to noise check.

Parameter	Specification	Results	Pass/Fail
Baseline Noise	≤ 0.005 Abs.	0.0010	Passed
Standard Deviation	≤ 0.005	0.0003	Passed

7.3 Chromium Characteristic Mass and Precision

Description: Calculate the characteristic mass using the characteristic mass tool and precision from the integrated absorbance values.

Parameter	Specification	Results	Pass/Fail
Cr m ₀ Results	≤ 7.0 pg/0.0044 A-s	3.8	Passed
Precision	≤ 2.0 %	1.02	Passed

7.4 Copper Characteristic Mass and Zeeman Ratio

Description: Calculate the characteristic mass using the characteristic mass tool and check the Zeeman Ratio.

Parameter	Specification	Results	Pass/Fail
Cu m ₀ Result	≤ 16.5 pg/0.0044 A-s	11.8	Passed
Zeeman Ratio	0.52 ± 0.04	0.56	Passed

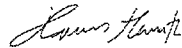

8. Review:

- ☒ Review with the customer PM work performed.
- ☒ Review with the customer routine maintenance procedures.
- ☒ Discuss recommended customer supplied materials to have on hand.
- ☒ Attach PM sticker.

Additional Comments

Additional Comments Regarding the PM	
Zeeman Ratio	$= \frac{\text{Atomic Signal (Peak area)}}{\text{Atomic Signal (Peak area)} + \text{Background Signal (Peak area)}}$
	$= \frac{0.1934}{0.1934 + 0.1481}$
	$= 0.56$

Review

The preventive maintenance checks and if applicable performance tests for PinAAcle 900Z have been completed.	
This PinAAcle 900Z Passes <input checked="" type="checkbox"/> Fails <input type="checkbox"/> the preventive maintenance.	
Review of Preventive Maintenance:	
Authorized PerkinElmer Representative: 	Date: 14-Jun-2021 (DD-MMM-YYYY)
Authorized Customer Representative: 	Date: 14-Jun-2021 (DD-MMM-YYYY)

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

METTLER TOLEDO



Accuracy Calibration Certificate

Customer

Company: ENVIRONMENT RESEARCH&TECHNOLOGY CO., LTD.
Address: 25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Rd., Tuongsongho
City: Laksi 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-LIN-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.

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

As Found Calibration Date: 19-Jan-2022

As Left Calibration Date: N/A

Issue Date: 20-Jan-2022

Calibrator:

Smicha C

Suwicha Choykamchu

Approved Signatory:

Kassakorn Tassunachaisakul

- ☒ Kassakorn Tassunachaisakul
☐ Santi Jitinyom
☐ Surachet Sukkate

METTLER TOLEDO Service

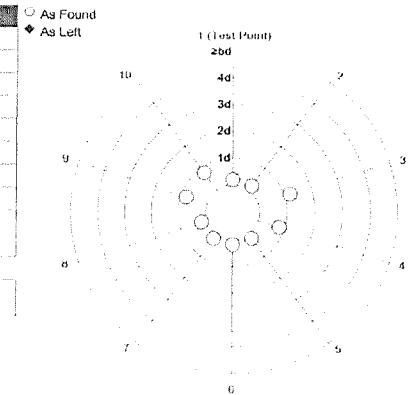
Measurement Results

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
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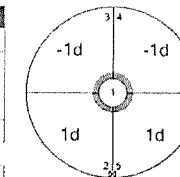
The "d" in the graph represents the readability of the range/interval in which the test was performed.
The results of this graph are based upon the absolute values of the differences from the mean value.

Eccentricity

Test Load: 100 g

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

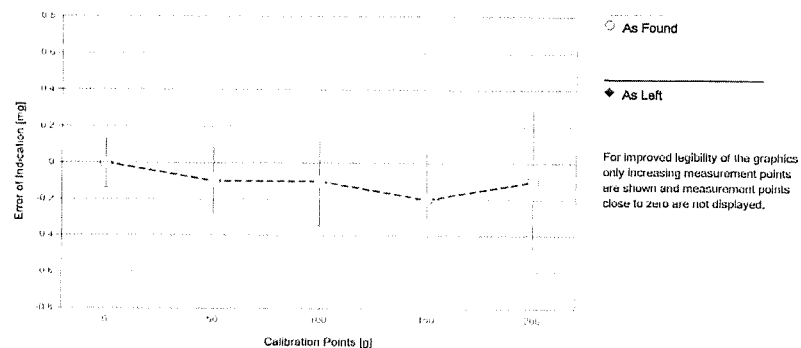
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Error of Indication

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%.

This 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

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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.

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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

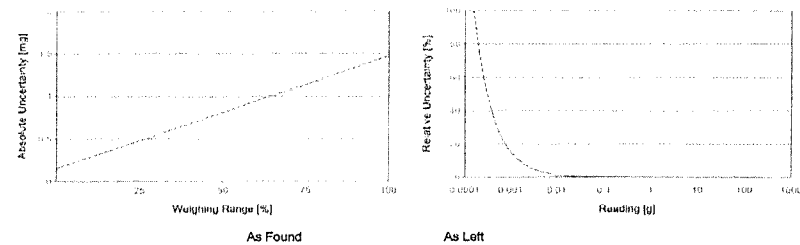
Linearization of Uncertainty Equation

	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.

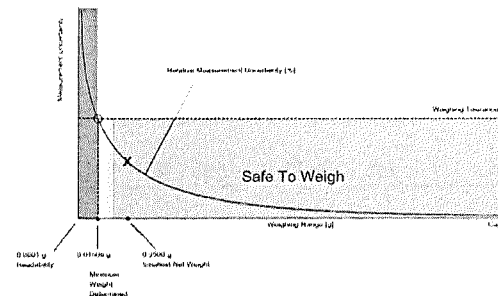
Process Requirements

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.

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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

i_1 = 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	0.00006 g*	N/A	0.00006 g*	N/A
0.2%	0.00005 g		✗		✗
0.5%	0.00013 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 0.41st 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	0.0001 g	✓	0.0001 g	✓
0.2%	0.1000 g		✓		✓
0.5%	0.2500 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	-0.0001 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

		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	-0.0001 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 Chinakot 1, Ngamwongwan Rd., Toongsongho นานาเทคโนโลยี, Laksi, Bangkok 10210
Ramita Teengthai

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	✓	Leveling	✓
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		Doplot repair	
User training		Use of accessories (see additional remarks)	

Contact	Name: Ramita Teengthai	Position: N/A	Phone: 0869334490	Email: ramita@enviresearch.co.th
Additional Remarks & Recommendations				Engineer Details
				Date: 19-Jan-2022
				Name: Suwiche 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

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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 Chinakot 1,
Ngamwongwan Road, Toongsonghong, Laksi,
Bangkok 10210
Location : Laboratory (ERTC)
Received Order : 5 January 2022
Calibration Date : 5 January 2022
Ambient Temperature : $(26 \pm 10) ^\circ\text{C}$
Relative Humidity : $(50 \pm 30) \%$
Calibrated by : Man Pattanapongpaiboon

Approved by :

Malee

Approved Signatory

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

Issue Date : 21 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.

24-1-65

A 0036819



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

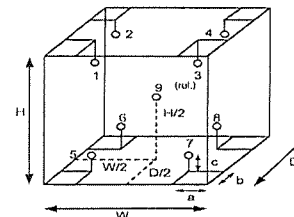
2. This certificate is valid only to the item calibrated on date and place of calibration.

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 : 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 m³

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

24-1-65

Malee

a 1090218



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2201-0006ON-3
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 22TM152

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>
104.0	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								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	105.219	103.394	103.908	104.133	104.348	104.096	103.878	104.103	104.360
180.0	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 %.

-o0o-

96-1-65

Mali.

a 1090217



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 : $(26 \pm 10) ^\circ\text{C}$
Relative Humidity : $(50 \pm 30) \%$
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%

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.

24-1-65

A 0036818



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

Cert. No.: 22TM151
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) 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

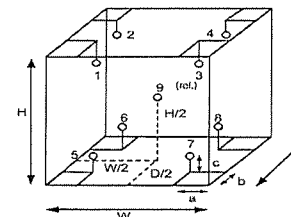
2. This certificate is valid only to the item calibrated on date and place of calibration.

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 : Dimension of Chamber :
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 m³

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

24-1-65

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 %.

-o0o-

Signature: *Mdu.*
 Sb-1-6

a 1090219


Mettler-Toledo (Thailand) Ltd.
846/4 - 849/5 Lasalle Rd., Bangna Tai Sub-District
Bangna District, Bangkok 10260
+66 2723 0382
MT-TH.ServiceSupport@mt.com

METTLER TOLEDO



Accuracy Calibration Certificate

Customer

Company: ENVIRONMENT RESEARCH&TECHNOLOGY CO., LTD.
Address: 25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Rd., Toongsongkho
City: Lakxi Contact: Ramita Toengthai
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: CPW002/20


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
As Left Calibration Date: N/A
Issue Date: 20-Jan-2022

Calibrator: 
Suwicha Choykamchu

Approved Signatory: 
☒ Kassakorn Tassanachaisakul
☐ Santi Jitniyom
☐ Surachot Sukkate

METTLER TOLEDO Service

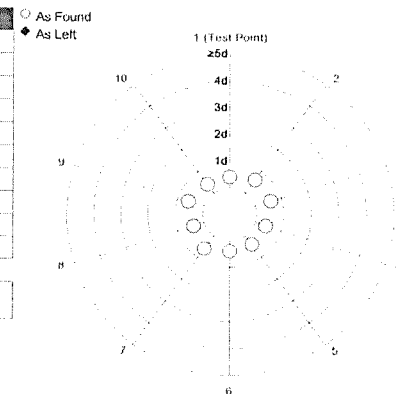
Measurement Results

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	99.9998 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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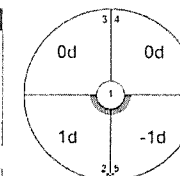
The "d" in the graph represents the readability of the range/interval in which the test was performed.
The results of this graph are based upon the absolute values of the differences from the mean value.

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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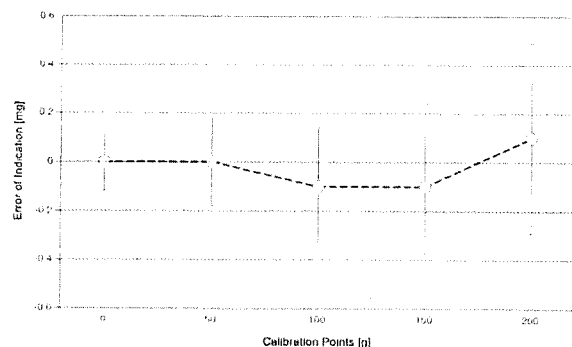
As Found

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

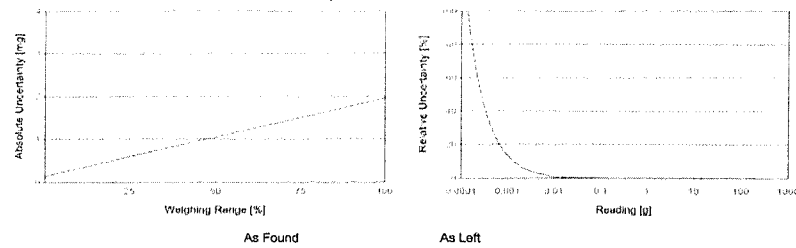
Linearization of Uncertainty Equation

	Range		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	
	Value	Relative [%]	Value	Relative [%]
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.

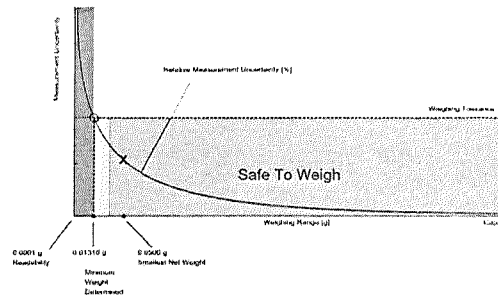
The weighing device meets the given process requirements.

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 loading, unless only As Found was performed.

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 those not 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	0.00005 g*	N/A	0.00005 g*	N/A
0.2%	0.00005 g		✓		✓
0.5%	0.00013 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	0.0001 g	✓	0.0001 g	✓
0.2%	0.1000 g		✓		✓
0.5%	0.2500 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 8, Soi Chinsaket 1, Ngamwongwan Rd., Toongsonghro 6, บางกะปิ, Bangkok 10210
Ramita Teengithai

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		

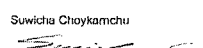
Check List

Environmental Conditions		General & Functional Checks	
Room temperature fluctuation	✓	Leveling	✓
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 Teengithai Position: N/A Phone: 0868334490 Email: ramita@envresearch.co.th

Additional Remarks & Recommendations		Engineer Details	
		Date:	19-Jan-2022
		Name:	Suwichai 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



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



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



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

Certificate of Calibration

Certificate No. : MT22-1359
Page : 1 of 4

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.

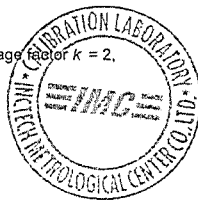
Reference Standard Instruments :

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

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%

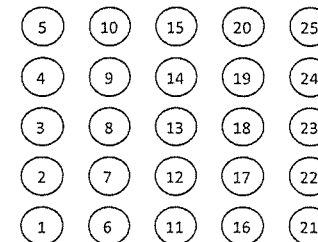


Calibrated by : Miss Jarunee Tubsay
Issue date : Jan 18, 2022

Approved by :
(Mr.Panuwat Phuklan)

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Position



Top view

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

Result : Without adjustment

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

25-1-65



Inctech Metrological Center Co.Ltd.
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Tel. (662) 909-8820 (Auto 10 lines) www.imcinstrument.com



Certificate No. : MT22-1359

Page : 3 of 4

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

Result : Without adjustment

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.)
Calibration point : 105, 150 °C
Immersion depth : 50 mm.

Result : Without adjustment

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



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Certificate No. : MT22-1359

Page : 4 of 4

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

Result : Without adjustment

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



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-2000-27 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 ห้องปฏิบัติการบ่มอาหารเลี้ยงเชื้อ
Received Order : 5 January 2022
Calibration Date : 6 January 2022
Ambient Temperature : $(26 \pm 10) ^\circ\text{C}$
Relative Humidity : $(50 \pm 30) \%$
Calibrated by : Khit Ruttanaprapachai
Approved by :
() 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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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

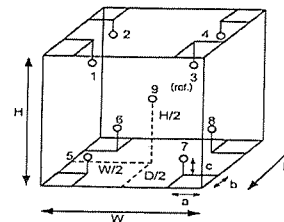
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

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



Cert.No.: 22CHO8

Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Eutech
Model : pH 700
Serial No. : 2732154
ID No. : ERTC-L-In.-155
Condition As-Received: Used Item
Received Date : 05 January 2022
Calibration Date : 07 January 2022
Reference : 2201-0006ON-17
Submitted by : Environment Research & Technology Company Limited.
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,
Toongsonghong, Laksi, Bangkok 10210
Calibration Place : ห้องเตรียมสารงานอากาศ
Ambient Temperature : (26.5 - 24.1) °C
Relative Humidity : (50 - 52) %
Calibration Procedure : In - house method :
- CP-OCH2 by direct measurement with standard
voltage calibrator and direct measurement
with certified reference material (CRM)

Calibrated by : Uthen Kankawi

Approved by :

Approved Signatory

(✓) Malee Butkruea

() Saithip Meangmai

() Warakorn Lernagtrakul

Issue Date : 19 January 2022

The Uncertainties are for a confidence probability of approximately 95%

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Cert. No.: 22CHO8

Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument : -

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Document Process Calibrator	46530031	130RC098	21E3245	07 Oct 2022
2) Digital Thermometer	-	130RC017	21T686	08 Apr 2022

This certification is traceable to the International System of Unit maintained at:-

- Traceable to National Institute of Metrology (Thailand), NIMT

2. 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	766820	23 Sep 2023
pH 6.982	CPA chem	761017	02 Aug 2022
pH 10.015	CPA chem	761018	02 Aug 2022

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

Calibration Results**Function : mV Measurement**

Performing standard curve by Fluke at pH (4,7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (\pm mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N.: 2732154	4.00	177.48	177.5	4.00	0.058	2.00
	7.00	0.00	0.0	7.00	0.058	2.00
	10.00	-177.48	-177.5	10.00	0.058	2.00

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.: 2970016	4.008	4.00	177.3	0.010	2.11
	6.982	6.98	2.9	0.011	2.00
	10.015	10.04	-171.0	0.019	2.15

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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