

ภาคผนวก 3ค

เอกสารการสอบเทียบเครื่องมือตรวจวัด

การตรวจวัดคุณภาพอากาศในบรรยากาศ
และระดับเสียงทั่วไป

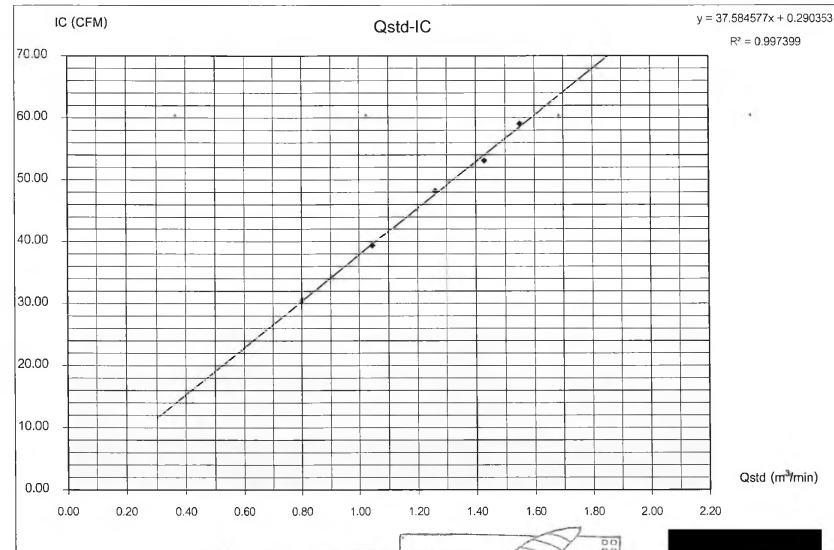
TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2024-00271	Date	June 6, 2024
Sampler Location	ท่าอากาศยานเชียงใหม่	Start Time	10:47 AM
Sampler Number	TSP No A27	Transfer Standard Type	Orifice
Instrument Model	HVOL-BBCBE	Calibrator Model	TE-5025A
Motor Serial Number	2215	Calibrator Serial Number	2014
Recorder Serial Number	2133	Calibrated By	Mr.Watcharapon On-nom

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric	Start	Stop	
	Pressure Drop Across Orifice (mmHg)			$[\Delta H_O(Pa/P_{std}(T_{std}/Ta))]^{1/2}$	$Qstd = (1/m)[(A-b)]$ (m ³ /min)	sample Flow Rate Indicator (ft ³ /min)	$IC = [(Pa/P_{std})(T_{std}/Ta)]^{1/2}$ (°K = °C+273)		Pressure (mmHg)	Meter	Meter	
	Positive	Negative	ΔH ₂ O									
5	1.4	1.4	2.8	1.64586	0.80072	31.0	30.40	306.0	755.0			
7	2.4	2.4	4.8	2.15494	1.04562	40.0	39.34	306.0	755.0			
10	3.5	3.5	7.0	2.60233	1.26085	49.0	48.20	306.0	755.0			
13	4.5	4.5	9.0	2.95077	1.42847	54.0	53.11	306.0	755.0			
18	5.3	5.3	10.6	3.20234	1.54949	60.0	59.02	306.0	755.0			
Linear Regression Y ON X: Y= mX + b							Average	306.0	755.0			
1	Slope (m)			2.07871	Linear Equation		r ²	0.997399	Pstd(mmHg)		760	
2	Intercept (b)			-0.01861	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9980987	Tstd	298	
3	Correlation Coefficient (r)			0.99984	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)	0.96744925			
Result									C=(Pa/Pstd)*(Tstd/Ta)*0.5			0.983589986

COMMENT

Andersen Instruments, Inc.



Checked By

Technician

Approved By

Environmental Scientist

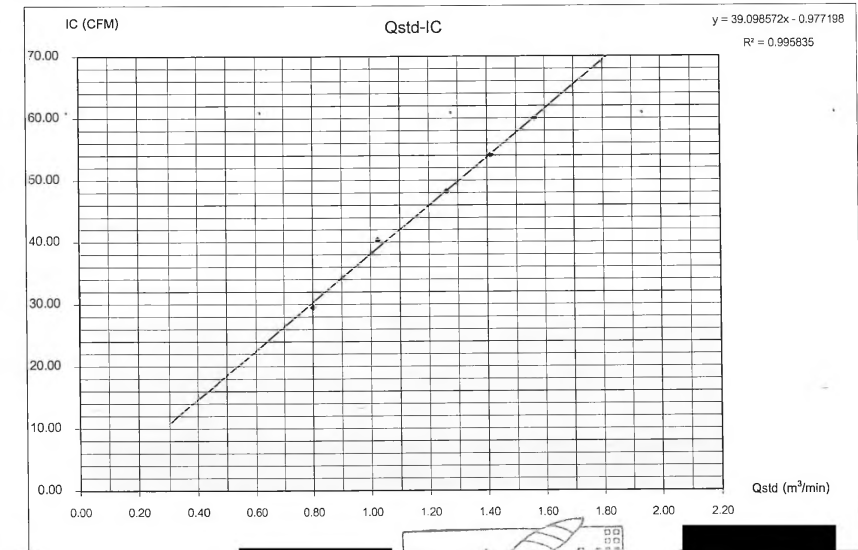
PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2024-00271	Date	June 6, 2024
Sampler Location	ท่าอากาศยานเชียงใหม่	Start Time	10:37 AM
Sampler Number	PM-10 No.12	Transfer Standard Type	Orifice
Instrument Model	HVOL-BMBBE	Calibrator Model	TE-5025A
Motor Serial Number	B2012-10	Calibrator Serial Number	2914
Recorder Serial Number	4650	Calibrated By	Mr.Watcharapon On-nom

Plate No.	(Delta H)		(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter	
	Pressure Drop Across Orifice (inH ₂ O)		$[\Delta H_O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ (m ³ /min)	sample Flow Rate Indicator (ft ³ /min)	$IC = [(Pa/P_{std})(T_{std}/Ta)]^{1/2}$ (°K = °C+273)	(°K = °C+273)	(mmHg)	Meter	Meter	
5	1.4	1.4	2.8	1.64586	0.80072	30.0	29.51	306.0	755.0		
7	2.3	2.3	4.6	2.10957	1.02380	41.0	40.33	306.0	755.0		
10	3.5	3.5	7.0	2.60233	1.26085	49.0	48.20	306.0	755.0		
13	4.4	4.4	8.8	2.91780	1.41261	55.0	54.10	306.0	755.0		
18	5.4	5.4	10.8	3.23241	1.56396	61.0	60.00	306.0	755.0		
Linear Regression Y ON X : Y= mX + b						Average	306.0	755.0			
1	Slope (m)		2.07871	Linear Equation			r ²	0.995835	Pstd(mmHg)	760.0	
2	Intercept (b)		-0.01861	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9979153	Tstd	298.0	
3	Correlation Coefficient (r)		0.99984	Final Set Flow Rate = (I)			0	(Pa/Pstd)*(Tstd/Ta)	0.96744926		
Result						C=(Pa/Pstd)*(Tstd/Ta)*0.5					0.983589986

COMMENT

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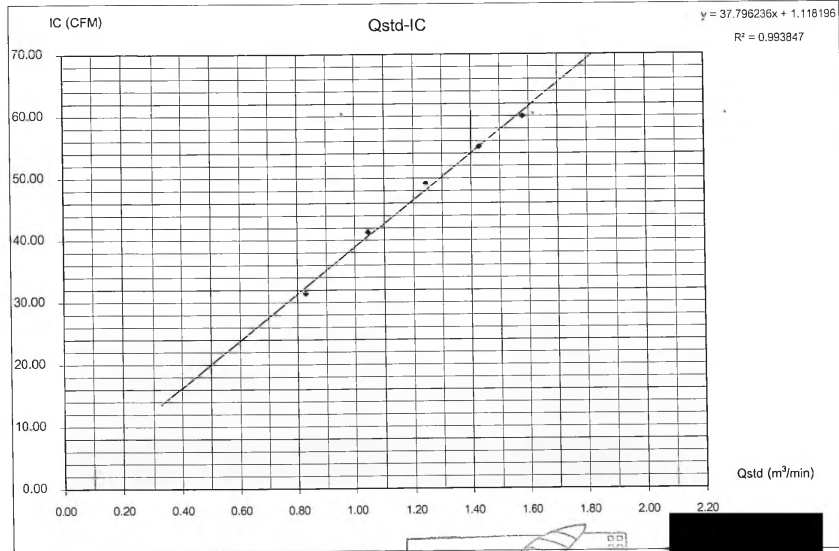
TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2024-00271	Date	June 6, 2024
Sampler Location	พื้นที่วัด	Start Time	10:12 AM
Sampler Number	TSP No.A31	Transfer Standard Type	Office
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A
Motor Serial Number	57-507	Calibrator Serial Number	2914
Recorder Serial Number	507-012	Calibrated By	Mr.Watcharapon On-nom

Plate No.	(Delta H)	(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (mmHg)	$[\Delta H \cdot O(Pa/P_{std}(T_{std}/T_a))]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$	Sample Flow Rate Indicator	$IC = I[(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	(°K = °C+273)	(mmHg)		
	Positive Negative ΔH_{H_2O}		(m³/min)	(l/min)					
5	1.5 1.5 3.0	1.70363	0.82851	32.0	31.47	306.0	755.0		
7	2.4 2.4 4.8	2.15494	1.04562	42.0	41.31	306.0	755.0		
10	3.4 3.4 6.8	2.56499	1.24284	50.0	49.18	306.0	755.0		
13	4.5 4.5 9.0	2.95077	1.42847	56.0	55.08	306.0	755.0		
18	5.5 5.5 11.0	3.26220	1.57829	61.0	60.00	306.0	755.0		
Linear Regression Y ON X: Y = mX + b						Average	306.0	755.0	
1	Slope (m)	2.07871	Linear Equation			r²	0.993847	Pstd/mmHg	750.0
2	Intercept (b)	-0.01861	Set Point Flow Rate (X) (m³/min)	1.133	r	0.9996029	Tntp		298.0
3	Correlation Coefficient (r)	0.99984	Final Set Flow Rate = (I)	0	(Pa/Pstd)*(Tstd/Ta)	0.96744926			
Result						C=(Pa/Pstd)*(Tstd/Ta)^0.5			
						0.98358996			

COMMENT

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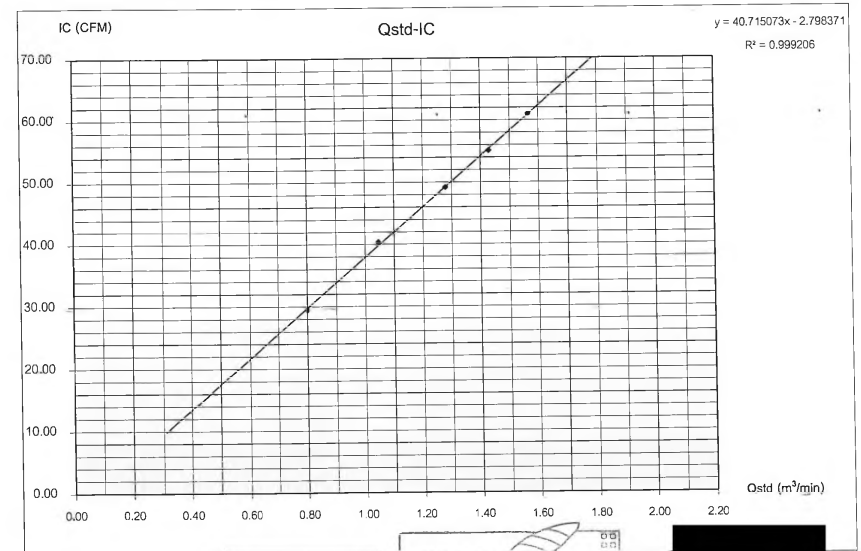
PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2024-00271	Date	June 6, 2024
Sampler Location	พื้นที่วัด	Start Time	10:02 AM
Sampler Number	PM-10 No.27	Transfer Standard Type	Office
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A
Motor Serial Number	2209	Calibrator Serial Number	2914
Recorder Serial Number	2612	Calibrated By	Mr.Watcharapon On-nom

Plate No.	(Delta H)	(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (mmHg)	$[\Delta H \cdot O(Pa/P_{std}(T_{std}/T_a))]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$	Sample Flow Rate Indicator	$IC = I[(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	(°K = °C+273)	(mmHg)		
	Positive Negative ΔH_{H_2O}		(m³/min)	(l/min)					
5	1.4 1.4 2.8	1.64586	0.80072	30.0	29.51	306.0	755.0		
7	2.4 2.4 4.8	2.15494	1.04562	41.0	40.33	306.0	755.0		
10	3.6 3.6 7.2	2.63925	1.27861	50.0	49.18	306.0	755.0		
13	4.5 4.5 9.0	2.95077	1.42847	56.0	55.08	306.0	755.0		
18	5.4 5.4 10.8	3.23241	1.50396	62.0	60.98	306.0	755.0		
Linear Regression Y ON X: Y = mX + b						Average	306.0	755.0	
1	Slope (m)	2.07871	Linear Equation			r²	0.999206	Pstd/mmHg	750.0
2	Intercept (b)	-0.01861	Set Point Flow Rate (X) (m³/min)	1.133	r	0.9996029	Tntp		298.0
3	Correlation Coefficient (r)	0.99984	Final Set Flow Rate = (I)	0	(Pa/Pstd)*(Tstd/Ta)	0.96744926			
Result						C=(Pa/Pstd)*(Tstd/Ta)^0.5			
						0.98358996			

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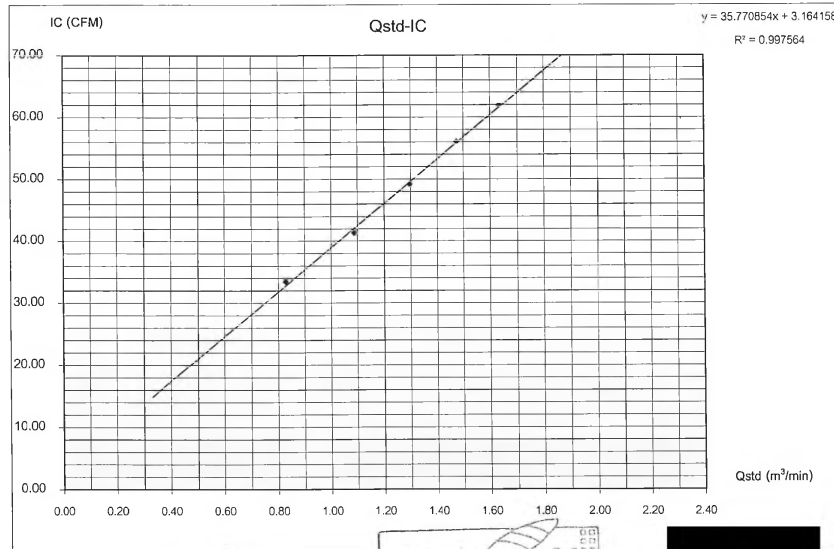
TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2024-00271			Date	June 6, 2024
Sampler Location	A3 กรุงเทพมหานคร			Start Time	12:05 PM
Sampler Number	TSP No.A30	Transfer Standard Type	Orifice	Stop Time	12:15 PM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Anan Kongguennok
Motor Serial Number	2213	Calibrator Serial Number	2914		
Recorder Serial Number	2136				

Plate No.	(Delta H) Pressure Drop Across Orifice (mmHg)			(A) [ΔH ₂ O(Pa/P _{std} KT _{std} /Ta)] ^{1/2}	(X) Qstd = {1/m}[(A-b)] (m ³ /min)	(I) Sample Flow Rate Indicator (l ³ /min)	(Y) [C = I{(Pa/P _{std} KT _{std} /Ta)] ^{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	1.70383	0.82851	34.0	33.44	306.0	755.0			
7	2.5	2.6	5.2	2.24293	1.08795	42.0	41.31	306.0	755.0			
10	3.7	3.7	7.4	2.67565	1.29612	50.0	49.18	306.0	755.0			
13	4.8	4.8	9.6	3.04754	1.47503	57.0	56.06	306.0	755.0			
18	5.9	5.9	11.8	3.37874	1.63436	63.0	61.97	306.0	755.0			
Linear Regression Y ON X: Y = mX + b							Average	306.0	755.0			
1	Slope (m)			2.07871	Linear Equation			r ²	0.997564	Pstd(mmHg)	760.0	
2	Intercept (b)			-0.01861	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9987813	T _{std}	298.0	
3	Correlation Coefficient (r)			0.99984	Final Set Flow Rate = (I)		0	(Pa/Pstd)(Tstd/Ta)	0.96744926			
Result								C=(Pa/Pstd)*(Tstd/Ta) ^{0.5}				0.983589986

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F-AB-028, Rev. 02, June 3, 2019

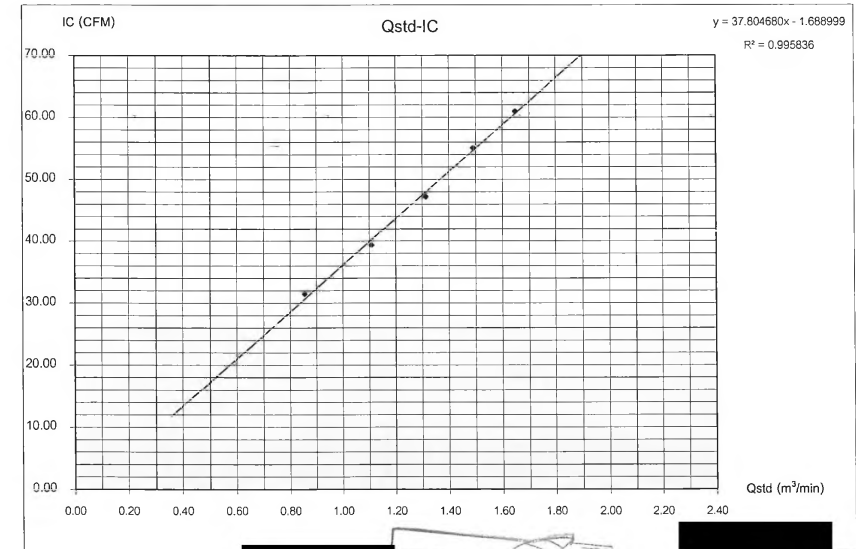
PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2024-00271			Date	June 6, 2024
Sampler Location	A3 กรุงเทพมหานคร			Start Time	12:15 PM
Sampler Number	PM-10 No.18	Transfer Standard Type	Orifice	Stop Time	12:25 PM
Instrument Model	HVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Anan Kongguennok
Motor Serial Number	2065	Calibrator Serial Number	2914		
Recorder Serial Number	2217				

Plate No.	(Delta H) Pressure Drop Across Orifice (mmH ₂ O)			(A) [ΔH ₂ O/(Pa(P _{std})(T _{std} /T _a))] ^{1/2}	(X) Q _{std} = (1/m)[(A-b)] (m ³ /min)	(I) Sample Flow Rate Indicator (l ³ /min)	(Y) IC = I[(P(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	1.6	1.6	3.2	1.75950	0.85539	32.0	31.47	306.0	755.0			
7	2.7	2.7	5.4	2.28566	1.10851	40.0	39.34	306.0	755.0			
10	3.8	3.8	7.6	2.71157	1.31340	48.0	47.21	306.0	755.0			
13	4.9	4.9	9.8	3.07912	1.49022	56.0	55.08	306.0	755.0			
18	6.0	6.0	12.0	3.40726	1.64807	62.0	60.98	306.0	755.0			
Linear Regression Y ON X: Y = mX + b								Average	306.0	755.0		
1	Slope (m)			2.07871	Linear Equation			r ²	0.995836	Pstd(mmHg)	760.0	
2	Intercept (b)			-0.01861	Set Point Flow Rate (X) (m ³ /min)			1.133	r	0.9979158	T _{std}	298.0
3	Correlation Coefficient (r)			0.99984	Final Set Flow Rate = (I)			0	(Pa/Pstd)*(Tstd/Ta)	0.96744926		
Result								C=(Pa(Pstd)*(Tstd/Ta) ^{0.5}				0.983589986

COMMENT

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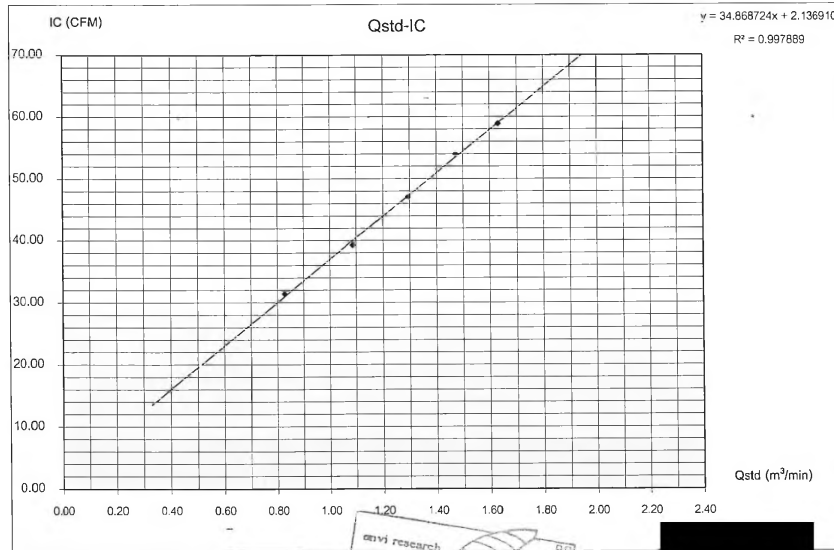
TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2024-00271	Date	June 6, 2024
Sampler Location	A4 ท่าอากาศยานดอนเมือง(วัดใกล้)	Start Time	13:45:00 PM
Sampler Number	TSP No. A25	Transfer Standard Type	Onifice
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A
Motor Serial Number	2152	Calibrator Serial Number	2914
Recorder Serial Number	2411	Calibrated By	Mr. Anan Kongguennok

Plate No.	(Delta H)	(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (mmH ₂ O)	$[\Delta H_2O(Pa/P_{std})/(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$	Sample Flow Rate Indicator	$IC = [(Pa/P_{std})/(T_{std}/T_a)]^{1/2}$	(°K = °C+273)	(mmHg)		
	Positive Negative ΔH_2O		(m ³ /min)	(ft ³ /min)					
5	1.5 1.5 3.0	1.70085	0.82718	32.0	31.42	307.0	755.0		
7	2.6 2.6 5.2	2.23927	1.08619	40.0	39.28	307.0	755.0		
10	3.7 3.7 7.4	2.67129	1.29403	48.0	47.14	307.0	755.0		
13	4.8 4.8 9.6	3.04257	1.47264	55.0	54.01	307.0	755.0		
18	5.9 5.9 11.8	3.37324	1.63171	60.0	58.92	307.0	755.0		
Linear Regression Y ON X: Y = mX + b						Average	307.0	755.0	
1	Slope (m)	2.07871	Linear Equation			r ²	0.997889	Pstd(mmHg)	760.0
2	Intercept (b)	-0.01861	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9989439	T _{K19}	298.0
3	Correlation Coefficient (r)	0.99984	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)	0.96429796		
Result						C=(Pa/Pstd)*(Tstd/Ta)*0.5	0.981986741		

COMMENT

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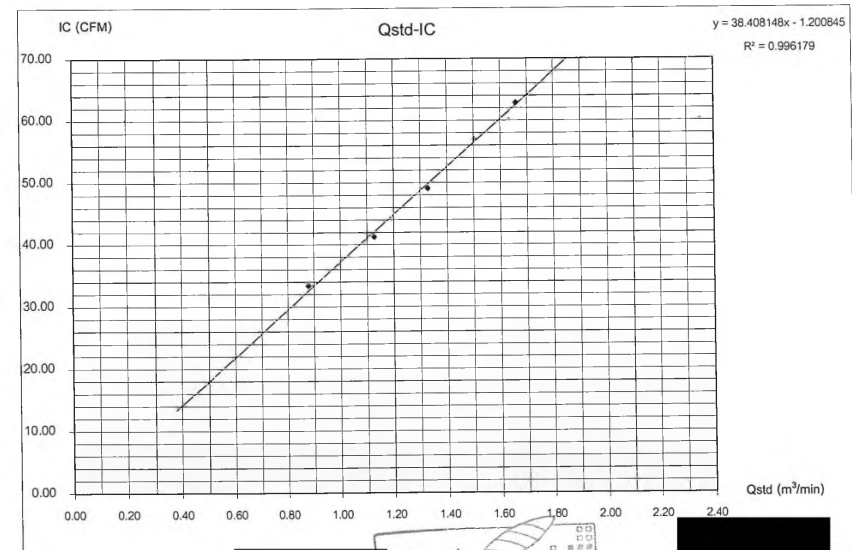
PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2024-00271	Date	June 6, 2024
Sampler Location	A4 ท่าอากาศยานดอนเมือง(วัดใกล้)	Start Time	13:35:00 PM
Sampler Number	PM-10 No.31	Transfer Standard Type	Onifice
Instrument Model	HIVOL-BM8BE	Calibrator Model	TE-5025A
Motor Serial Number	407-492	Calibrator Serial Number	2914
Recorder Serial Number	507-008	Calibrated By	Mr. Anan Kongguennok

Plate No.	(Delta H)	(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (mmH ₂ O)	$[\Delta H_2O(Pa/P_{std})/(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$	Sample Flow Rate Indicator	$IC = [(Pa/P_{std})/(T_{std}/T_a)]^{1/2}$	(°K = °C+273)	(mmHg)		
	Positive Negative ΔH_2O		(m ³ /min)	(ft ³ /min)					
5	1.7 1.7 3.4	1.81069	0.86002	34.0	33.39	307.0	755.0		
7	2.8 2.8 5.6	2.32380	1.12686	42.0	41.24	307.0	755.0		
10	3.9 3.9 7.8	2.74254	1.32630	50.0	49.10	307.0	755.0		
13	5.0 5.0 10.0	3.10531	1.50282	58.0	56.96	307.0	755.0		
18	6.1 6.1 12.2	3.42993	1.63898	64.0	62.85	307.0	755.0		
Linear Regression Y ON X: Y = mX + b						Average	307.0	755.0	
1	Slope (m)	2.07871	Linear Equation			r ²	0.996179	Pstd(mmHg)	760.0
2	Intercept (b)	-0.01861	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9989877	T _{K19}	298.0
3	Correlation Coefficient (r)	0.99984	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)	0.96429796		
Result						C=(Pa/Pstd)*(Tstd/Ta)*0.5	0.981986741		

COMMENT

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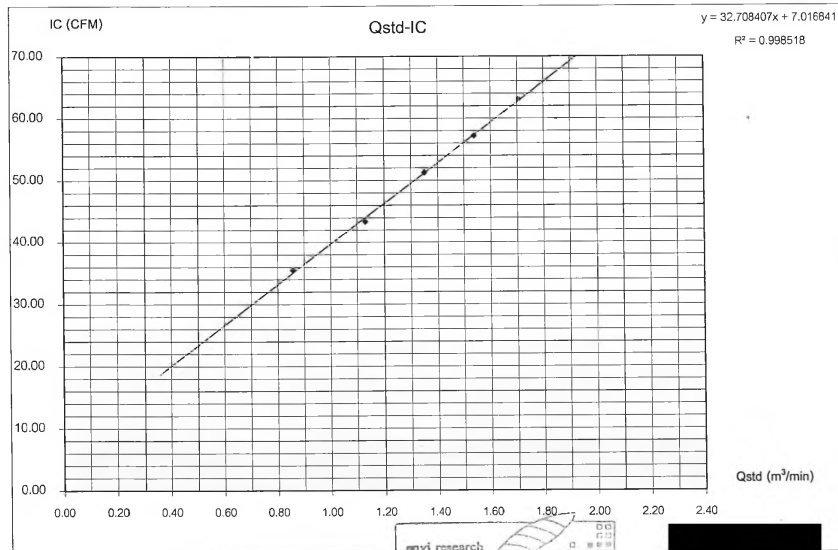
TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2024-00271	Date	June 6, 2024
Sampler Location	A5 ต.บ้านใหม่	Start Time	10:45 AM
Sampler Number	TSP No.A10	Transfer Standard Type	Orifice
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A
Motor Serial Number	2012-04	Calibrator Serial Number	2914
Recorder Serial Number	1504	Calibrated By	Mr.Anan Kongguennok

Plats	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric	Start	Stop	
No.	Pressure Drop Across Orifice (mmHg)			$[\Delta H_2O / (Pa \cdot P_{std}) (T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m) [(I)(A-b)]$	Sample Flow Rate Indicator	$IC = I [(Pa/P_{std}) (T_{std}/T_a)]^{1/2}$	(*K = °C+273)	Pressure	Meter	Meter	
	Positive	Negative	ΔH_2O		(m ³ /min)	(l ³ /min)			(mmHg)			
5	1.6	1.6	3.2	1.76355	0.85734	36.0	35.49	305.0	756.0			
7	2.8	2.8	5.6	2.33295	1.13126	44.0	43.38	305.0	756.0			
10	4.0	4.0	8.0	2.78841	1.35037	52.0	51.26	305.0	756.0			
13	5.2	5.2	10.4	3.17928	1.53840	58.0	57.18	305.0	756.0			
16	6.4	6.4	12.8	3.52710	1.70572	64.0	63.09	305.0	756.0			
Linear Regression Y ON X: Y= mX + b								Average	305.0	756.0		
1	Slope (m)			2.07871	Linear Equation			r ²	0.998518	Pstd(mmHg)	760.0	
2	Intercpt (b)			-0.01861	Set Point Flow Rate (X) (m ³ /min)			1.133	r	0.9992587	T _{std}	298.0
3	Correlation Coefficient (r)			0.99984	Final Set Flow Rate = (I)			0	(Pa/Pstd)*(Tstd/Ta)	0.971906816		
Result								C=-(Pa/Pstd)*(Tstd/Ta)*0.5			0.985653344	

COMMENT

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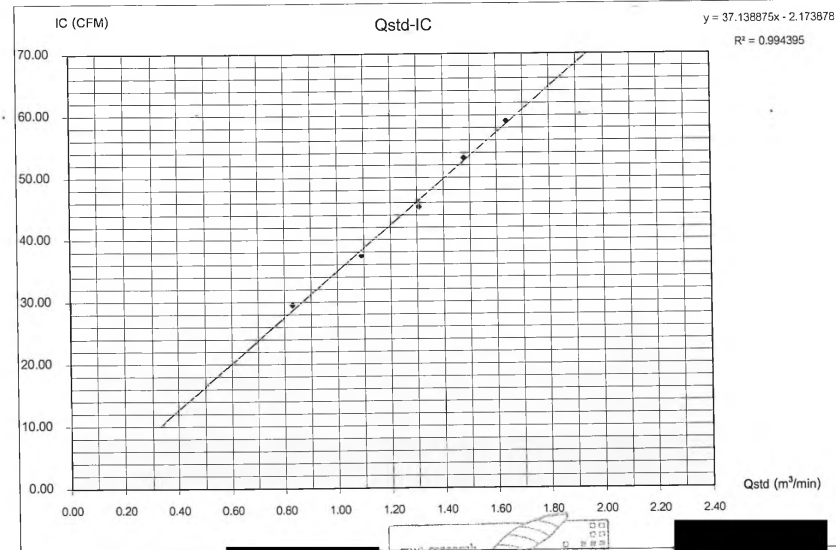
PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2024-00271	Date	June 6, 2024
Sampler Location	A5 ต.บ้านใหม่	Start Time	10:55 AM
Sampler Number	PM-10 No.20	Transfer Standard Type	Orifice
Instrument Model	HIVOL-9MBBE	Calibrator Model	TE-5025A
Motor Serial Number	2140	Calibrator Serial Number	2914
Recorder Serial Number	2393	Calibrated By	Mr.Anan Kongguennok

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter	
	Pressure Drop Across Orifice (mmHg)			$[\Delta H_O(Pa/P_{atm})(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$	Sample Flow Rate Indicator	$IC = I[(Pa/P_{atm})(T_{std}/T_a)]^{1/2}$	(*K = °C+273)	(mmHg)			
	Positive	Negative	ΔH_O		(m ³ /min)	(l ³ /min)						
5	1.5	1.5	3.0	1.70642	0.82986	30.0	29.56	305.0	755.0			
7	2.6	2.6	5.2	2.24660	1.08972	38.0	37.44	305.0	755.0			
10	3.7	3.8	7.5	2.69808	1.30691	46.0	45.32	305.0	755.0			
13	4.8	4.8	9.6	3.05253	1.47743	54.0	53.20	305.0	755.0			
16	5.9	5.9	11.8	3.38428	1.63702	60.0	59.11	305.0	755.0			
Linear Regression Y ON X : Y = mX + b								Average	305.0	755.0		
1	Slope (m)			2.07871	Linear Equation			r ²	0.994395	Pstd(mmHg)	760.0	
2	Intercept (b)			-0.01861	Set Point Flow Rate (X) (m ³ /min)			1.133	r	0.9971936	T _{std}	298.0
3	Correlation Coefficient (r)			0.99984	Final Set Flow Rate = (I)			0	(Pa/Pstd)*(Tstd/Ta)	0.970621225		
Result									C=(Pa/Pstd)*(Tstd/Ta)*0.5			0.985201109

COMMENT

Andersen Instruments, Inc.



Checked By

Technician

Approved By

Environmental Scientist

F-AB-028, Rev. 02, June 3, 2019



JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd.
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd. Watthapra, Bangkokkai,
Bangkok 10600 (Thailand)
Tel: +6608680812
Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

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

Flow measurement laboratory
Calibration services department.



JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number COF-006-66

Page 2 of 2 Pages

CERTIFICATE OF CALIBRATION

Certificate No. : COF-006-66

Page 1 of 2 Pages

MEASUREMENT ITEM : Top Load Orifice
MANUFACTURER : TISCH
MODEL/TYPE : TE-5025A
SERIAL NUMBER : 2914
ID NUMBER : -
CONDITION AS-RECEIVED : Used item
CUSTOMER : Environment Research & Technology Co., Ltd.
25/114 Moo 6 Soi Chinaket 1, Ngamwongwan Road,
Toongsonghong, Laksi, Bangkok 10210

RECEIVED DATE : 27 Jul 2023
MEASUREMENT DATE : 31 Jul 2023
ISSUE DATE : 31 Jul 2023

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

CALIBRATION CONDITION:

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are 24.3 °C and 50.5 %RH.

Calibration procedure:

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

Traceability:

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

Uncertainty of Measurement:

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

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:

☒
☐



Approved signatory:

Calibration Department Manager

MEASUREMENT RESULTS:

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

Table 1: The results of Q Standard calibration data

Plate	Flow rate m^3/min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Δp_{meter} mmHg	$\Delta p_{\text{Orifice}}$ inH ₂ O	γ	Standard Flow [Q_s] m^3/min
1	0.699	755.476	24.24	23.40	53.510	1.786	1.334	0.649
2	1.000	755.470	24.17	23.68	58.170	3.598	1.894	0.921
3	1.111	755.481	24.19	23.60	40.793	4.682	2.160	1.050
4	1.167	755.465	23.87	23.48	31.004	5.323	2.305	1.118
5	1.411	755.522	24.29	23.78	30.145	7.846	2.796	1.352

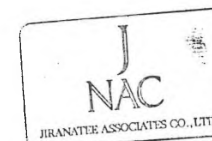
Slope (m): 2.07871
Intercept (b): -0.01861
Correlation coefficient (r): 0.99984
Uncertainty ($k=2$): 0.015 m^3/min

Table 2: The results of Q actual calibration data

Plate	Flow rate m^3/min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Δp_{meter} mmHg	$\Delta p_{\text{Orifice}}$ inH ₂ O	γ	Standard Flow [Q_s] m^3/min
1	0.699	755.476	24.24	23.40	53.510	1.786	0.839	0.651
2	1.000	755.470	24.17	23.68	58.170	3.598	1.190	0.924
3	1.111	755.481	24.19	23.60	40.793	4.682	1.357	1.053
4	1.167	755.465	23.87	23.48	31.004	5.323	1.447	1.121
5	1.411	755.522	24.29	23.78	30.145	7.846	1.758	1.357

Slope (m): 1.30200
Intercept (b): -0.01171
Correlation coefficient (r): 0.99984
Uncertainty ($k=2$): 0.015 m^3/min

End of Certificate of Calibration




Mettler-Toledo (Thailand) Ltd.
846/4 - 846/5 Lasalle Rd., Bangna Tai Sub-District
Bangna District, Bangkok 10260
+662 723 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., Toongsonghong
City: Laksi Contact:
Zip / Postal: 10210
State / Province: Bangkok
Order Number: 

Weighing Device

Manufacturer: Mettler Toledo Instrument Type: Weighing Instrument
Model: AB204-S Asset Number: ERTC-L-IN-0048
Serial No.: 1123103723 Terminal Model: N/A
Building: N/A Terminal Serial No.: N/A
Floor: 4 Terminal Asset No.: N/A
Room: 406

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 and As Left calibrations.
The sensitivity/span of the weighing instrument was adjusted before As Found and As Left calibrations 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: 25.4 °C	End: 25.3 °C	Start: 36.4 %	End: 34.9 %
As Left	Start: 25.3 °C	End: 25.2 °C	Start: 34.9 %	End: 34.1 %

As Found Calibration Date: 15-Jan-2024 Calibrator:
As Left Calibration Date: 15-Jan-2024
Issue Date: 15-Jan-2024
Approved Signatory:
Technical Manager / Head of Calibration Center

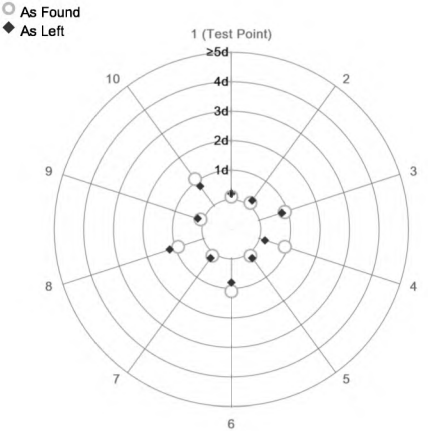
Measurement Results

Repeatability

Test Load: 100 g

	As Found	As Left
1	99.9993 g	100.0002 g
2	99.9993 g	100.0002 g
3	99.9992 g	100.0003 g
4	99.9992 g	100.0002 g
5	99.9993 g	100.0002 g
6	99.9994 g	100.0003 g
7	99.9993 g	100.0002 g
8	99.9992 g	100.0001 g
9	99.9993 g	100.0002 g
10	99.9994 g	100.0003 g

Standard Deviation	0.00007 g	0.00006 g
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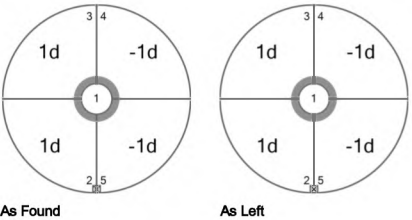
The "d" in the graph represents the readability of the range/interval in which the test was performed.
The results of this graph are based upon the absolute values of the differences from the mean value.

Eccentricity

Test Load: 100 g

Position	As Found	As Left
1	99.9993 g	100.0002 g
2	99.9994 g	100.0003 g
3	99.9994 g	100.0003 g
4	99.9992 g	100.0001 g
5	99.9992 g	100.0001 g

Maximum Deviation	0.0001 g	0.0001 g
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The "d" in the graph represents the readability of the range/interval in which the test was performed.

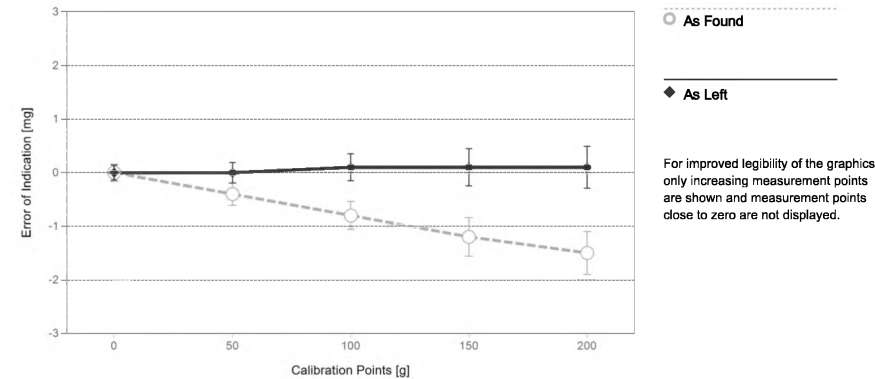
Error of Indication

As Found

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.0000 g	0.16 mg	2
2	0.0500 g	0.0501 g	0.0001 g	0.17 mg	2
3	0.1000 g	0.1000 g	0.0000 g	0.17 mg	2
4	0.5000 g	0.5001 g	0.0001 g	0.17 mg	2
5	1.0000 g	1.0000 g	0.0000 g	0.17 mg	2
6	5.0000 g	4.9999 g	-0.0001 g	0.17 mg	2
7	10.0000 g	9.9998 g	-0.0002 g	0.18 mg	2
8	50.0000 g	49.9996 g	-0.0004 g	0.21 mg	2
9	100.0001 g	99.9993 g	-0.0008 g	0.26 mg	2
10	150.0001 g	149.9989 g	-0.0012 g	0.36 mg	2
11	200.0000 g	199.9985 g	-0.0015 g	0.40 mg	2

As Left

	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	50.0000 g	0.0000 g	0.19 mg	2
9	100.0001 g	100.0002 g	0.0001 g	0.25 mg	2
10	150.0001 g	150.0002 g	0.0001 g	0.35 mg	2
11	200.0000 g	200.0001 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.
The results of this calibration certificate relate only to the calibrated item.

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.:	WS52	Date of Issue:	22-Nov-2022
Certificate Number:	182272	Calibration Due Date:	21-May-2024

Thermo Hygrometer

Equipment No.:	IN302	Date of Issue:	11-Oct-2023
Certificate Number:	SG-H-00656/66	Calibration Due Date:	08-Oct-2024

Remarks

Value of the built-in weight adjusted
Equipment condition: Good
Next calibration according to customer's procedure
Calibration data not decide by calibration laboratory

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 · 10⁻⁶ / K

Temperature range on site for the evaluation of the measurement uncertainty in use: 3 K

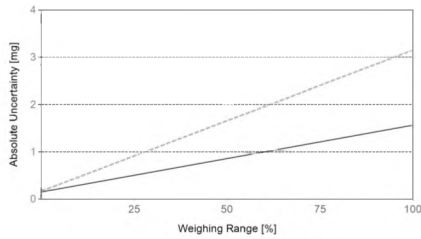
Linearization of Uncertainty Equation

	Range		As Found	As Left
	d	Max		
1	0.0001 g	220 g	$U_1 = 0.17 \text{ mg} + 0.0136 \text{ mg/g} \cdot R$	$U_1 = 0.15 \text{ mg} + 0.00644 \text{ mg/g} \cdot R$

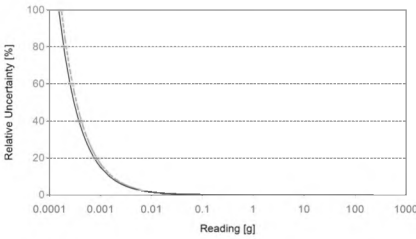
To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

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%	0.15 mg	0.68%
0.2200 g	0.17 mg	0.079%	0.15 mg	0.069%
2.2000 g	0.20 mg	0.0091%	0.16 mg	0.0075%
22.0000 g	0.47 mg	0.0021%	0.29 mg	0.0013%
220.0000 g	3.2 mg	0.0014%	1.6 mg	0.00071%



As Found



As Left

GWP®
Certificate



As
Found



As
Left



The weighing device meets the given
process requirements.

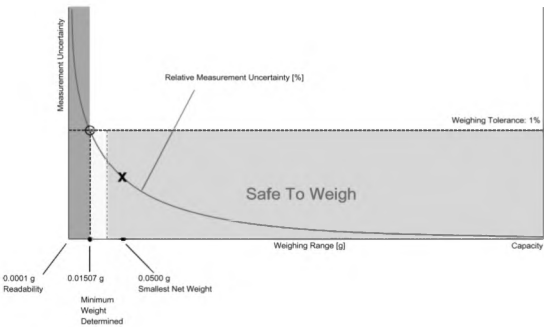
The weighing device meets the given
process requirements.

Tests Performed: ☒ As Found ☒ As Left

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.

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%	0.17097 g	0.34671 g	0.52742 g	0.90460 g	1.95110 g
0.2%	0.08490 g	0.17097 g	0.25823 g	0.43643 g	0.90460 g
0.5%	0.03382 g	0.06783 g	0.10202 g	0.17097 g	0.34671 g
1%	0.01689 g	0.03382 g	0.05080 g	0.08490 g	0.17097 g
2%	0.00844 g	0.01689 g	0.02535 g	0.04231 g	0.08490 g
5%	0.00337 g	0.00675 g	0.01013 g	0.01689 g	0.03382 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%	0.15153 g	0.30504 g	0.46056 g	0.77780 g	1.60910 g
0.2%	0.07552 g	0.15153 g	0.22803 g	0.38254 g	0.77780 g
0.5%	0.03015 g	0.06038 g	0.09068 g	0.15153 g	0.30504 g
1%	0.01507 g	0.03015 g	0.04525 g	0.07552 g	0.15153 g
2%	0.00753 g	0.01507 g	0.02261 g	0.03770 g	0.07552 g
5%	0.00301 g	0.00602 g	0.00904 g	0.01507 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:
- If "N/A" is shown above, no appropriate value could be calculated.
 - 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

		As Found		As Left	
Tolerance	Control Limit	Std. Deviation	Result	Std. Deviation	Result
0.1%	N/A	0.00007 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 0.41*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

		As Found		As Left	
Tolerance	Control Limit	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	-0.0004 g	0.0250 g	0.0500 g	0.1250 g	0.2500 g	0.5000 g	1.2500 g
100.0001 g	-0.0008 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0001 g	-0.0012 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
200.0000 g	-0.0015 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
100.0001 g	0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0001 g	0.0001 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
200.0000 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.





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert.No.: 24MM1
Page.: 1 of 3

Certificate of Calibration

Equipment : Electronic Balance
Manufacturer : AND
Model : BM-5
Serial No. : T1004302
ID No. : ERTC-L-In.-176
Submitted by : Environment Research & Technology Company Limited.
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,
Toongsonghong, Laksi,
Bangkok 10210
Location : ห้องปฏิบัติการวิเคราะห์ (411)
Received order : 03 January 2024
Calibration Date : 04 January 2024
Ambient Temperature : 15 °C to 40 °C
Relative Humidity : 30 % to 90 %
Calibrated by : 
Approved by : 
Issue Date : 16 January 2024

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.



Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2401-0001ON-10

Cert.No.: 24MM1
Page: 2 of 3

Procedure used :-

Calibration were conducted using in-house calibration procedure CP-OB01 according to direct measurement method against standard weight.

Condition of this result of calibration

1. Reference standard instruments:-

Instruments	Model	Serial No.	ID No.	Test report No.	Due date
1) Standard Weight Set (E2)	15884	-	70RC138	MM-0020-23	30 Jan 2025

- This certificate is valid only to the item calibrated on date and place of calibration.
- This result of calibration was made on requested at the point specified by customer.
- This certificate is not certified for any commercial transaction.
- This certification is traceable to the International System of Unit.

Result of calibration () Without Adjustment (*) After Adjustment by External Calibration

Range capacity : 0 g to 5.2 g **Resolution** 0.000001 g

Before Adjustment :

Applied Weight	Balance Reading	Correction	Measurement Uncertainty	Coverage Factor
(g)	(g)	(g)	(\pm mg)	(k)
2.5	2.500047	-0.000047	0.026	2
5	5.000057	-0.000057	0.028	2

After Adjustment :

1. Determination of the standard deviation of weighing machine (n = 10)

Applied Weight	Standard Deviation of Reading (g)
(g)	
2.5	0.0000056
5	0.0000048



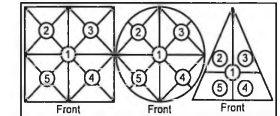
Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2401-0001ON-10

Cert.No.: 24MM1
Page: 3 of 3

Result of calibration

2. Effect of off center loading

A mass of 2 g was placed to various position on the pan.
The weighing machine reading error obtained is given in the table



Position 1	Position 2	Position 3	Position 4	Position 5	Maximum difference between off-center and central loading
(g)	(g)	(g)	(g)	(g)	(g)
+0.000010	+0.000012	0.000000	+0.000013	+0.000009	0.000010

3. Departure from nominal value

Applied Weight	Balance Reading	Correction	Measurement Uncertainty	Coverage Factor
(g)	(g)	(g)	(\pm mg)	(k)
Unload	0.000000	0.000000	0.0094	2.37
0.014	0.013991	+0.000009	0.012	2.11
0.015	0.015011	-0.000011	0.012	2.17
0.5	0.499996	+0.000004	0.013	2.06
1	0.999995	+0.000005	0.016	2.04
1.5	1.499985	+0.000015	0.022	2
2	1.999995	+0.000005	0.022	2
2.5	2.499988	+0.000012	0.026	2
3	2.999992	+0.000008	0.026	2
4	3.999998	+0.000002	0.028	2
5	4.999990	+0.000010	0.028	2

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-

Calibration Data of NOx Analyzer

Analyzer Performance Test

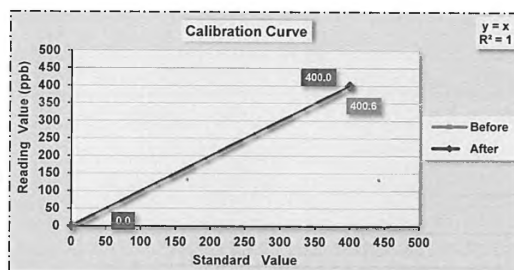
Equipment	Gas Analyzer (NOx)	Customer Name	ทีแอลที คอนซัลแตนท์
Manufacture	HORIBA	Location	Envi Research
Model	APNA-370	Quotation	2024-00271, 2024-00273, 2024-00271
Serial No.	A4LUUFHB	Calibration Date	April 10, 2024
Analyzer Unit	ppb	Time	2:09 PM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300	0165
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	-0.8	0.0	-0.2	0.0	-0.6	0.0	-	-	-
Span	400	401.7	400.0	400.6	400.0	1.1	0.0	-	-	0.2



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	1.6	1.6	Voltage of the measured NO value
Signal NOx	mV	9.7	9.4	Voltage of the measured NOx value
Detector	°C	41.3	41.3	43 °C ± 5 °C
Ambient	kPa	100.2	100.2	Current atmospheric pressure
DC 24V	V	23.7	23.7	24V ±0.5
DC 5V	V	5.0	5.0	5V ±0.5
NO Slope	-	1.03450	1.03420	0.50000 - 2.0000
NOx Slope	-	1.74100	1.07150	0.50000 - 2.0000

Calibrate By :

April 10, 2024

Checked By :

April 10, 2024

Calibration Data of NOx Analyzer

Analyzer Performance Test

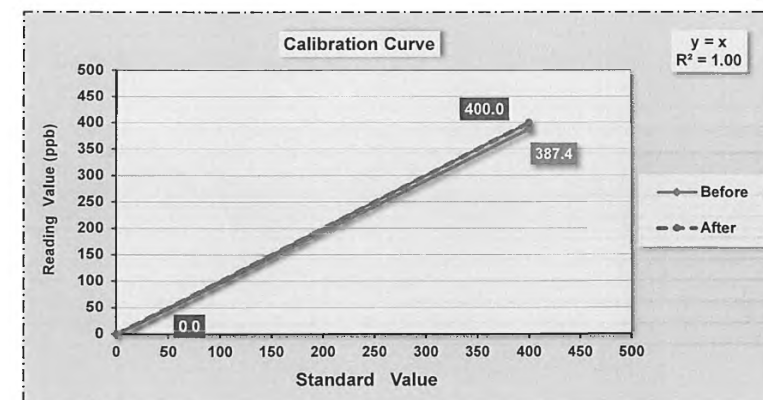
Equipment	Gas Analyzer (NOx)	Customer Name	ทีแอลที คอนซัลแตนท์
Manufacture	API	Location	Envi Research
Model	200A	Quotation	2024-00271, 2024-00273, 2024-00275
Serial No.	1464	Calibration Date	May 21, 2024
Analyzer Unit	ppb	Time	11:56 AM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300	0165
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	-0.8	0.0	-0.2	0.0	-0.6	0.0	-	-	-
Span	400	388.6	405.0	387.4	400.0	1.2	5.0	-	-	3.2



STATUS TEST AND VALIDATION OF NOx ANALYZER MODEL 200A

Parameter	Display As	Unit	Observed Value		Nominal Range
			Before Adjust	After Adjust	
Range	RANGE	ppb	500	500	0 - 500 standard
Stability	STABIL	ppb	1.7	0.1	< 2 with zero air
Sample Flow	SAMP FL	cc / min	517.0	5522.0	500 +/- 50
Ozone Flow	OZONE FL	cc / min	78.0	80.0	80 +/- 10
PMT signal	PMT	mV	57.9	40.6	0 to 5,000
Auto - Zero	AZERO	mV	39.4	39.3	-20 to 150
High Voltage Power Supply	HVPS	V	777.0	776.0	450 to 900
Reaction Cell Temperature	RCELL TEMP	°C	50.1	49.8	50 +/- 1
Box Temperature	BOX TEMP	°C	33.3	34.3	Ambient temp.+3 / -7
PMT Temperature	PMT TEMP	°C	7.0	6.9	7 +/- 1
Converter Temperature	MOLY TEMP	°C	314.6	314.9	315 +/- 5
Reaction Cell Pressure	RCEL	In - Hg - A	10.0	7.9	2 to 10 (Constant)
Sample Pressure	SAMP	In - Hg - A	30.1	30.4	Ambient - 1 (Constant)
NO _x Slope	NO _x SLOPE	-	1.167	1.050	1.000 +/- 0.300
NO _x Offset	NO _x OFFSET	mV	-2.9	-8.1	0 +/- 20
NO Slope	NO SLOPE	-	1.148	1.025	1.000 +/- 0.300
NO Offset	NO OFFSET	mV	-1	-9	0 +/- 20

Calibration Data of NOx Analyzer

Analyzer Performance Test

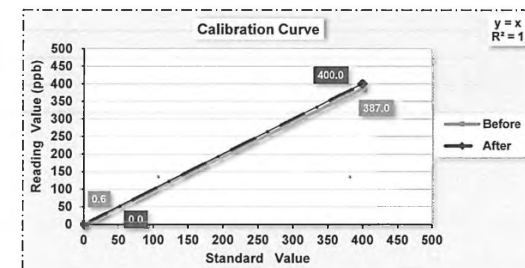
Equipment	Gas Analyzer (NOx)	Customer Name	ทีแอลที คอมพิวเตอร์
Manufacturer	HORIBA	Location	Envi Research
Model	APNA-370	Quotation	2024-00271, 2024-00273, 2024-00271
Serial No.	4VWFEBUK	Calibration Date	May 16, 2024
Analyzer Unit	ppb	Time	5:11 PM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyle	300	0165
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	0.6	0.0	0.6	0.0	0.0	0.0	-	-	-
Span	400	787.0	400.0	387.0	400.0	400.0	0.0	-	-	3.3



STATUS TEST AND VALIDATION OF NOx ANALYZER MODEL APNA-370

Parameter	Unit	Observed Value		Nominal Range
		Before Adjust	After Adjust	
Range	ppb	500	500	0 - 500 Standard
Signal NO	mV	1.0	1.4	Voltage of the measured NO value
Signal NOx	mV	24.0	25.2	Voltage of the measured NOx value
Detector	°C	34.1	33.9	43 °C ± 5 °C
Ambient	kPa	101.0	101.0	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	-	0.76960	0.77120	0.50000 - 2.0000
NOx Slope	-	0.76540	0.76840	0.50000 - 2.0000

Calibrate By :



May 21, 2024

Checked By :



May 21, 2024

Calibrate By :



May 16, 2024

Checked By :



May 16, 2024

Calibration Data of NOx Analyzer

Analyzer Performance Test

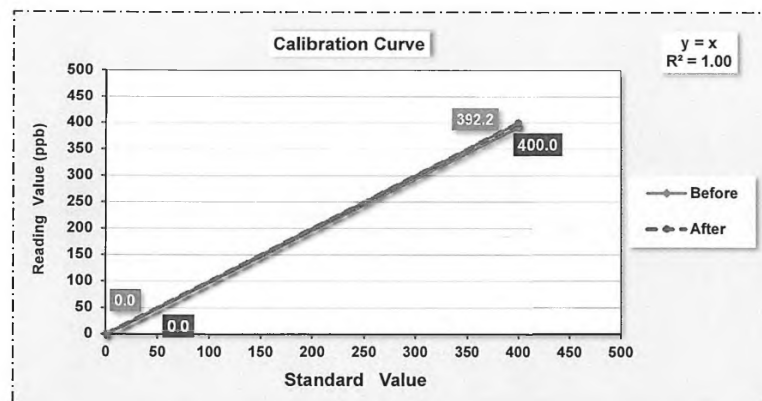
Equipment	Gas Analyzer (NOx)	Customer Name	ที่แลสที่ คอนซัลแตนส์
Manufacture	API	Location	Envi Research
Model	200A	Quotation	2024-00271, 2024-00273, 2024-00275
Serial No.	1975	Calibration Date	May 31, 2024
Analyzer Unit	ppb	Time	1:54 PM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300	0165
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	-0.1	0.0	0.0	0.0	-0.1	0.0	-	-	-
Span	400	392.2	405.0	392.2	400.0	0.0	5.0	-	-	2.0



STATUS TEST AND VALIDATION OF NOx ANALYZER MODEL 200A

Parameter	Display As	Unit	Observed Value		Nominal Range
			Before Adjust	After Adjust	
Range	RANGE	ppb	500	500	0 - 500 standard
Stability	STABIL	ppb	0.40	0.10	< 2 with zero air
Sample Flow	SAMP FL	cc / min	523	5522	500 +/- 50
Ozone Flow	OZONE FL	cc / min	80	80	80 +/- 10
PMT signal	PMT	mV	44	41	0 to 5,000
Auto - Zero	AZERO	mV	40	39	-20 to 150
High Voltage Power Supply	HVPS	V	776	776	450 to 900
Reaction Cell Temperature	RCELL TEMP	°C	50	50	50 +/- 1
Box Temperature	BOX TEMP	°C	33	34	Ambient temp. +3 / -7
PMT Temperature	PMT TEMP	°C	7	7	7 +/- 1
Converter Temperature	MOLY TEMP	°C	315	315	315 +/- 5
Reaction Cell Pressure	RCEL	In - Hg - A	8	8	2 to 10 (Constant)
Sample Pressure	SAMP	In - Hg - A	30	30	Ambient - 1 (Constant)
NO _x Slope	NO _x SLOPE	-	0.930	1.050	1.000 +/- 0.300
NO _x Offset	NO _x OFFSET	mV	-8	-8	0 +/- 20
NO Slope	NO SLOPE	-	0.916	1.025	1.000 +/- 0.300
NO Offset	NO OFFSET	mV	-9	-9	0 +/- 20

Calibrate By :

envi research
ENVIRONMENT RESEARCH & TECHNOLOGY CO., LTD.

May 31, 2024

Checked By :

May 31, 2024

Calibration Data of NOx Analyzer

Analyzer Performance Test

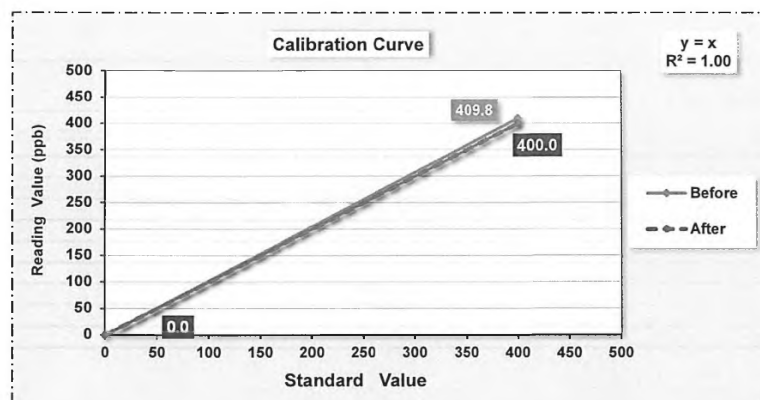
Equipment	Gas Analyzer (NOx)	Customer Name	ที่แอลที คอนซัลแตนท์
Manufacture	API	Location	Envi Research
Model	200A	Quotation	2024-00271, 2024-00273, 2024-00275
Serial No.	1650	Calibration Date	May 31, 2024
Analyzer Unit	ppb	Time	2:10 PM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300	0165
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

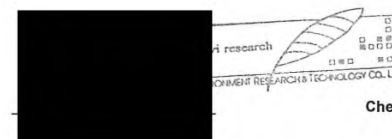
Standard Gas	Standard Gas Value	Analyzer Value								% Abs Error
		NO _x (ppb)		NO (ppb)		NO ₂ (ppb)		Stability		
		Before	After	Before	After	Before	After	Before	After	
Zero	0	-0.6	0.0	-0.4	0.0	-0.2	0.0	-	-	-
Span	400	411.0	405.0	409.8	400.0	1.2	5.0	-	-	2.5



STATUS TEST AND VALIDATION OF NOx ANALYZER MODEL 200A

Parameter	Display As	Unit	Observed Value		Nominal Range
			Before Adjust	After Adjust	
Range	RANGE	ppb	500	500	0 - 500 standard
Stability	STABIL	ppb	1.6	0.1	< 2 with zero air
Sample Flow	SAMP FL	cc / min	475.0	479.0	500 +/- 50
Ozone Flow	OZONE FL	cc / min	80.0	79.0	80 +/- 10
PMT signal	PMT	mV	50.7	44.7	0 to 5,000
Auto - Zero	AZERO	mV	37.4	36.7	-20 to 150
High Voltage Power Supply	HVPS	V	790.0	790.0	450 to 900
Reaction Cell Temperature	RCELL TEMP	°C	50.3	50.4	50 +/- 1
Box Temperature	BOX TEMP	°C	31.8	32.8	Ambient temp.+3 / -7
PMT Temperature	PMT TEMP	°C	7.1	7.1	7 +/- 1
Converter Temperature	MOLY TEMP	°C	314.3	314.5	315 +/- 5
Reaction Cell Pressure	RCEL	In - Hg - A	9.0	9.1	2 to 10 (Constant)
Sample Pressure	SAMP	In - Hg - A	30.9	31.0	Ambient - 1 (Constant)
NO _x Slope	NO _x SLOPE	-	1.3	1.3	1.000 +/- 0.300
NO _x Offset	NO _x OFFSET	mV	-1.8	-1.8	0 +/- 20
NO Slope	NO SLOPE	-	-1.3	1.3	1.000 +/- 0.300
NO Offset	NO OFFSET	mV	-0.4	-0.4	0 +/- 20

Calibrate By :



May 31, 2024

Checked By :



May 31, 2024

Calibration Data of SO₂ Analyzer

Analyzer Performance Test

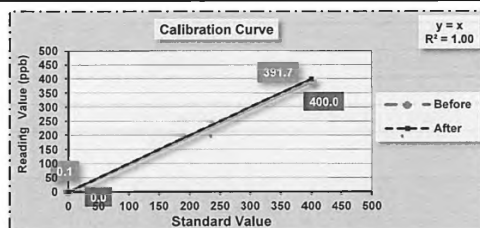
Equipment	Gas Analyzer (SO ₂)	Customer Name	ที่แลตที่ คอนซิลแลนส์
Manufacture	Horiba	Location	Envi Research
Model	APSA-370	Quotation	2024-00271, 2024-00273, 2024-00275
Serial No.	A5VTX5AF	Calibration Date	May 24, 2024
Analyzer Unit	ppb	Time	11:13 AM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300	0165
Standard Gas Components	CO = 4,516 ppm NO = 55.3 ppm SO ₂ = 54.9 ppm		
Cylinder No :	EB0123013		
Expire Date :	Oct 22, 2027		

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	391.7	400.0	-	-	2.1



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	30.4	30.2	Voltage of the measured SO ₂ value
LAMP	mV	277.9	277.9	200 mV - 1200 mV
CELL	°C	33.6	33.3	Ambient temperature + 5 °C - 15 °C
PUMP	Kpa	43.1	43.1	65 kPa or less
AMBIENT	kPa	101.0	101.0	Current atmospheric pressure
DC 24V	V	24.0	24.0	24 V ±0.5 V
DC 5V	V	4.9	4.9	5 V ±0.5 V

Calibrate By :

May 24, 2024

Checked By :

May 24, 2024

Calibration Data of SO₂ Analyzer

Analyzer Performance Test

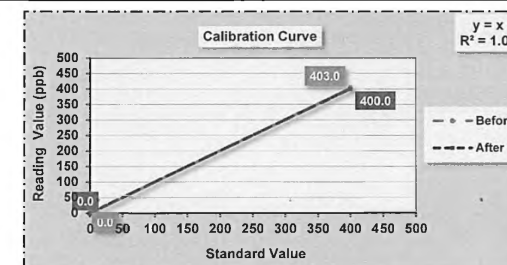
Equipment	Gas Analyzer (SO ₂)	Customer Name	ที่แลตที่ คอนซิลแลนส์
Manufacture	Thermo	Location	Envi Research
Model	43C	Quotation	2024-00271, 2024-00273, 2024-00275
Serial No.	58283-317	Calibration Date	May 16, 2024
Analyzer Unit	ppb	Time	1:31 PM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300	0165
Standard Gas Components	CO = 4,516 ppm NO = 55.3 ppm SO ₂ = 54.9 ppm		
Cylinder No :	EB0123013		
Expire Date :	Oct 22, 2027		

Single Point Calibration

Standard Gas	Standard Gas Value	Analyzer Value (ppb)		Stability		% Abs Error
		Before	After	Before	After	
Zero	0	0.0	0.0	-	-	-
Span	400	403.0	400.0	-	-	0.8



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	30.9	31	8.0 °C to 47.0 °C
Chamber Temp	CHAMBER	°C	44.5	44.7	43.0 °C to 47.0 °C
Pressure	PRESSURE	mmHg	732.6	732.6	400.0 to 1,000
Sample Flow	SAMP FLOW	LPM	0.946	0.946	0.350 to 1.000
Lamp Intensity	INTENSITY	Hz	23,763	23,811	20,000 to 50,000
Lamp Voltage	LAMP VOLTAGE	V	855	853	750 to 1,200
SO ₂ Concentration	SO ₂ CONCENTRATION	ppb	2.1	1.5	0 to 10,000
Motherboard Status	MOTHERBOARD STATUS	-	OK	OK	OK
Interface Status	INTERFACE STATUS	-	OK	OK	OK

Calibrate By :

May 16, 2024

Checked By :

May 16, 2024

Calibration Data of SO₂ Analyzer

Analyzer Performance Test

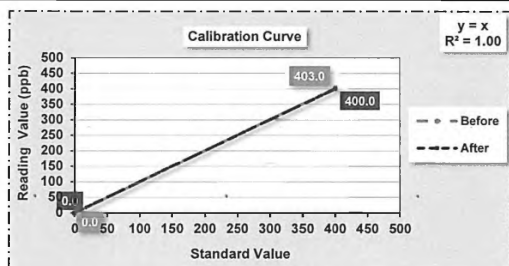
Equipment	Gas Analyzer (SO ₂)	Costomer Name	ที่แลกร์ คอนซิลเดนท์
Manufacture	Thermo	Location	Envi Research
Model	43C	Quotation	2024-00271, 2024-00273, 2024-00275
Serial No.	0611116460	Calibration Date	May 16, 2024
Analyzer Unit	ppb	Time	5:31 PM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300	0165
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	0.0	0.0	-	-	-
Span	400	403.0	400.0	-	-	0.8



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	30.9	31	8.0 °C to 47.0 °C
Chamber Temp	CHAMBER	°C	44.5	44.4	43.0 °C to 47.0 °C
Pressure	PRESSURE	mmHg	732.6	732.6	400.0 to 1,000
Sample Flow	SAMP FLOW	LPM	0.946	0.946	0.350 to 1,000
Lamp Intensity	INTENSITY	Hz	23,763	23,811	20,000 to 50,000
Lamp Voltage	LAMP VOLTAGE	V	855	853	750 to 1,200
SO ₂ Concentration	SO ₂ CONCENTRATION	ppb	2.1	1.5	0 to 10,000
Motherboard Status	MOTHERBOARD STATUS	-	OK	OK	OK
Interface Status	INTERFACE STATUS	-	OK	OK	OK

Calibrate By :

May 16, 2024

Checked By :

May 16, 2024

Calibration Data of SO₂ Analyzer

Analyzer Performance Test

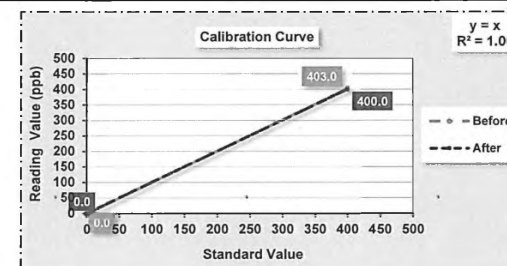
Equipment	Gas Analyzer (SO ₂)	Costomer Name	ที่แลกร์ คอนซิลเดนท์
Manufacture	Thermo	Location	Envi Research
Model	43C	Quotation	2024-00271, 2024-00273, 2024-00275
Serial No.	64390-343/2	Calibration Date	May 16, 2024
Analyzer Unit	ppb	Time	5:31 PM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300	0165
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	0.0	0.0	-	-	-
Span	400	403.0	400.0	-	-	0.8



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	30.9	31	8.0 °C to 47.0 °C
Chamber Temp	CHAMBER	°C	44.5	44.4	43.0 °C to 47.0 °C
Pressure	PRESSURE	mmHg	732.6	732.6	400.0 to 1,000
Sample Flow	SAMP FLOW	LPM	0.946	0.946	0.350 to 1,000
Lamp Intensity	INTENSITY	Hz	23,763	23,811	20,000 to 50,000
Lamp Voltage	LAMP VOLTAGE	V	855	853	750 to 1,200
SO ₂ Concentration	SO ₂ CONCENTRATION	ppb	2.1	1.5	0 to 10,000
Motherboard Status	MOTHERBOARD STATUS	-	OK	OK	OK
Interface Status	INTERFACE STATUS	-	OK	OK	OK

Calibrate By :

May 16, 2024

Checked By :

May 16, 2024

Calibration Data of SO₂ Analyzer

Analyzer Performance Test

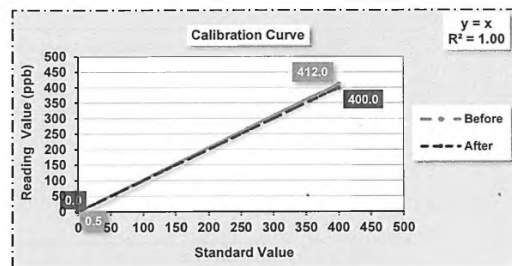
Equipment	Gas Analyzer (SO ₂)	Customer Name	ที่แอลที คอนซัลแตนท์
Manufacture	Thermo	Location	Envi Research
Model	43C	Quotation	2024-00271, 2024-00273, 2024-00275
Serial No.	0607415768	Calibration Date	May 29, 2024
Analyzer Unit	ppb	Time	6:09 PM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300	0165
Standard Gas Components	CO = 4,516 ppm NO = 55.3 ppm SO ₂ = 54.9 ppm		
Cylinder No :	EB0123013		
Expire Date :	Oct 22, 2027		

Single Point Calibration

Standard Gas	Standard Gas Value	Analyzer Value (ppb)		Stability		% Abs Error
		Before	After	Before	After	
Zero	0	0.5	0.0	-	-	-
Span	400	412.0	400.0	-	-	3.0



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	36.7	35.8	8.0 °C to 47.0 °C
Chamber Temp	CHAMBER	°C	45.6	45.5	43.0 °C to 47.0 °C
Pressure	PRESSURE	mmHg	662.9	726.8	400.0 to 1,000
Sample Flow	SAMP FLOW	LPM	0.419	0.635	0.350 to 1.000
Lamp Intensity	INTENSITY	Hz	25,671	20,093	20,000 to 50,000
Lamp Voltage	LAMP VOLTAGE	V	838	900	750 to 1,200
SO ₂ Concentration	SO ₂ CONCENTRATION	ppb	2.4	2.0	0 to 10,000
Motherboard Status	MOTHERBOARD STATUS	-	OK	OK	OK
Interface Status	INTERFACE STATUS	-	OK	OK	OK

Calibrate By :

May 29, 2024

Checked By :

May 29, 2024

Calibration Data of CO Analyzer

Analyzer Performance Test

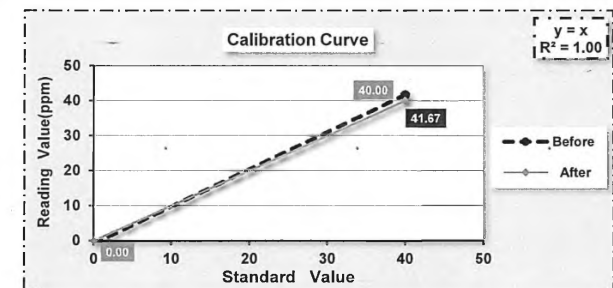
Equipment	Gas Analyzer (CO)	Customer Name	ที่แอลที คอนซัลแตนท์
Manufacture	HORIBA	Location	Envi Research
Model	APMA-370	Quotation	2024-00271, 2024-00273, 2024-00275
Serial No.	WNTLD9N8	Calibration Date	May 8, 2024
Analyzer Unit	ppm	Time	2:08 PM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300	0165
Standard Gas Components	CO = 4,516 ppm NO = 55.3 ppm SO ₂ = 54.9 ppm		
Cylinder No :	EB0123013		
Expire Date :	Oct 22, 2027		

Single Point Calibration

Standard Gas	Standard Gas Value	Analyzer Value (ppm)		Stability		% Abs Error
		Before	After	Before	After	
Zero	0	-0.84	0.00	-	-	-
Span	40	41.67	40.00	-	-	4.18



STATUS TEST AND VALIDATION OF CO ANALYZER MODEL APMA-370

Parameter	Unit	Observed Value		Nominal Range
		Before Adjust	After Adjust	
SIGNAL(MAIN)	mV	8	8.3	Voltage of the measured CO Value
SIGNAL (COMP)	mV	9.1	9.7	Voltage of the interference component Value
CELL	°C	33.2	33.1	Ambient + (5 to 10 °C)
PUMP	kpa	40.8	40.8	less than 65
AMBIENT	kpa	101.2	101.2	Atmospheric pressure
DC 24V	mV	23.9	23.9	24 +/- 0.5 V
DC 5V	mV	4.9	4.9	5 +/- 0.5 V

Calibrate By :

May 8, 2024

Checked By :

May 8, 2024

Calibration Data of CO Analyzer

Analyzer Performance Test

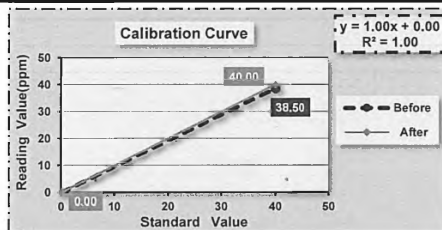
Equipment	Gas Analyzer (CO)	Customer Name	ทีแอลที คอนซัลแตนท์
Manufacture	Thermo	Location	Envi Research
Model	48C	Quotation	2024-00271, 2024-00273, 2024-00275
Serial No.	73426-373	Calibration Date	May 3, 2024
Analyzer Unit	ppm	Time	4:01 PM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300T	0165
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 (ppm)		Stability		% Abs Error
		Before	After	Before	After	
Zero	0	-0.10	0.00	-	-	-
Span	40	38.50	40.00	-	-	3.75



STATUS TEST AND VALIDATION OF CO ANALYZER MODEL 48C

Parameter	Display As	Unit	Observed Value		Nominal Range
			Before Adjust	After Adjust	
Range	RANGE	ppm	50	50	0 - 100 standard
Internal Temp	INTERNAL TEMP	°C	40	37.4	8.0 to 47.0
Chamber Temp	CHAMBER TEMP	°C	46.5	46.1	40.0 to 59.0
Pressure	PRESSURE	mmHg	733.9	725.2	250 to 1,000
Sample Flow	FLOW	LPM	0.898	1.104	0.350 to 1.500
Bias Voltage	BIAS VOLT	V	-115.4	-118.1	-130 to -100
AGC Intensity	AGC	Hz	202,927	199361	150,000 to 300,000
Motor Speed	SPEED	%	100	100	100
Concentration	Conc.	ppm	0.646	0.468	0 to 10,000
Motherboard Status	MOTHERBOARD	-	OK	OK	OK
Interface Status	INTERFACE	-	OK	OK	OK

Calibrate By :

May 3, 2024

Checked By :

May 3, 2024

Calibration Data of CO Analyzer

Analyzer Performance Test

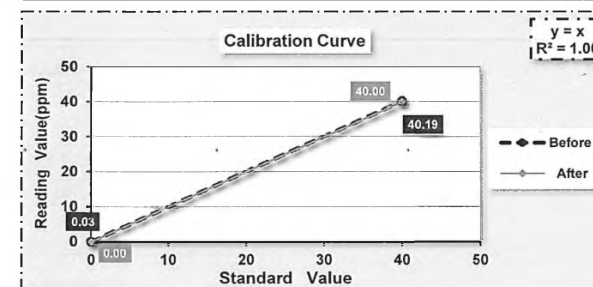
Equipment	Gas Analyzer (CO)	Customer Name	ทีแอลที คอนซัลแตนท์
Manufacture	HORIBA	Location	Envi Research
Model	APMA-370	Quotation	2024-00271, 2024-00273, 2024-00275
Serial No.	FEYATYPA	Calibration Date	May 24, 2024
Analyzer Unit	ppm	Time	1:31 PM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300	0165
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 (ppm)		Stability		% Abs Error
		Before	After	Before	After	
Zero	0	0.03	0.00	-	-	-
Span	40	40.19	40.00	-	-	0.47



STATUS TEST AND VALIDATION OF CO ANALYZER MODEL APMA-370

Parameter	Unit	Observed Value		Nominal Range
		Before Adjust	After Adjust	
SIGNAL(MAIN)	mV	2.8	3.1	Voltage of the measured CO Value
SIGNAL (COMP)	mV	4.8	4.9	Voltage of the interference component Value
CELL	°C	31.2	31.3	Ambient + (5 to 10 C)
PUMP	kpa	40.7	40.8	less than 65
AMBIENT	kpa	101.0	101.0	Atmospheric pressure
DC 24V	mV	24.0	24.0	24 +/- 0.5 V
DC 5V	mV	4.9	4.9	5 +/- 0.5 V

Calibrate By :

May 24, 2024

Checked By :

May 24, 2024

Calibration Data of CO Analyzer

Analyzer Performance Test

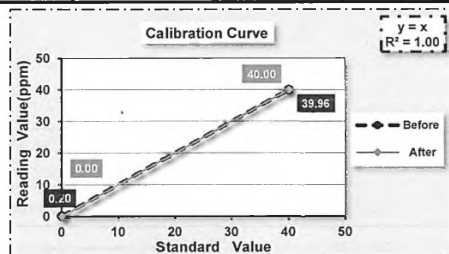
Equipment	Gas Analyzer (CO)	Customer Name	ที่แอลที คอนซิลเดนต์
Manufacture	HORIBA	Location	Envi Research
Model	APMA-360 CE	Quotation	2024-00271, 2024-00273, 2024-00275
Serial No.	577583094	Calibration Date	May 31, 2024
Analyzer Unit	ppm	Time	5:16 PM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300	0165
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 (ppm)		Stability		% Abs Error
		Before	After	Before	After	
Zero	0	0.20	0.00	-	-	-
Span	40	39.96	40.00	-	-	0.10



STATUS TEST AND VALIDATION OF CO ANALYZER MODEL APMA-360CE

Parameter	Unit	Observed Value		Nominal Range
		Before Adjust	After Adjust	
SIGNAL (MAIN)	mV	5.3	8.4	Voltage of the measured CO Value
SIGNALI (COMP)	mV	0.2	2.5	Voltage of the interference component Value
CELL	°C	35.5	39.8	Ambient + (5 to 15 °C)
SAMPLE	L/min	1.2	1.4	1 L/min to 2 L/min
OVER FLOW	LPM	0.0	0.0	< 1.2

Calibrate By :

May 31, 2024

Checked By :

May 31, 2024

Calibration Data of CO Analyzer

Analyzer Performance Test

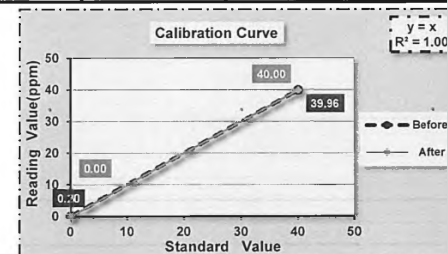
Equipment	Gas Analyzer (CO)	Customer Name	ที่แอลที คอนซิลเดนต์
Manufacture	HORIBA	Location	Envi Research
Model	APMA-360 CE	Quotation	2024-00271, 2024-00273, 2024-00275
Serial No.	41346760054	Calibration Date	May 31, 2024
Analyzer Unit	ppm	Time	5:16 PM

Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300	0165
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 (ppm)		Stability		% Abs Error
		Before	After	Before	After	
Zero	0	0.20	0.00	-	-	-
Span	40	39.96	40.00	-	-	0.10



STATUS TEST AND VALIDATION OF CO ANALYZER MODEL APMA-360CE

Parameter	Unit	Observed Value		Nominal Range
		Before Adjust	After Adjust	
SIGNAL (MAIN)	mV	5.9	8.4	Voltage of the measured CO Value
SIGNALI (COMP)	mV	0.2	2.5	Voltage of the interference component Value
CELL	°C	35.5	39.8	Ambient + (5 to 15 °C)
SAMPLE	L/min	1.2	1.4	1 L/min to 2 L/min
OVER FLOW	LPM	0.0	0.0	< 1.2

Calibrate By :

May 31, 2024

Checked By :

May 31, 2024



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 25 December, 2023

Certification No. 457/23

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : Davis Instruments Inc.

Type : Weather Wizard III Product No. 7425

Serial No. : WC30506A54A ID No. : No.4

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 1017.9 hPa

NATIONAL STANDARD WIND TUNNEL :

: Micromanometer Theodor Friedrichs FC014 Serial No. 9310119

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

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

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

Serial Number 110730029 (sensor 120629586)

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

Calibrated by :

Mechanical Engineer



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 457/23

25 December, 2023

Page : 2 of 2

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure m/sec	Vacuum inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.2	0.82
5.00	-	-	-	4.5	0.50
7.04	-	-	-	6.3	0.74
9.02	-	-	-	8.5	0.52
11.01	-	-	-	10.3	0.71
13.01	-	-	-	12.5	0.51
15.01	-	-	-	14.3	0.71
17.02	-	-	-	16.5	0.52
20.02	-	-	-	19.3	0.72

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

Calibrated by :

Mechanical Engineer





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 11 August, 2023

Certification No. 283/23

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : Davis Instruments Inc.

Type : Weather Wizard III Product No. 7425

Serial No. : WE91016A07 ID No. : No.9

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 1008.3 hPa

NATIONAL STANDARD WIND TUNNEL :

: Micromanometer Theodor Friedrichs FC014 Serial No. 9310119

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

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

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

Serial Number 110730029 (sensor 120629586)

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

Calibrated by :

Mechanical Engineer



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 283/23

11 August, 2023

Page : 2 of 2

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacumm	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	0.9	0.10
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.9	0.10
7.04	-	-	-	6.7	0.34
9.02	-	-	-	8.9	0.12
11.01	-	-	-	10.7	0.31
13.01	-	-	-	13.0	0.01
15.01	-	-	-	14.8	0.21
17.02	-	-	-	17.0	0.02
20.02	-	-	-	19.8	0.22

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

Calibrated by :

Mechanical Engineer





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 25 December, 2023

Certification No. 456/23

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : Davis Instruments Inc.

Type : Weather Wizard III Product No. 7425

Serial No. : WC20214A68 ID No. : No.3

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 1018.1 hPa

NATIONAL STANDARD WIND TUNNEL :

: Micromanometer Theodor Friedrichs FC014 Serial No. 9310119

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

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

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

Serial Number 110730029 (sensor 120629586)

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

Calibrated by :

Mechanical Engineer



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 456/23

25 December, 2023

Page : 2 of 2

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	0.9	0.10
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.9	0.10
7.04	-	-	-	6.7	0.34
9.02	-	-	-	8.9	0.12
11.01	-	-	-	10.7	0.31
13.01	-	-	-	12.9	0.11
15.01	-	-	-	14.5	0.51
17.02	-	-	-	16.9	0.12
20.02	-	-	-	19.5	0.52

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

Calibrated by :



Mechanical Engineer





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 17 April, 2024

Certification No. 182/24

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : Davis Instruments Inc.

Type : Weather Wizard III Product No. 7425

Serial No. : WC20318B07 ID No. : No.2

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

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1008.5 hPa

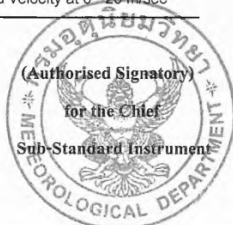
NATIONAL STANDARD WIND TUNNEL :

: Micromanometer Theodor Friedrichs FC014 Serial No. 9310119
: HOOK GAGE NO 1425 Pitot Tube Theodor Friedrichs Type 0800.0000 serial 9023
N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec
: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)
Serial Number 110730029 (sensor 120629586)

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

Calibrated by :

Mechanical Engineer



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 182/24

17 April, 2024

Page : 2 of 2

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H2O	Vacuum inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.9	0.10
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.9	0.10
7.04	-	-	-	6.7	0.34
9.02	-	-	-	8.9	0.12
11.01	-	-	-	10.7	0.31
13.01	-	-	-	13.0	0.01
15.01	-	-	-	14.7	0.31
17.02	-	-	-	17.0	0.02
20.02	-	-	-	19.8	0.22

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

Calibrated by :

Mechanical Engineer





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 17 April, 2024

Certification No. 184/24

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : Davis Instruments Inc.

Type : Weather Wizard III Product No. 7425

Serial No. : WC60110A03 ID No. : No.11

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 1009.1 hPa

NATIONAL STANDARD WIND TUNNEL :

: Micromanometer Theodor Friedrichs FC014 Serial No. 9310119
: HOOK GAGE NO 1425 Pitot Tube Theodor Friedrichs Type 0800.0000 serial 9023
N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec
: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)
Serial Number 110730029 (sensor 120629586)

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

Calibrated by :

Mechanical Engineer



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 184/24

17 April, 2024

Page : 2 of 2

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure m/sec	Vacumm inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.2	0.82
5.00	-	-	-	4.5	0.50
7.04	-	-	-	6.3	0.74
9.02	-	-	-	8.5	0.52
11.01	-	-	-	10.3	0.71
13.01	-	-	-	12.5	0.51
15.01	-	-	-	14.8	0.21
17.02	-	-	-	16.5	0.52
20.02	-	-	-	19.8	0.22

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 :

Mechanical Engineer





THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0311

MTC No. EEL. BP. 116/0267

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 : Sound Calibrator

Manufacturer : BSWA

Model : CA111

Serial No. : 590331

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/N4106495.

7. Condenser Microphone B&K 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 : 27 Feb. 2024

Date of Calibration : 5 Mar. 2024

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

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

FM.BL.MTC.002 Rev.4

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Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
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196 Phahonyothin Road, Chatuchak, Bangkok 10900,
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E-mail : sumalee@tistr.or.th



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0311

MTC No. EEL. BP. 116/0267

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 μPa at 1000 Hz

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	93.82	-0.18	± 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&Kjaer 4180	1000.5	0.5	± 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	2.80	± 0.70	$\pm 3.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Date of Calibration : 5 Mar. 2024

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

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FM.BL.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0064

MTC No. EEL. BP. 121/1066

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. : 3606

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 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 : 30 Oct. 2023

Date of Calibration : 31 Oct. 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0064

MTC No. EEL. BP. 121/1066

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	93.42	-0.58	± 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	1000.4	0.4	± 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	1.80	± 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 : 31 Oct. 2023

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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	113.45	-0.55	± 0.10	±0.40 dB

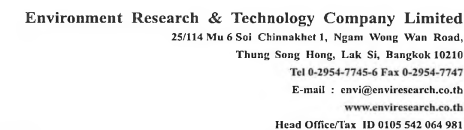
Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1000.2	0.2	± 1.5	±1.0%

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	0.60	± 0.50	±3.0%

(Mr.Prawate Kluaypa)

3 / 3

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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.23-66/0663

MTC.No.23-66/0663-01

Number of page(s) 2

CALIBRATION CERTIFICATE

Nomenclature : DRYCAL DC-LITE

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

Serial No.: 3328

Model : DCL-ML

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 : 23 August 2023

Condition of measured item : Normal

Calibration date : 4 September 2023

Standard :

Standard	Certificate No.	Date due	Traceability
RTD Thermometer	PSL-T 643/65	1-Jun-24	TISTR
Molbox/PressureTransducer/UpStream	MP-0076-23	2-Apr-25	NIMT
Primary Flow Calibrator S/N 117982	MW-0034-23	11-Jun-25	NIMT
Primary Flow Calibrator S/N 119521	MW-0033-23	6-Jun-25	NIMT

Calibrated by :

Approved by :

Director

Mechanical Engineering Standards Laboratory

Ref. 2013266082303323001

Issued Date 8 September 2023

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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.23-66/0663

2/2

MTC.No.23-66/0663-01

Calibration point : (0.1, 1, 2.5) l/min

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

Atmospheric pressure (1010±13) hPa

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

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

Measurement data :

UUC Value (l/min)	Standard Value (l/min)	Temperature (°C)	Pressure (hPa)	Deviation (%)	Uncertainty (%)
0.1017	0.10114	24.230	1003.96	+0.56	1.02
1.005	1.0026	24.456	1004.65	+0.24	0.87
2.502	2.4967	24.528	1005.72	+0.20	0.86

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

The end of calibration certificate.

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การตรวจวัดคุณภาพน้ำผิวดินและคุณภาพน้ำทิ้ง



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert.No.: 24CH16
Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Water Proof
Model : pHTestr 30
Serial No. : 3066354
ID No. : -
Condition As-Received: Used Item
Received Date : 05 January 2024
Calibration Date : 09 January 2024
Reference : 2401-0077DN-2
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)

Calibrated by :



Approved by :

(✓)
()
()



Issue Date : 10 January 2024

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.



Cert.No.: 24CH16
Page.: 2 of 2

Condition of this calibration result

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	940102	27 Nov 2025
pH 6.986	CPA chem	931959	01 Oct 2024
pH 9.997	CPA chem	940106	02 Nov 2024

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

Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement (±)	Coverage factor k
pH Electrode S/N.: 3066354	4.008	4.01	N/A	0.0079	2.00
	6.986	6.99	N/A	0.0099	2.00
	9.997	10.01	N/A	0.0085	2.00

Remark

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

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

-o0o-

Mettler-Toledo (Thailand) Ltd.
846/4 - 846/5 Lasalle Rd., Bangna Tai Sub-District
Bangna District, Bangkok 10260
+662 723 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., Toongsonghong		
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-L-IN-088
Serial No.:	B334691537	Terminal Model:	N/A
Building:	N/A	Terminal Serial No.:	N/A
Floor:	5	Terminal Asset No.:	N/A
Room:	504		

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

Procedure

Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)


METTLER TOLEDO Work Instruction: CP/W002/20

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

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

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

	Temperature		Humidity	
As Found	Start: 27.5 °C	End: 26.9 °C	Start: 44.1 %	End: 44.8 %

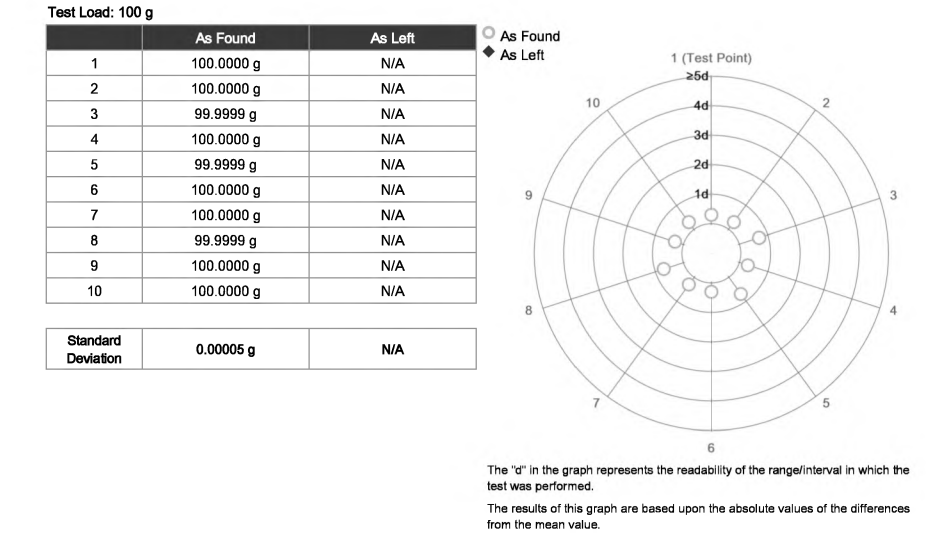
As Found Calibration Date:	15-Jan-2024	Calibrator:	
As Left Calibration Date:	N/A		
Issue Date:	15-Jan-2024		

Approved Signatory: _____

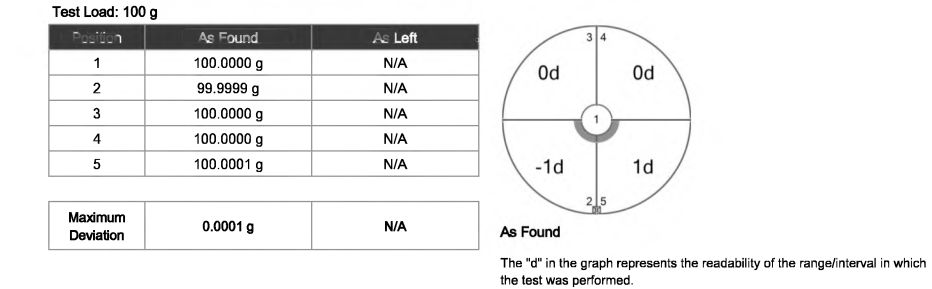
Technical Manager / Head of Calibration Center

Measurement Results

Repeatability



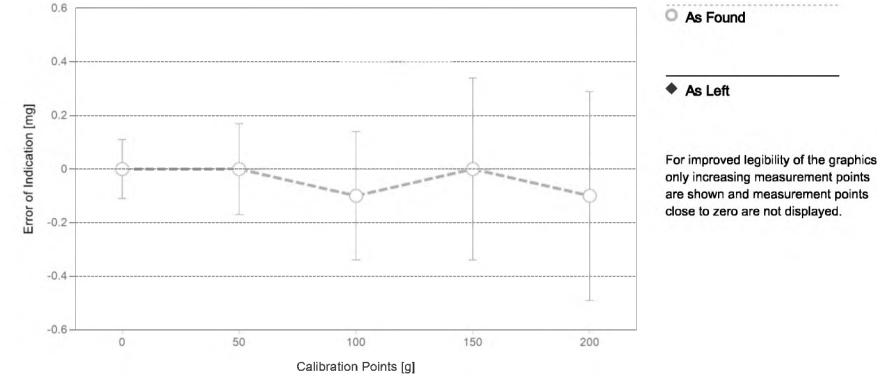
Eccentricity



Error of Indication

As Found

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.0000 g	0.11 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	0.13 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	0.17 mg	2
9	100.0001 g	100.0000 g	-0.0001 g	0.24 mg	2
10	150.0001 g	150.0001 g	0.0000 g	0.34 mg	2
11	200.0000 g	199.9999 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.
The results of this calibration certificate relate only to the calibrated item.

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.:	WS52	Date of Issue:	22-Nov-2022
Certificate Number:	182272	Calibration Due Date:	21-May-2024

Thermo Hygrometer

Equipment No.:	IN302	Date of Issue:	11-Oct-2023
Certificate Number:	SG-H-00656/66	Calibration Due Date:	08-Oct-2024

Remarks

FACT adjustment functionality activated
Equipment condition: Good
Next calibration according to customer's procedure
Calibration data not decide by calibration laboratory

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: 1.5 · 10⁻⁶ / K

Temperature range on site for the evaluation of the measurement uncertainty in use: 3 K

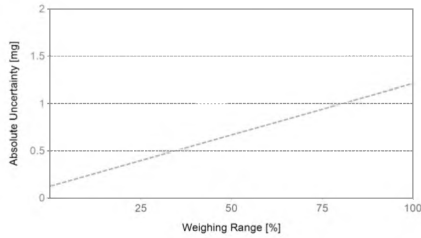
Linearization of Uncertainty Equation

	Range		As Found	As Left
	d	Max		
1	0.0001 g	220 g	U ₁ = 0.13 mg + 0.00494 mg/g · R	N/A

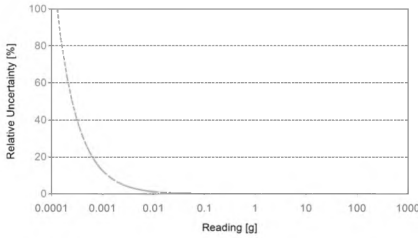
To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

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

Net Indication	As Found		As Left	
0.0220 g	0.13 mg	0.59%	N/A	N/A
0.2200 g	0.13 mg	0.060%	N/A	N/A
2.2000 g	0.14 mg	0.0064%	N/A	N/A
22.0000 g	0.24 mg	0.0011%	N/A	N/A
220.0000 g	1.2 mg	0.00055%	N/A	N/A



As Found



As Left

GWP® Certificate



As
Found



As
Left



The weighing device meets the given
process requirements.

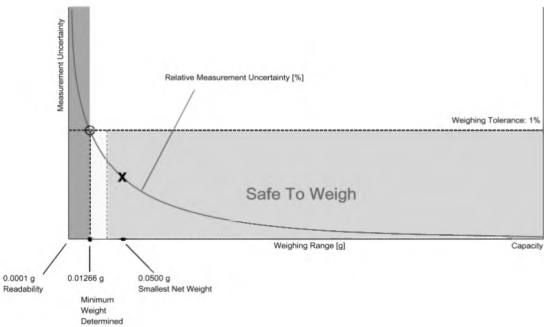
The weighing device meets the given
process requirements.

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.

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%	0.12712 g	0.25551 g	0.38518 g	0.64847 g	1.33062 g
0.2%	0.06340 g	0.12712 g	0.19115 g	0.32018 g	0.64847 g
0.5%	0.02532 g	0.05070 g	0.07612 g	0.12712 g	0.25551 g
1%	0.01266 g	0.02532 g	0.03800 g	0.06340 g	0.12712 g
2%	0.00633 g	0.01266 g	0.01899 g	0.03166 g	0.06340 g
5%	0.00253 g	0.00506 g	0.00759 g	0.01266 g	0.02532 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%	0.12712 g	0.25551 g	0.38518 g	0.64847 g	1.33062 g
0.2%	0.06340 g	0.12712 g	0.19115 g	0.32018 g	0.64847 g
0.5%	0.02532 g	0.05070 g	0.07612 g	0.12712 g	0.25551 g
1%	0.01266 g	0.02532 g	0.03800 g	0.06340 g	0.12712 g
2%	0.00633 g	0.01266 g	0.01899 g	0.03166 g	0.06340 g
5%	0.00253 g	0.00506 g	0.00759 g	0.01266 g	0.02532 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:
- If "N/A" is shown above, no appropriate value could be calculated.
 - 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

		As Found		As Left	
Tolerance	Control Limit	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

		As Found		As Left	
Tolerance	Control Limit	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

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
100.0001 g	-0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0001 g	0.0000 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
200.0000 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
100.0001 g	-0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0001 g	0.0000 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
200.0000 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.





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert. No.: 24TM93
Page : 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven
Manufacturer : Memmert
Model : UF 110
Serial No. : B414.0652
ID No. : ERTC-L-In.-098
Submitted by : Environment Research & Technology Company Limited.
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,
Toongsonghong, Laksi,
Bangkok 10210
Location : Laboratory (ERTC)
Received Order : 03 January 2024
Calibration Date : 03 January 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : 
Approved by : 
()
()
()

Issue Date : 16 January 2024

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.



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2401-0001ON-3

Cert. No.: 24TM93
Page : 2 of 3

Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013823	23LM66	TPA	25 Mar 2024

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

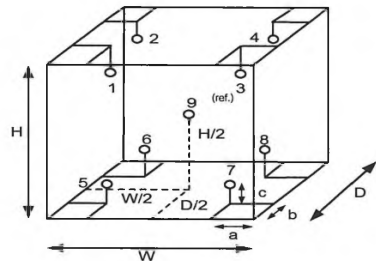
3. This certification is traceable to the International System of Unit.

Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details : Dimension of Chamber :

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

Environment during calibration		
	Beginning	Finished
Temp. (°C)	30	30
REL.Humid. (%)	53	53
AC Supply (Volt)	226	225

Ref. Std. ID No.: @ Calibration Point		
Position :	(104) °C	(180) °C
1	21-17RTD-01	22-17TC-01
2	21-17RTD-02	23-17TC-02
3	17RTD-03	19-17TC-03
4	23-17RTD-10	19-17TC-04
5	17RTD-05	19-17TC-05
6	17RTD-06	19-17TC-06
7	17RTD-07	19-17TC-07
8	23-17RTD-08	19-17TC-08
9 (ref.)	23-17RTD-09	19-17TC-09



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2401-0001ON-3

Cert. No.: 24TM93
Page : 3 of 3

Result of Calibration :-

(*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
104.0	104.0	104.0	0.075	1.2	2.4	2
180.0	180.0	180.0	0.41	3.4	3.9	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
104.0	105.068	102.783	103.239	103.695	104.855	103.867	102.799	103.295	103.959	0.42
180.0	179.954	177.587	177.414	178.118	181.087	179.869	179.584	178.045	180.704	1.3

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

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

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

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

UUC* : Unit Under Calibration

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

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert. No.: 24TM92
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 : 03 January 2024
Calibration Date : 03 January 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : [Redacted]

Approved by : [Redacted]
Approved Signatory

() [Redacted]
(✓) [Redacted]
() [Redacted]

Issue Date : 16 January 2024

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.



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2401-0001ON-2
Procedure Used :-

Cert. No.: 24TM92
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	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013823	23LM66	TPA	25 Mar 2024

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.

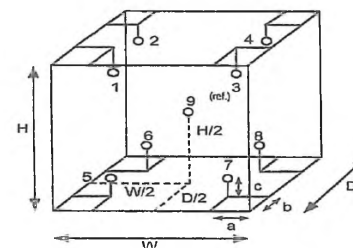
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :-

(*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



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

Environment during calibration		
	Beginning	Finished
Temp. (°C)	30	33
REL.Humid. (%)	53	41
AC Supply (Volt)	226	225

Ref. Std. ID No.: @ Calibration Point		
Position :	(104) °C	(180) °C
1	21-17RTD-01	22-17TC-01
2	21-17RTD-02	23-17TC-02
3	17RTD-03	19-17TC-03
4	23-17RTD-10	19-17TC-04
5	17RTD-05	19-17TC-05
6	17RTD-06	19-17TC-06
7	17RTD-07	19-17TC-07
8	23-17RTD-08	19-17TC-08
9 (ref.)	23-17RTD-09	19-17TC-09

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Equipment : Hot Air Oven
 Condition As-Received : Used Item
 Reference : 2401-0001ON-2
 Result of Calibration :- (*) Without Adjustment
 Function of UUC* : Temperature Source
 Fresh air setting : Close

Cert. No.: 24TM92
 Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor <i>k</i>
104	104	104	0.10	1.8	2.1	2
180	180	180	0.27	4.4	5.0	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (±°C)
	Position									
	1	2	3	4	5	6	7	8	9 (ref.)	
104	104.379	103.463	103.443	103.893	104.213	103.223	105.222	104.297	103.494	0.77
180	179.045	177.562	181.299	179.300	180.773	177.931	182.136	178.131	178.019	1.6

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

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

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

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

UUC* : Unit Under Calibration

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

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

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

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

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

Cert.No.: 23TW254
 Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
 Manufacturer : YSI
 Model : 5000-115
 Serial No. : 17H104220
 ID No. : ERTC-L-In.137
 Received Date : 29 November 2023
 Test Date : 30 November 2023
 Reference : 2311-0939DN-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 :

Approved by :

Approved Signatory

Issue Date :

4 December 2023

B 0328870



Cert.No.: 23TW254
Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

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

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Burette	-	130BU10	23CG1172	22 Mar 2025
2) Balance	1124013382	140RC006	23MM18	20 Feb 2024

2. Standard Material :-

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

Result : Dissolved Oxygen Meter Adjustment With Air 100 %
Dissolved Oxygen Probe No.: 17J100003

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.18	8.17	0.0055

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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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 of Calibration

Certificate No. : MT23-7846
Page : 1 of 2

Customer : Environment Research & Technogy Co., Ltd.
Address : 25/114 Moo 6 Soi Chinaket1, Ngamwongwan Road, Toongsonghong, Laksi, Bangkok 10210

Description	: Incubator	Order No.	: 3936/23
Manufacturer	: Accuplus	Received date	: Dec 12, 2023
Model	: Smart i250	Calibration date	: Dec 12, 2023
Serial No.	: 2059-0218-0002	Environment Condition :	
Identification No.	: ERTC-L-IN-143	Temperature	: (25+/-10) °C
Calibration Place	: Customer Laboratory	Humidity	: (50+/-30) %RH

Calibration Method : Calibration were conducted using In-house calibration procedure CP-MT-006 According to comparison with LXI Data Acquisition Switch Unit with sensor. The calibration methods based on Euramet Calibration Guide No.20 - guidelines on the Calibration of Temperature and/or Humidity Controlled Enclosures.

Reference Standard Instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
LXI Data Acquisition Switch Unit with Sensor	34972A	MY57003222	MT23-5938	Oct 05, 2024

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 based on standard uncertainty multiplied by coverage factor $k = 2$, providing a level of confidence of not less than 95%



Calibrated by : [Redacted]
Issue date : Jan 09, 2024

Approved by : [Redacted]

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



Certificate No. : MT23-7846

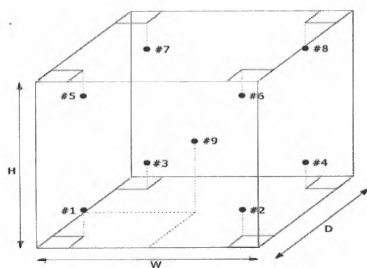
Page : 2 of 2

Function : Temperature measurement
Calibration point : 20 °C

Result : Without adjustment
Resolution : 0.1 °C

Calibration point (°C)	Temperature of UUC* at each position (°C)									Uncertainty of measurement (+/- °C)
	Ch.1	Ch.2	Ch.3	Ch.4	Ch.5	Ch.6	Ch.7	Ch.8	Ch.9	
20	20.542	20.166	20.504	20.211	20.551	20.501	20.477	20.728	19.867	0.46

Setting temperature (°C)	Indicating Temperature (°C)	Measured stability (+/- °C)	Measured uniformity (°C)	Overall variation (°C)
20.0	20 to 20.3	0.25	1.0	1.3



Front view

- #1 Lower Left Front
- #2 Lower Right Front
- #3 Lower Left Rear
- #4 Lower Right Rear
- #5 Upper Left Front
- #6 Upper Right Front
- #7 Upper Left Rear
- #8 Upper Right Rear
- #9 Geometric Center

UUC* = Unit under calibration

Uniformity = Maximum and Minimum difference of measured temperature at any probes and the measured temperature at the reference and same time.

Overall Variation = Difference of temperature value between the maximum and minimum any time.

Stability = One half of the maximum difference of measured temperatures at any one probe.

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Calibration Certificate ID
TH3067-066-011524-ACC-TH

METTLER TOLEDO

Mettler-Toledo (Thailand) Ltd.

846/4 - 846/5 Lasalle Rd., Bangna Tai Sub-District
Bangna District, Bangkok 10260
+662 723 0382
MT-TH.ServiceSupport@mt.com



NSC-TISI-TIS 17025
CALIBRATION 0062

Accuracy Calibration Certificate

Customer

Company: Environment Research & Technology Co., Ltd.
Address: 25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Rd., Toongsonghong
City: Laksi Contact: [REDACTED]
Zip / Postal: 10210
State / Province: Bangkok
Order Number: [REDACTED]

Weighing Device

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

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

Procedure

Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)

METTLER TOLEDO Work Instruction: CP/W002/20

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

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

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

	Temperature		Humidity	
As Found	Start: 26.9 °C	End: 27.0 °C	Start: 44.5 %	End: 44.6 %

As Found Calibration Date: 15-Jan-2024

As Left Calibration Date: N/A

Issue Date: 15-Jan-2024

Calibrator: [REDACTED]

Approved Signatory: [REDACTED]

Technical Manager / Head of Calibration Center

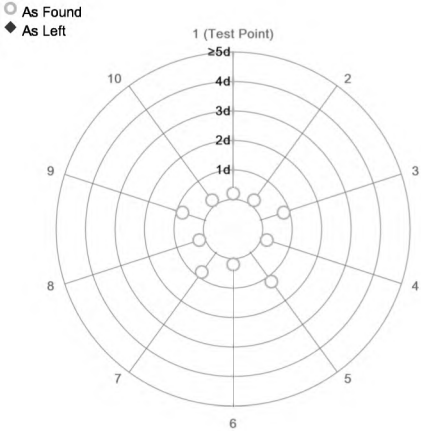
Measurement Results

Repeatability

Test Load: 100 g

	As Found	As Left
1	100.0000 g	N/A
2	100.0000 g	N/A
3	100.0001 g	N/A
4	100.0000 g	N/A
5	99.9999 g	N/A
6	100.0000 g	N/A
7	100.0001 g	N/A
8	100.0000 g	N/A
9	100.0001 g	N/A
10	100.0000 g	N/A

Standard Deviation	0.00006 g	N/A
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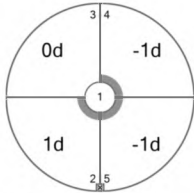
The "d" in the graph represents the readability of the range/interval in which the test was performed.
The results of this graph are based upon the absolute values of the differences from the mean value.

Eccentricity

Test Load: 100 g

Position	As Found	As Left
1	100.0000 g	N/A
2	100.0001 g	N/A
3	100.0000 g	N/A
4	99.9999 g	N/A
5	99.9999 g	N/A

Maximum Deviation	0.0001 g	N/A
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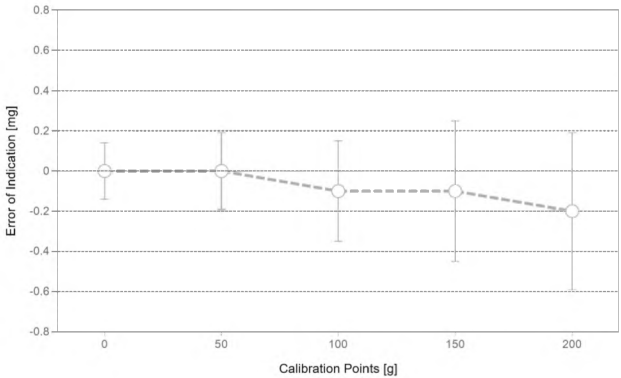


As Found
The "d" in the graph represents the readability of the range/interval in which the test was performed.

Error of Indication

As Found

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.0000 g	0.14 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	0.5001 g	0.0001 g	0.15 mg	2
5	1.0000 g	1.0000 g	0.0000 g	0.15 mg	2
6	5.0000 g	5.0001 g	0.0001 g	0.16 mg	2
7	10.0000 g	10.0000 g	0.0000 g	0.16 mg	2
8	50.0000 g	50.0000 g	0.0000 g	0.19 mg	2
9	100.0001 g	100.0000 g	-0.0001 g	0.25 mg	2
10	150.0001 g	150.0000 g	-0.0001 g	0.35 mg	2
11	200.0000 g	199.9998 g	-0.0002 g	0.39 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.
The results of this calibration certificate relate only to the calibrated item.

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.:	WS52	Date of Issue:	22-Nov-2022
Certificate Number:	182272	Calibration Due Date:	21-May-2024

Thermo Hygrometer

Equipment No.:	IN302	Date of Issue:	11-Oct-2023
Certificate Number:	SG-H-00656/66	Calibration Due Date:	08-Oct-2024

Remarks

FACT adjustment functionality activated
Equipment condition: Good
Next calibration according to customer's procedure
Calibration data not decide by calibration laboratory

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 · 10⁻⁶ / K

Temperature range on site for the evaluation of the measurement uncertainty in use: 3 K

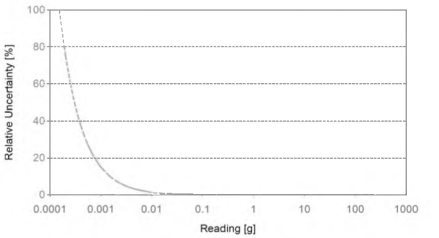
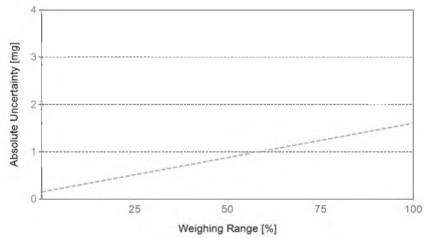
Linearization of Uncertainty Equation

Range			As Found	As Left
	d	Max		
1	0.0001 g	220 g	$U_1 = 0.15 \text{ mg} + 0.00663 \text{ mg/g} \cdot R$	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	0.0075%	N/A	N/A
22.0000 g	0.30 mg	0.0013%	N/A	N/A
220.0000 g	1.6 mg	0.00073%	N/A	N/A



GWP® Certificate



As
Found



As
Left



The weighing device meets the given
process requirements.

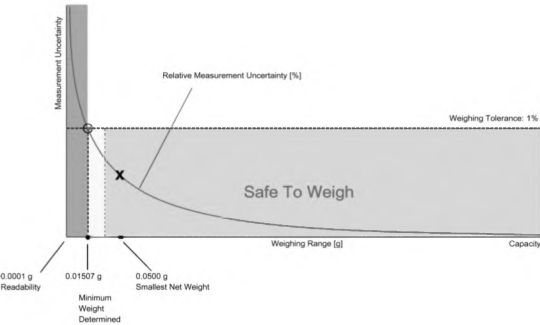
The weighing device meets the given
process requirements.

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.

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%	0.15156 g	0.30515 g	0.46083 g	0.77857 g	1.61241 g
0.2%	0.07553 g	0.15156 g	0.22810 g	0.38273 g	0.77857 g
0.5%	0.03015 g	0.06038 g	0.09069 g	0.15156 g	0.30515 g
1%	0.01507 g	0.03015 g	0.04526 g	0.07553 g	0.15156 g
2%	0.00753 g	0.01507 g	0.02261 g	0.03770 g	0.07553 g
5%	0.00301 g	0.00602 g	0.00904 g	0.01507 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%	0.15156 g	0.30515 g	0.46083 g	0.77857 g	1.61241 g
0.2%	0.07553 g	0.15156 g	0.22810 g	0.38273 g	0.77857 g
0.5%	0.03015 g	0.06038 g	0.09069 g	0.15156 g	0.30515 g
1%	0.01507 g	0.03015 g	0.04526 g	0.07553 g	0.15156 g
2%	0.00753 g	0.01507 g	0.02261 g	0.03770 g	0.07553 g
5%	0.00301 g	0.00602 g	0.00904 g	0.01507 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:

- If "N/A" is shown above, no appropriate value could be calculated.
- 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	0.00006 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 0.41*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

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
100.0001 g	-0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0001 g	-0.0001 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
200.0000 g	-0.0002 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
100.0001 g	-0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0001 g	-0.0001 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
200.0000 g	-0.0002 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.



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



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

TEL. 0-2717-3000-29 FAX. 0-2719-9484

Certificate of Calibration

Cert.No.: 24CH185

Page.: 1 of 2

Equipment : Turbidity Meter
Manufacturer : Exttech
Model : TB400
Serial No. : A.123264
ID. No. : -
Condition As-Received: Used Item
Received Date : 07 February 2024
Calibration Date : 08 February 2024
Reference : 2402-0223WN-1
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 ± 20) %
Calibration Procedure : In - house method : CP-CH11
based on direct measurement by
using Formazin standard solution
Calibrated by : 
Approved by : 
(✓)
()
()
Issue Date : 13 February 2024

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 Calibration and Testing Equipment Services.

A0012568



Cert.No. : 24CH185

Page. : 2 of 2

Condition of this calibration result

1. Reference Standard Instruments :

This certification is traceable to the International System of unit (SI unit) through:-
- Technology Promotion Association (Thailand-Japan).

Instruments	Serial No.	ID No.	Certificate No.	Due date
1) Thermo-Hygrograph	1103328	130EC010	23H1361	13 June 2024
2) Electronic Balance	1124013382	140RC006	23MM18	20 Feb 2024

2. Standard Material : The Formazin suspension has been prepared gravimetric from

Material	Manufacturer	Lot No.	Assay
1) Hexamethylenetetramine	HIMEDIA	0000493947	99.65%
2) Hydrazinium Sulfate	HIMEDIA	0000522014	99.40%

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

Calibration result

Performing two - Formazin suspension standard curve by using 0,100 NTU

Turbidity Meter Serial Number : A.123264

Standard Formazine suspension (NTU)	UUC* Reading (NTU)	Uncertainty of Measurement (± NTU)	Coverage Factor k
20	27.08	0.38	2.00
40	46.17	0.40	2.00
100	101	0.78	2.00

Remark - UUC* = Unit Under Calibration
- NTU = Nephelometric Turbidity Units

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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Cert.No.: 24CH17
Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Water Proof
Model : pHTestr 30
Serial No. : 3066320
ID No. : -
Condition As-Received: Used Item
Received Date : 05 January 2024
Calibration Date : 09 January 2024
Reference : 2401-0077DN-3
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)

Calibrated by :

Approved by :

(✓)
()
()

Issue Date :

10 January 2024

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.: 24CH17
Page.: 2 of 2

Condition of this calibration result

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	940102	27 Nov 2025
pH 6.986	CPA chem	931959	01 Oct 2024
pH 9.997	CPA chem	940106	02 Nov 2024

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

Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement (±)	Coverage factor k
pH Electrode	4.008	4.01	N/A	0.0071	2.00
S/N.: 3066320	6.986	7.00	N/A	0.0093	2.00
	9.997	10.00	N/A	0.0095	2.00

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

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

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A 0062385

a 1196385



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Cert.No.: 24TW2

Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : YSI
Model : Pro2030
Serial No. : 21H104437
ID No. : -
Received Date : 05 January 2024
Test Date : 08 January 2024
Reference : 2401-0077DN-10
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 :

Approved by :

Approved Signatory

(✓)
()
()

Issue Date :

10 January 2024



Cert.No.: 24TW2

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

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

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Burette	-	130BU10	23CG1172	22 Mar 2025
2) Balance	1124013382	140RC006	23MM18	20 Feb 2024

2. Standard Material :-

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

Result : Dissolved Oxygen Meter Adjustment With Air 100 %
Dissolved Oxygen Probe No.: 21G100097

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.18	8.18	0.0055

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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TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert. No.: 24TM95
Page : 1 of 3

Certificate of Calibration

Equipment : Incubator
Manufacturer : Memmert
Model : IF 160
Serial No. : D522.0070
ID No. : ERTC-L-In.-181
Submitted by : Environment Research & Technology Company Limited
25/114 Moo 6 Soi Chinaket 1,
Ngamwongwan Road, Toongsonghong, Laksi,
Bangkok 10210
Location : 408/2 ห้องปฏิบัติการปฏิกิริยาเคมี
Received Order : 03 January 2024
Calibration Date : 04 January 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by :

Approved by :

()
()
()

Approved Signatory

Issue Date : 16 January 2024

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.



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2401-0001ON-5

Cert. No.: 24TM95
Page : 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 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	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013711	23LM115	TPA	11 Jul 2024

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.

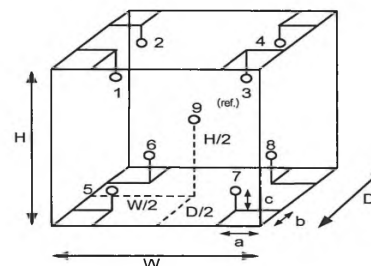
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Fan setting : 50%



Environment during calibration		
	Beginning	Finished
Temp. (°C)	26	29
REL.Humid. (%)	47	50
AC Supply (Volt)	225	226

Position :	Ref. Std. ID No.:
1	22-18RTD-2/1
2	18RTD-2/2
3	18RTD-2/3
4	18RTD-2/4
5	18RTD-2/5
6	18RTD-2/6
7	18RTD-2/7
8	18RTD-2/8
9 (ref.)	18RTD-2/9

Probe Installation Details :

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

Dimension of Chamber :

D = 0.40 m
W = 0.56 m
H = 0.73 m
Capacity = 0.16 m³



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2401-0001ON-5
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 24TM95
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor <i>k</i>
35.0	35.0	35.0	0.020	0.15	0.24	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	Position									
	1	2	3	4	5	6	7	8	9 (ref.)	
35.0	35.043	34.933	35.015	34.992	35.019	34.980	34.843	34.961	34.985	0.32

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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Cert. No.: 24TM96
Page : 1 of 3

Certificate of Calibration

Equipment : Incubator
Manufacturer : Ehret
Model : BK 4106
Serial No. : 22162
ID No. : ERTC-L-In.-022
Submitted by : Environment Research & Technology Company Limited
25/114 Moo 6 Soi Chinaket 1,
Ngamwongwan Road, Toongsonghong, Laksi,
Bangkok 10210
Location : 408/2 ห้องปฏิบัติการบ่มอาหารเลี้ยงเชื้อ
Received Order : 03 January 2024
Calibration Date : 04 January 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by :

Approved by :

Approved Signatory

()
(✓)
()

Issue Date : 16 January 2024

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.

A 0062475



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2401-0001ON-6

Cert. No.: 24TM96
Page : 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 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	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013711	23LM115	TPA	11 Jul 2024

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

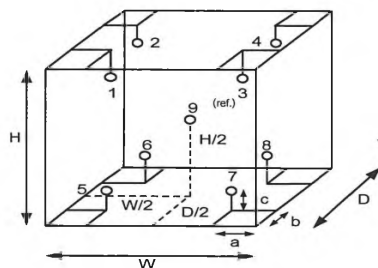
3. This certification is traceable to the International System of Unit.

Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available



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	29
REL.Humid. (%)	45	50
AC Supply (Volt)	225	226

Position :	Ref. Std. ID No.:
1	18-18RTD-01
2	18-18RTD-02
3	18-18RTD-03
4	18-18RTD-04
5	18-18RTD-05
6	23-18RTD-06
7	18-18RTD-07
8	22-18RTD-08
9 (ref.)	18-18RTD-09



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2401-0001ON-6

Cert. No.: 24TM96
Page : 3 of 3

Result of Calibration :-

(*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
44.5	44.5	45.0	0.20	0.77	1.6	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	Position									
	1	2	3	4	5	6	7	8	9 (ref.)	
44.5	45.038	45.142	45.077	45.127	43.812	44.180	44.402	44.990	44.497	0.85

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.

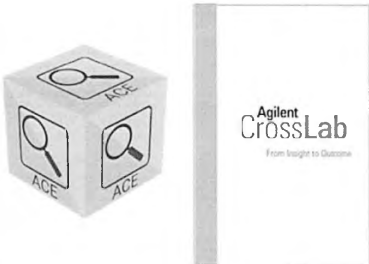
Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

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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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 28, 2023 1:10:31 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 the Overall Qualification Status and details for each test that meets at least one of the following criteria: (1) was not scheduled; (2) was scheduled but not run; (3) was processed more than once; (4) passed recommended limits only when dual limits were selected; (5) required deviation(s) or comment(s); (6) required integration event change(s). Tests that pass and do not meet any criteria above are not included.

For a complete list of scheduled tests, see the table of contents. For supporting documentation, refer to the Attachments section.

NOTE: A Pass for the Overall Qualification Status indicates that all scheduled tests were run and passed; R, I, D, and C are blank if not applicable for that specific test.

- R: runs
- I: integration event changes
- D: number of deviations submitted
- C: number of comments submitted
- Status: NS (not scheduled); NR (scheduled but not run); NC (unlocked but not completed)

Details

Test	Status			
	R	I	D	C
There were no repeated or re-integrated tests. All test resulted in a pass status.				
Overall Qualification Status				
Pass				

Service Details

Purpose

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

General Details

Service Order No./Request:	6006377416
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:	K Raiwin Posit
Job Title:	Supervisor Scientist
Qualification Location:	ICPOES Room

Operator Details

Name:	Worawit Timakul
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
-----------------------------	----------------

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

Vapor Generator 1

Manufacturer	Agilent Technologies
Name	VGA77P
Model Number	G8475A
Serial Number	MY15330002

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 28, 2023 12:56:03 PM

Host Name:

5CG0202NQ4

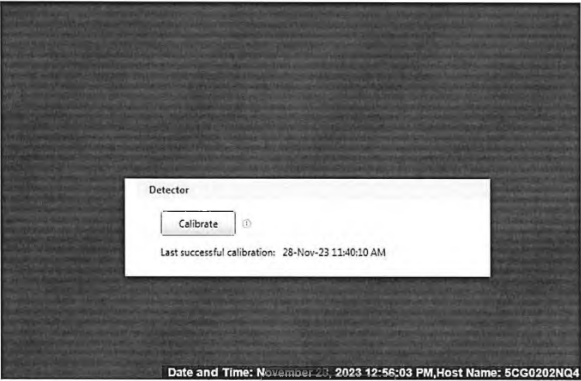


Image Details:

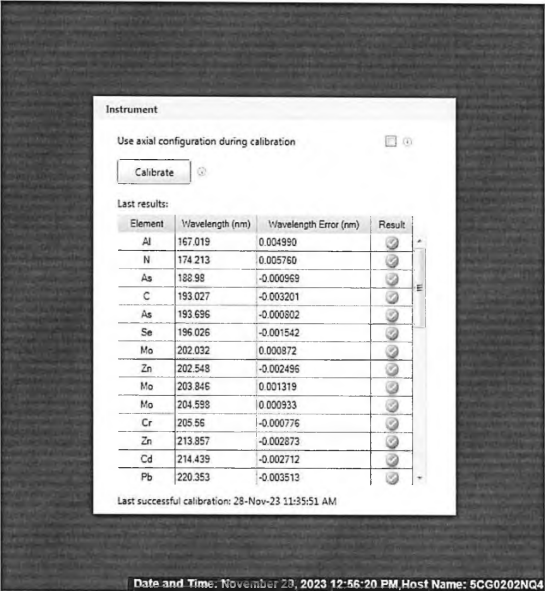
Was the instrument calibration performed and completed successfully?

Date and Time:

November 28, 2023 12:56:20 PM

Host Name:

5CG0202NQ4



Overall Test Status

Pass

Runs: 1

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

Are the Functional Tests results within acceptance criteria?

Subsystem Communications	<div>Yes</div>	<div>Yes</div>	<div>Pass</div>
Air Flow	<div>Yes</div>	<div>Yes</div>	<div>Pass</div>
Water Flow	<div>Yes</div>	<div>Yes</div>	<div>Pass</div>
Gas Flows	<div>Yes</div>	<div>Yes</div>	<div>Pass</div>
RF Generator	<div>Yes</div>	<div>Yes</div>	<div>Pass</div>
Camera	<div>Yes</div>	<div>Yes</div>	<div>Pass</div>
Optics	<div>Yes</div>	<div>Yes</div>	<div>Pass</div>

Are the Instrument Performance Tests results within acceptance criteria?

Resolution	<div>Yes</div>	<div>Yes</div>	<div>Pass</div>
Sensitivity	<div>Yes</div>	<div>Yes</div>	<div>Pass</div>
Precision	<div>Yes</div>	<div>Yes</div>	<div>Pass</div>

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)?	<div>Yes</div>	<div>Yes</div>	<div>Pass</div>
--	----------------	----------------	-----------------

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	13
EQR	General	Operator's training certificate and qualifications	14
EQR	General	Operator's training certificate and qualifications	15
EQR	General	Certificate of System Qualification	16
EQR	General	Instrument's Test Report	17
EQR	General	Software Verification	20
EQR	Material	Certificate of Analysis Wavelength calibration solution	21

General

General

Document Name: Certificate of Qualification for ACE

Document Name: Operator's training certificate and qualifications



Agilent Compliance Engine Self Qualification

Date: October 18, 2023 10:19:46 AM
Drive Serial #: 90593EBA Platform Revision: ACE 3.12.112

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
Atomic Absorption	7	Conforms
Capillary Electrophoresis	10	Conforms
Dissolution	6	Conforms
Emission Spectroscopy	3	Conforms
Gas Chromatography - GCMS	17	Conforms
Gas Chromatography	29	Conforms
Gel Permeation Chromatography	9	Conforms
ICP-MS	6	Conforms
Infrared Spectroscopy	7	Conforms
Liquid Chromatography	17	Conforms
Liquid Chromatography - LCMS	8	Conforms
Microfluidics	18	Conforms
Sample Preparation - Gas Chromatography	9	Conforms
Sample Preparation - Liquid Chromatography	8	Conforms
Supercritical Fluid Chromatography	15	Conforms
Software	6	Conforms
UV-Vis Spectrophotometer	13	Conforms

Overall Qualification Status
Conforms



Certificate of Completion

Learner Name: Worawit Timakul
Title Of Course: ANV-CE-ICPOES-2-008-A: Agilent 5100 ICP-OES Support Neophyte Training
Completion Date: August 25, 2016
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.

General

Document Name: Operator's training certificate and qualifications

 Agilent Technologies

Certificate of Completion

Learner Name:

Worawit Timakul

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.

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General

Document Name: Certificate of System Qualification

 Agilent Technologies

Certificate of Completion

Learner Name:

Worawit Timakul

Title Of Course:

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

Completion Date:

July 1, 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.

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	7.1.0.6821	
Firmware Version	2994	
Tested By	Worawit T.	
Test Completed On	27-Nov-23 2:23:13 PM	

Result Summary

Resolution Test	Pass
Sensitivity Test	Pass
Precision Test	Pass

Resolution Test

Pass

Element Wavelength	Specification	Width
N (174.213 nm)	≤ 9.40	7.28
As (188.980 nm)	≤ 8.20	6.66
C (193.027 nm)	≤ 11.50	8.01
Mo (202.032 nm)	≤ 8.20	6.71
Cr (206.158 nm)	≤ 13.40	10.27
Zn (213.857 nm)	≤ 8.70	7.56
Pb (220.353 nm)	≤ 9.50	7.70
Co (228.615 nm)	≤ 17.20	10.70
Ba (230.424 nm)	≤ 9.40	8.14
Mn (257.610 nm)	≤ 13.30	9.43
Mn (260.568 nm)	≤ 20.30	15.91
Cr (267.716 nm)	≤ 11.00	9.30
Cu (324.754 nm)	≤ 25.00	17.80
Cu (327.395 nm)	≤ 14.20	12.73
Sr (338.071 nm)	≤ 33.50	27.28
Ba (455.403 nm)	≤ 44.00	31.08
Sr (460.733 nm)	≤ 36.00	21.11
Ba (493.408 nm)	≤ 36.00	29.33
Ba (614.171 nm)	≤ 42.00	32.02
Ar (675.283 nm)	≤ 74.00	64.85
K (766.491 nm)	≤ 80.00	62.51

Document Name: Instrument's Test Report

Sensitivity Test					
Pass					
Radial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	111.1	1111.0	85.2
Se (196.026 nm)	≥ 41.0	SRBR	68.5	856.2	116.6
Zn (213.857 nm)	≥ 1421.0	SRBR	3583.1	52766.1	215.1
Pb (220.353 nm)	≥ 46.0	SRBR	183.7	2811.8	201.8
Mn (257.610 nm)	≥ 3518.0	SRBR	10286.2	279763.9	735.8
Al (396.152 nm)	≥ 3.4	SBR	8.2	37571.9	4071.0
Ba (493.408 nm)	≥ 34.0	SBR	100.5	1198903.7	11807.1
K (766.491 nm)	≥ 1.8	SBR	3.8	100874.8	20871.5
Axial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	248.6	3738.6	202.3
Se (196.026 nm)	≥ 159.0	SRBR	163.8	3040.9	283.3
Zn (206.200 nm)	≥ 234.0	SRBR	1402.0	19648.6	192.6
Zn (213.857 nm)	≥ 1743.0	SRBR	8340.9	200514.1	574.6
Cd (214.439 nm)	≥ 4227.0	SRBR	7606.2	156421.5	420.7
Pb (220.353 nm)	≥ 320.0	SRBR	631.4	16069.9	600.3
Mn (257.610 nm)	≥ 10625.0	SRBR	32328.3	1472044.4	2067.5
Cr (267.716 nm)	≥ 1048.0	SRBR	4308.3	155802.6	1286.3
Cu (324.754 nm)	≥ 19.0	SBR	57.8	242584.8	4123.5
Al (396.152 nm)	≥ 6.0	SBR	21.9	239924.8	10474.6
Ba (493.408 nm)	≥ 60.0	SBR	236.0	7235267.3	30527.2
K (766.491 nm)	≥ 24.0	SBR	68.8	3110677.8	44585.8

Document Name:

Instrument's Test Report

Precision Test			Pass
Radial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 2.60	0.74	
Se (196.026 nm)	≤ 2.60	0.65	
Zn (213.857 nm)	≤ 1.50	0.21	
Pb (220.353 nm)	≤ 2.60	0.51	
Mn (257.610 nm)	≤ 1.50	0.25	
Al (396.152 nm)	≤ 1.50	0.30	
Ba (493.408 nm)	≤ 1.50	0.60	
K (766.491 nm)	≤ 1.50	0.20	
Axial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 1.50	0.51	
Se (196.026 nm)	≤ 1.50	0.37	
Zn (206.200 nm)	≤ 1.50	0.30	
Zn (213.857 nm)	≤ 1.50	0.26	
Cd (214.439 nm)	≤ 1.50	0.21	
Pb (220.353 nm)	≤ 1.50	0.30	
Mn (257.610 nm)	≤ 1.50	0.63	
Cr (267.716 nm)	≤ 1.50	0.17	
Cu (324.754 nm)	≤ 1.50	0.32	
Al (396.152 nm)	≤ 1.50	0.30	
Ba (493.408 nm)	≤ 1.50	0.48	
K (766.491 nm)	≤ 1.50	0.53	

General

Document Name:

Software Verification

Software Verification Report					
Date:	Monday, November 27, 2023	Time:	2:58:23 PM [UTC +07:00:00]	Host Name:	S100VDV-HP
Windows User Name :	Admin	Base Revision Number:	7.0.1	Product Name :	ICP Expert
Install Type:	N/A	Additional Packages:	NA		

Base Reference File Name : ICPReferencefile.xml

Summary :

Overall Evaluation of Installation Check :PASS

File Report Summary

No missing files or invalid files found

No system file difference found

Files Registration Report Summary

Files Registration check not required for this product

Registry Report Summary

Registry entries check not required for this product

Materials

Document Name:

Certificate of Analysis Wavelength calibration solution

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: 6610030100
Lot No: 0012990411

Product Specifications

Analyte	Starting Material	CAS #	Certified Conc.	Analyte	Starting Material	CAS #	Certified Conc.
Al	Al(NO ₃) ₃	7794-27-2	5.000 ± 0.025 mg/L	Mn	Mn	7439-95-5	5.000 ± 0.025 mg/L
As	As	7440-38-2	5.000 ± 0.025 mg/L	Mo	(NH ₄) ₂ MoO ₄	13106-76-8	5.000 ± 0.025 mg/L
Ba	Ba(NO ₃) ₂	10022-31-8	5.000 ± 0.025 mg/L	Ni	Ni	7440-02-0	5.000 ± 0.025 mg/L
Cd	Cd	7440-43-9	5.000 ± 0.025 mg/L	Pb	Pb	7439-92-1	5.000 ± 0.025 mg/L
Co	Co	7440-48-4	5.000 ± 0.025 mg/L	Se	Se	7782-49-2	5.000 ± 0.025 mg/L
Cr	Cr(NO ₃) ₃	13548-38-4	5.000 ± 0.025 mg/L	Sr	Sr(NO ₃) ₂	10042-75-9	5.000 ± 0.025 mg/L
Cu	Cu	7440-50-8	5.000 ± 0.025 mg/L	Zn	Zn	7440-66-8	5.000 ± 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 spectroscopy (ICP-OES), inductively coupled plasma mass spectrometry (ICP-MS), atomic absorption spectroscopy (flame AAS or GFAAS), microwave plasma atomic emission spectroscopy (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 17034 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, 3105a, 3104a, 3108, 3113, 3112a, 3114, 3114a, 3132, 3134, 3136, 3126, 3148, 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.



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.

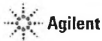
Sample lot approval:

Chuck Gaudreau

Chuck Gaudreau, Certifying Officer

Date of release: 18 October 2022
Date of expiration: 30 April 2024

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/sds.

Homogeneity: This solution was determined to be homogeneous by procedures consistent with the requirements of ISO 17034 and ISO Guide 35. Replicate samples of the finished solution were analyzed to confirm its homogeneity, in accordance with USP 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 16580231)
- Accredited to ISO 17034 – General Requirements for the Competence of Reference Material Producers (AZLA Cert. No. 2848.02)
 - ISO 17034 references additional requirements specified in ISO Guide 31 and ISO Guide 35.
- Accredited to ISO/IEC 17025 – General Requirements for the Competence of Testing and Calibration Laboratories (AZLA Cert. No. 2848.01)
- LGC Standards, 278 Abbey Road, Manchester, M11 2JH

Page 3 of 3

Document Name: Certificate of Analysis Wavelength calibration solution

Electronic Signature

Purpose

This signature page was created and published because the ACE sign-off action was executed, which is valid for the entire document, including attachments. The ACE sign-off is an electronic signature that requires two distinct identification components: unique username and personal password. The Agilent representative who has delivered this service understands the meaning and legal status of an electronic signature. As a trained official operator, the Agilent representative has a unique password and logon to access ACE and electronically sign this document. (Other e-signatures can be applied to this document using a Document Content Management or other suitable method defined in your data access and control procedures.)

Details

Full Name of Signer: Worawit Timakul

Logged On User Name: worawit.timakul@agilent.com

Signature Creation Date: November 28, 2023

Reason for Signature: Executed protocol and published this original version of document

Regulatory Disclaimer

This document provides a protocol to verify and record instrument configuration and evidence of proper operation. It has been prepared from our interpretation of applicable regulations as well as industry best practices. The document is designed to provide an important component of a complete compliance package. Validation depends upon many factors and use of this protocol alone does not assure compliance. Agilent Technologies makes no promises or representations as to its sufficiency for any specific regulatory program.

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User Name: worawit.timakul
Report Generated by Hostname: 5CG0202NQ4

System Id: MY15330001
Print Date: November 28, 2023 1:10:41 PM

OQHW ICP 5100 ENvi Research Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 28, 2023 12:54:08 PM	Audit	SessionCreated	Session	None
November 28, 2023 12:54:08 PM	Start	Configuration	Session	None
November 28, 2023 12:54:08 PM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
November 28, 2023 12:54:32 PM	Audit	EqpLoaded	Session	EQP details for primary technique [Es] - File path: [ProtocolPacks/Es/Configurations/02.50/Es.02.50.eqp], EQP File Name: [Es.02.50.eqp], EQP Name: [AgilentRecommended], Protocol Revision [Es.02.50]
November 28, 2023 12:54:38 PM	End	Configuration	Session	None
November 28, 2023 12:54:41 PM	Start	Qualification	Session	OQ
November 28, 2023 12:54:41 PM	Start	Execution	Preparation : 5100 VDV: Qualitative Test - No setpoints associated	None
November 28, 2023 12:55:26 PM	End	Execution	Preparation : 5100 VDV: Qualitative Test - No setpoints associated	Run Count : 1
November 28, 2023 12:56:27 PM	Start	Execution	Instrument Tests : 5100 VDV: Qualitative Test - No setpoints associated	None
November 28, 2023 12:56:57 PM	End	Execution	Instrument Tests : 5100 VDV: Qualitative Test - No setpoints associated	Run Count : 1

Page 1 / 3

User Name: worawit.timakul System Id: MY15330001
Report Generated by Hostname: 5CG0202NQ4 Print Date: November 28, 2023 1:10:41 PM

QJHW ICP 5100 ENvi Research Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 28, 2023 12:57:03 PM	Start	Execution	Autosampler Operation : Autosampler 1 - SPS4: Qualitative Test - No setpoints associated	None
November 28, 2023 12:57:08 PM	End	Execution	Autosampler Operation : Autosampler 1 - SPS4: Qualitative Test - No setpoints associated	Run Count : 1
November 28, 2023 12:57:09 PM	End	Qualification	Session	OQ
November 28, 2023 12:57:09 PM	Start	Reporting	Session	None
November 28, 2023 1:04:49 PM	Audit	AceRestarted	Session	None
November 28, 2023 1:04:50 PM	Audit	SessionReloaded	Session	None
November 28, 2023 1:04:58 PM	Start	Qualification	Session	OQ
November 28, 2023 1:08:10 PM	Audit	Reporting	Session	Report Generated : Certificate
November 28, 2023 1:09:28 PM	Audit	Reporting	Session	Report Generated : Report

Page 2 / 3

User Name: worawit.timakul System Id: MY15330001
Report Generated by Hostname: 5CG0202NQ4 Print Date: November 28, 2023 1:10:41 PM

QJHW ICP 5100 ENvi Research Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 28, 2023 1:10:31 PM	Audit	Reporting	Session	Report Signed : Certificate PDF Name: QJHW ICP 5100 ENvi Research_20231128_Certific ate_1.pdf User Name: worawit.timakul@agilent.com Full Name of Signer: Worawit Timakul Reason for signature: Executed protocol and published this original version of document

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PinAAcle 900Z Preventive Maintenance Report

Company Name: ENVIRONMENT RESEARCH

Instrument Location: 25/114 M.6, THANON NGAMWONGWAN,
THUNGSONGHONG, LAKSI, BANGKOK, 10210

Instrument Serial No.: PZAS19031401

Date: 30-Jun-2023

PinAAcle 900Z Preventive Maintenance (PM)			
Company Name:	ENVIRONMENT RESEARCH		
Address (Instrument Location):	25/114 M.6, THANON NGAMWONGWAN, THUNGSONGHONG, LAKSI, BANGKOK		
Serial Number:	PZAS19031401	PM Number:	1/2
Customer Name (if applicable):		Telephone Number:	099-182-9241
Customer Support Engineer Name:		Service Order Number:	WO-02273780
Date PM Performed: (DD-MMM-YYYY)	30-Jun-2023	Next PM Due Date: (DD-MMM-YYYY)	30-Dec-2023
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	56-021CRY1	30-Jun-2023

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	NA
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	105	Passed

7.2 Chromium Baseline Noise

Description: Signal to noise check.

Parameter	Specification	Results	Pass/Fail
Baseline Noise	≤ 0.005 Abs.	0.0011	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	6.6	Passed
Precision	≤ 2.0 %	1.47	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	15.4	Passed
Zeeman Ratio	0.52 ± 0.04	0.52	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

=

Atomic Signal (Peak area)

Atomic Signal (Peak area) + Background Signal (Peak area)

0.1456

=

0.1456+0.1293

=

0.52

Review

The preventive maintenance checks and if applicable performance tests for PinAAcle 900Z have been completed.

This PinAAcle 900Z

Passes

☒

Fails

☐ the preventive maintenance.

Review of Preventive Maintenance:

Authorized PerkinElmer Representative:

Authorized Customer Representative:

Date:

30-Jun-2023

(DD-MMM-YYYY)

Date:

30-Jun-2023

(DD-MMM-YYYY)



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

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

TEL. 0-2717-3000-29 FAX. 0-2719-9484

Cert.No.: 24CH12

Page.: 1 of 2

Certificate of Calibration

Equipment : Salinity Meter
Manufacturer : AZ
Model : AZ8372
Serial No. : 2103263
ID No. : NO.2
Condition As-Received: Used Item
Received Date : 05 January 2024
Calibration Date : 08 January 2024
Reference : 2401-0077DN-8
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 : (65 ± 15) %
Calibration Procedure: In - house method : based on direct measurement by
using Sodium Chloride Solution

Calibrated by :

Approved by :

()
(✓)
()

Approved Signatory

Issue Date : 10 January 2024

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 Calibration and Testing Equipment Services.



Cert.No.: 24CH12

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

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

Instruments	Serial No.	ID No.	Certificate No.	Due Date
1) Thermometer	9549224	130RC003	23I435	10 Apr 2024
2) Thermo-Hygraph	1103328	130EC010	23H1361	13 June 2024

2. Reference Standard Material :

- Conductivity calibrated solution, Eutech Instruments Pte Ltd., The measurement results are traceable to SI through ThermoFisher Scientific Water and Lab Products.
- Calibrated Total Dissolved Solids solution temperature controlled by Water bath at (25 ± 0.1) °C
- The Total Dissolved Solids has been prepared dilution from

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

Material	Manufacturer	Lot No.	Exp. Date
25 ppt	Eutech	292/01	22 July 2025

Calibration results (*) Without Adjustment

Probe Serial No. : 2103263

Standard NaCl Solution	UUC* Reading	Uncertainty of Measurement (±)
2.50 ppt	2.45 ppt	0.027 ppt
2.84 ppt	2.94 ppt	0.031 ppt

Remark:

- UUC* = Unit Under Calibration
- ppt = ppt of NaCl
- ppt = Parts per Thousand

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 %.

-o0o-

A 0012709

a 1196381