



ภาคผนวก จ

เอกสารสอบเทียบเครื่องมือวิเคราะห์

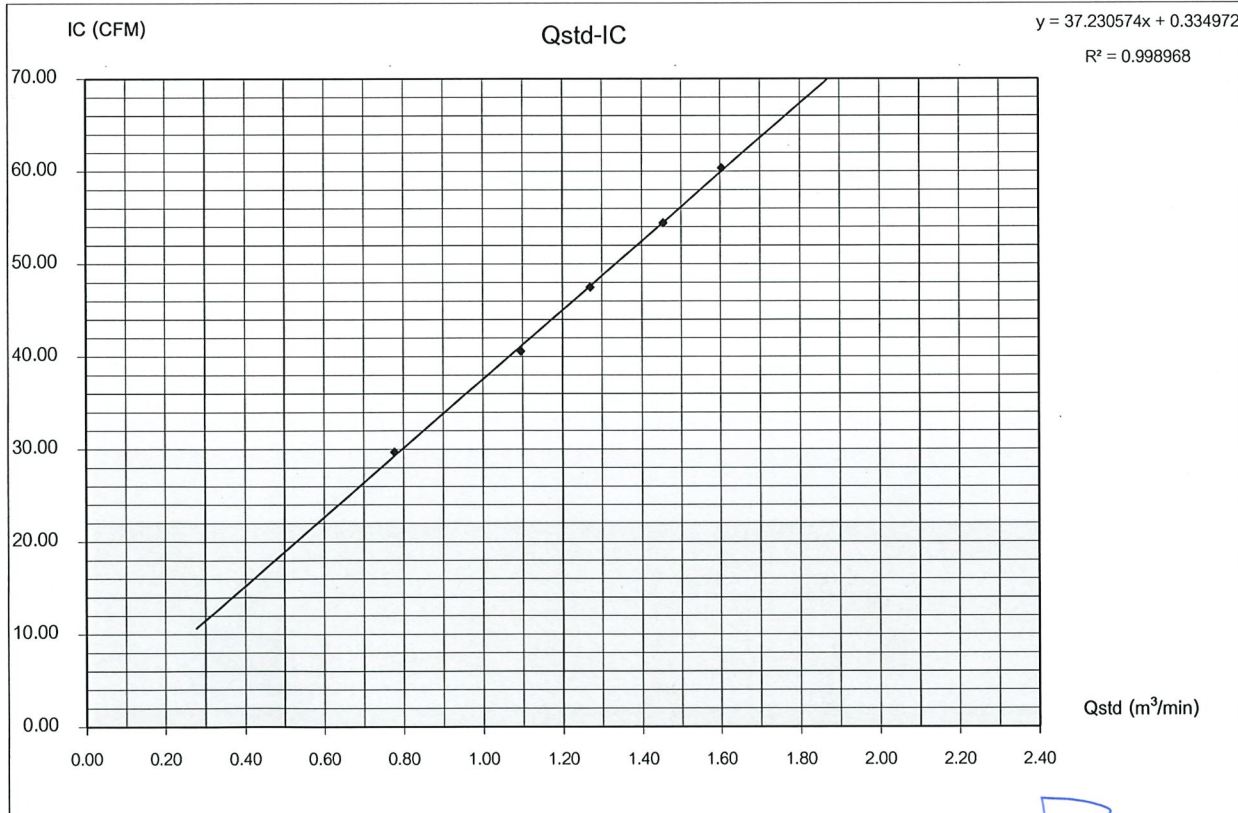
TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2022-01329, 2022-01330			Date	November 15, 2023
Sampler Location	หมู่ 13 บ้านคลองสมบุรณ์			Start Time	13:15 PM
Sampler Number	TSP No.A29	Transfer Standard Type	Orifice	Stop Time	13:25 PM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Nutapon Juisup
Motor Serial Number	2014-02	Calibrator Serial Number	2913		
Recorder Serial Number	2135				

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric	Start	Stop
	Pressure Drop Across Orifice (inH ₂ O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	Qstd = (1/m)[(A-b)] (m ³ /min)	ample Flow Rate Indicato (ft ³ /min)	IC = I[(Pa/P _{std})(T _{std} /Ta)] ^{1/2}	304.0 (°K = °C+273)	Pressure (mmHg)	Meter	Meter
	Positive	Negative	ΔH ₂ O								
5	1.3	1.3	2.6	1.59541	0.77758	30.0	29.68	304.0	759.0		
7	2.6	2.6	5.2	2.25625	1.09563	41.0	40.57	304.0	759.0		
10	3.5	3.5	7.0	2.61779	1.26963	48.0	47.49	304.0	759.0		
13	4.6	4.6	9.2	3.00109	1.45410	55.0	54.42	304.0	759.0		
18	5.6	5.6	11.2	3.31127	1.60339	61.0	60.36	304.0	759.0		
Linear Regression Y ON X : Y= mX + b							Average	304.0	759.0		
1	Slope (m)			2.07779	Linear Equation			r ²	0.998968	Pstd(mmHg)	760.0
2	Intercept (b)			-0.02023	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9994839	T _{NTP}	298.15
3	Correlation Coefficient (r)			0.99983	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.978973338	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.989430815	

COMMENT

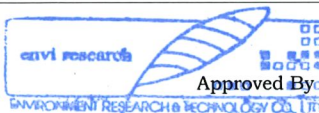
Andersen Instruments, Inc.



Checked By

(Mr. Prayun Detkla)

Technician



Approved By

(Mr. Panupon Podang)

Environmental Scientist

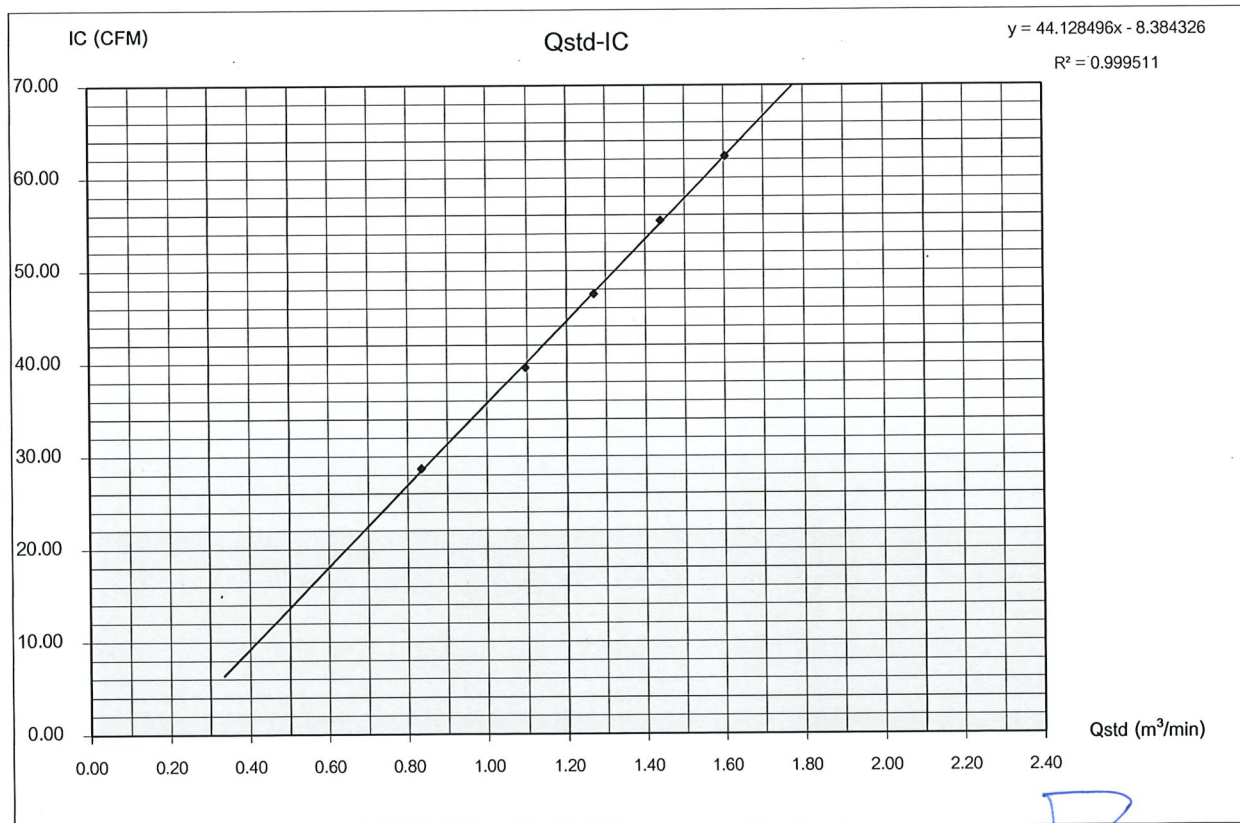
PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2022-01329, 2022-01330	Date	November 15, 2023
Sampler Location	หมู่ 13 บ้านคลองสนมบุรี	Start Time	1:27 PM
Sampler Number	PM-10.No.29	Transfer Standard Type	Orifice
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A
Motor Serial Number	2210	Calibrator Serial Number	2913
Recorder Serial Number	2614	Calibrated By	Mr. Nutapon Juisup

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH ₂ O)			[ΔH ₂ O(Pa/P _{std})(T _{std} /Ta)] ^{1/2}	Qstd = (1/m)/([A-b]) (m ³ /min)	ample Flow Rate Indicato (ft ³ /min)	IC = I/[(Pa/P _{std})(T _{std} /Ta)] ^{1/2}	(*K = °C+273)	(mmHg)		
	Positive	Negative	ΔH ₂ O								
5	1.5	1.5	3.0	1.71374	0.83453	29.0	28.69	304.0	759.0		
7	2.6	2.6	5.2	2.25625	1.09563	40.0	39.58	304.0	759.0		
10	3.5	3.5	7.0	2.61779	1.26963	48.0	47.49	304.0	759.0		
13	4.5	4.5	9.0	2.96829	1.43832	56.0	55.41	304.0	759.0		
18	5.6	5.6	11.2	3.31127	1.60339	63.0	62.33	304.0	759.0		
Linear Regression Y ON X : Y= mX + b							Average	304.0	759.0		
1	Slope (m)			2.07779	Linear Equation			r ²	0.999511	Pstd(mmHg)	760.0
2	Intercept (b)			-0.02023	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9997555	T _{NTP}	298.0
3	Correlation Coefficient (r)			0.99983	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.978973338	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.989430815	

COMMENT

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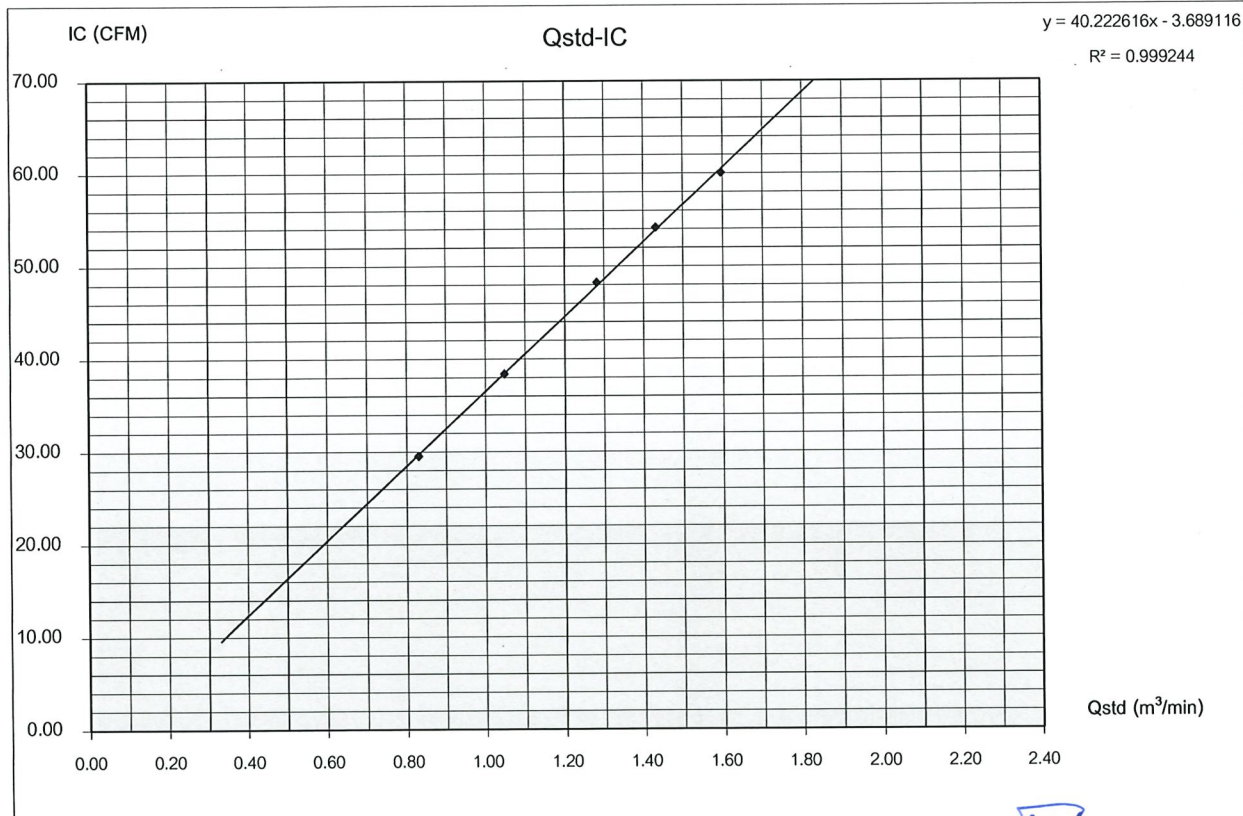
TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2022-01329, 2022-01330			Date	November 15, 2023
Sampler Location	หมู่ 9 บ้านโป่งทะโพ			Start Time	2:23 PM
Sampler Number	TSP No.A3	Transfer Standard Type	Orifice	Stop Time	2:33 PM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Nutapon Juisup
Motor Serial Number	704	Calibrator Serial Number	2913		
Recorder Serial Number	4651				

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH ₂ O)			[ΔH ₂ O(Pa/P _{std})(T _{std} /Ta)] ^{1/2}	Qstd = (1/m)[(A-b)] (m ³ /min)	ample Flow Rate Indicato (ft ³ /min)	IC = I[(Pa/P _{std})(T _{std} /Ta)] ^{1/2}	(°K = °C+273)	(mmHg)		
	Positive	Negative	ΔH ₂ O								
5	1.5	1.5	3.0	1.70529	0.83046	30.0	29.54	305.0	754.0		
7	2.4	2.4	4.8	2.15704	1.04788	39.0	38.40	305.0	754.0		
10	3.6	3.6	7.2	2.64182	1.28119	49.0	48.24	305.0	754.0		
13	4.5	4.5	9.0	2.95365	1.43127	55.0	54.15	305.0	754.0		
18	5.6	5.6	11.2	3.29493	1.59552	61.0	60.06	305.0	754.0		
Linear Regression Y ON X : Y= mX + b							Average	305.0	754.0		
1	Slope (m)			2.07779	Linear Equation			r ²	0.999244	Pstd(mmHg)	760.
2	Intercept (b)			-0.02023	Set Point Flow Rate (X) (m ³ /min)		1.133	r		T _{NTP}	298.
3	Correlation Coefficient (r)			0.99983	Final Set Flow Rate = (I)			0.1a/Pstd)*(Tstd/Ta)			0.969335634
Result								y/Pstd)*(Tstd/Ta)^0.5			0.984548442

COMMENT

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Mr. Panu
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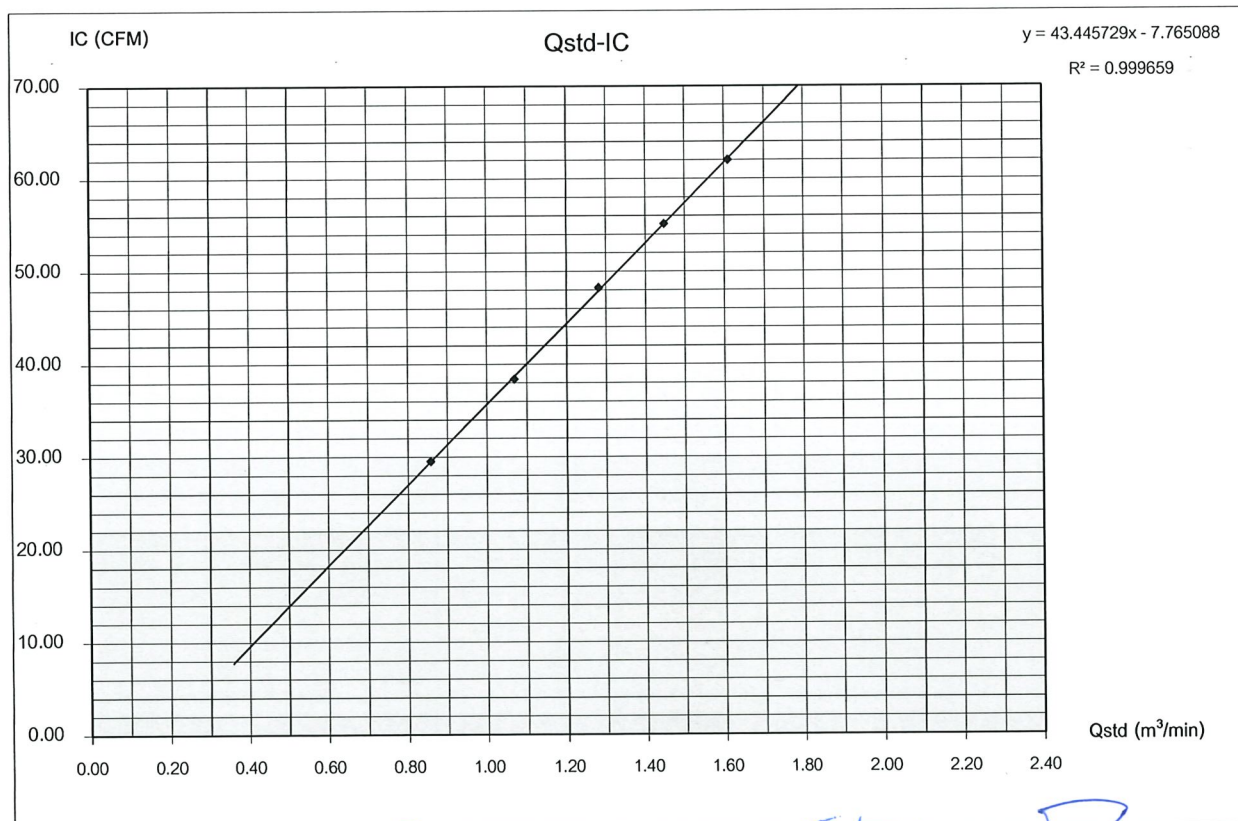
PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation		2022-01329, 2022-01330			Date	November 15, 2023
Sampler Location		หมู่ 9 บ้านโป่งกะห้อ			Start Time	2:34 PM
Sampler Number		PM-10.No18	Transfer Standard Type	Orifice	Stop Time	2:44 PM
Instrument Model		HIVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Nutapon Juisup
Motor Serial Number		2139	Calibrator Serial Number	2913		
Recorder Serial Number		2390				

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH ₂ O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$	sample Flow Rate Indicator	$IC = I[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$				
	Positive	Negative	ΔH ₂ O		(m ³ /min)	(ft ³ /min)		(°K = °C+273)	(mmHg)		
5	1.6	1.6	3.2	1.76121	0.85737	30.0	29.54	305.0	754.0		
7	2.5	2.5	5.0	2.20152	1.06928	39.0	38.40	305.0	754.0		
10	3.6	3.6	7.2	2.64182	1.28119	49.0	48.24	305.0	754.0		
13	4.6	4.6	9.2	2.98628	1.44698	56.0	55.13	305.0	754.0		
18	5.7	5.7	11.4	3.32422	1.60962	63.0	62.03	305.0	754.0		
Linear Regression Y ON X : Y= mX + b							Average	305.0	754.0		
1	Slope (m)			2.07779	Linear Equation			r ²	0.999659	Pstd(mmHg)	760
2	Intercept (b)			-0.02023	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9998295	T _{NTP}	298
3	Correlation Coefficient (r)			0.99983	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)			0.969335634
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5			0.984548442

COMMENT

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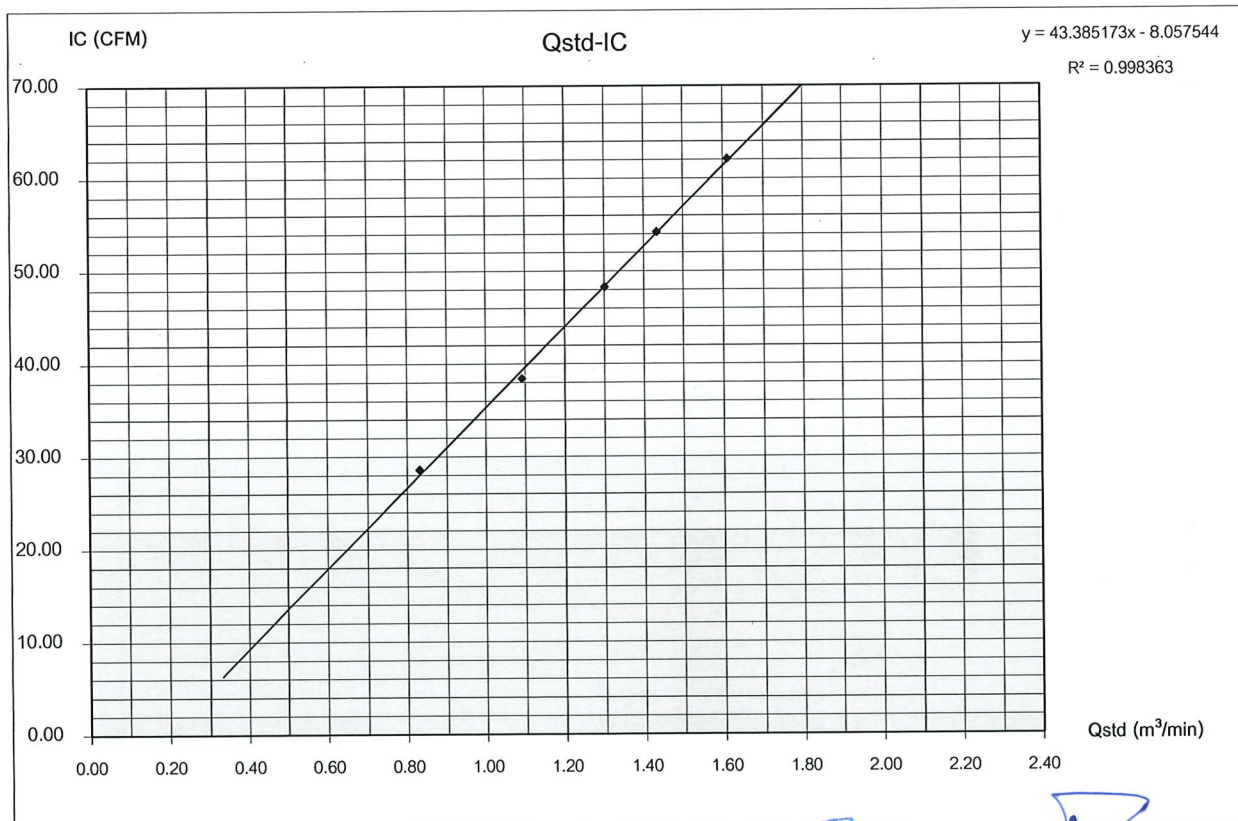
PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2022-01329, 2022-01330	Date	November 15, 2023
Sampler Location	หมู่ 12 บ้านโคกอุดมดี	Start Time	2:00 PM
Sampler Number	PM-10.No.31	Transfer Standard Type	Orifice
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A
Motor Serial Number	407-492	Calibrator Serial Number	2913
Recorder Serial Number	507-008	Calibrated By	Mr. Nutapon Juisup

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter	
	Pressure Drop Across Orifice (inH ₂ O)			[ΔH ₂ O(Pa/P _{std})(T _{std} /Ta)] ^{1/2}	Qstd = (1/m)[(A-b)] (m ³ /min)	Sample Flow Rate Indication (ft ³ /min)	IC = I/[(Pa/P _{std})(T _{std} /Ta)] ^{1/2}	(*K = °C+273)	(mmHg)			
	Positive	Negative	ΔH ₂ O									
5	1.5	1.5	3.0	1.70755	0.83155	29.0	28.59	305.0	756.0			
7	2.6	2.6	5.2	2.24809	1.09170	39.0	38.45	305.0	756.0			
10	3.7	3.7	7.4	2.68181	1.30044	49.0	48.31	305.0	756.0			
13	4.5	4.5	9.0	2.95756	1.43315	55.0	54.22	305.0	756.0			
18	5.7	5.7	11.4	3.32862	1.61174	63.0	62.11	305.0	756.0			
Linear Regression Y ON X : Y= mX + b							Average	305.0	756.0			
1	Slope (m)			2.07779	Linear Equation			r ²	0.998363	Pstd(mmHg)	760.0	
2	Intercept (b)			-0.02023	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9991812	T _{NTP}	298.0	
3	Correlation Coefficient (r)			0.99983	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.971906816		
Result									C=-(Pa/Pstd)*(Tstd/Ta)^0.5		0.985853344	

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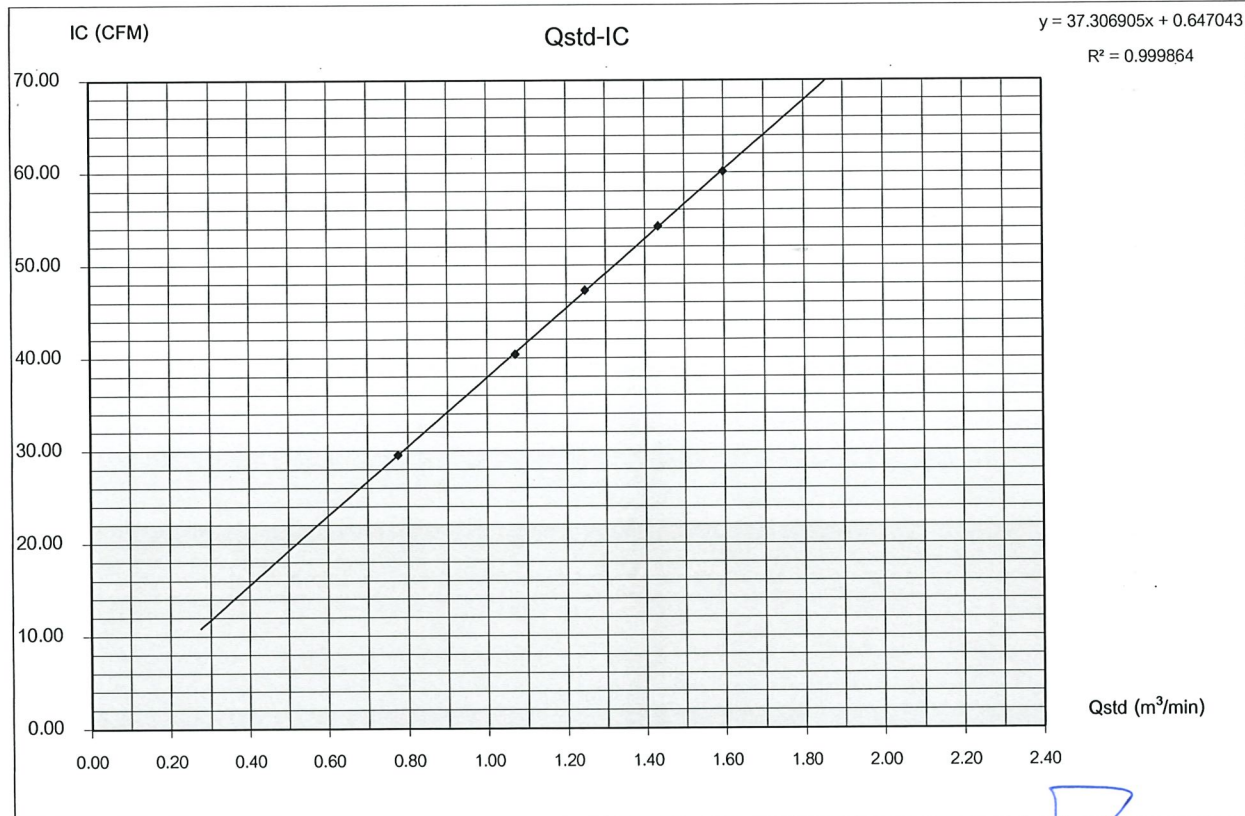
TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2022-01329, 2022-01330			Date	November 15, 2023
Sampler Location	หมู่ 12 บ้านโคกอุดมดี			Start Time	1:50 PM
Sampler Number	TSP No.A25	Transfer Standard Type	Orifice	Stop Time	2:00 PM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Nutapon Juisup
Motor Serial Number	2512	Calibrator Serial Number	2913		
Recorder Serial Number	2390				

Plate No.	(Delta H) Pressure Drop Across Orifice (inH ₂ O)			(A) [ΔH ₂ O(Pa/P _{std})(T _{std} /Ta)] ^{1/2}	(X) Qstd = (1/m)[(A-b)] (m ³ /min)	(I) Sample Flow Rate Indicator (ft ³ /min)	(Y) IC = I[(Pa/P _{std})(T _{std} /Ta)] ^{1/2}	Temperature (°K = °C+273)	Barometric Pressure (mmHg)	Start Meter	Stop Meter	
	Positive	Negative	ΔH ₂ O									
5	1.3	1.3	2.6	1.58964	0.77480	30.0	29.58	305.0	756.0	—		
7	2.5	2.5	5.0	2.20444	1.07069	41.0	40.42	305.0	756.0	—		
10	3.4	3.4	6.8	2.57079	1.24701	48.0	47.32	305.0	756.0	—		
13	4.5	4.5	9.0	2.95756	1.43315	55.0	54.22	305.0	756.0	—		
18	5.6	5.6	11.2	3.29930	1.59762	61.0	60.14	305.0	756.0	—		
Linear Regression Y ON X : Y= mX + b							Average	305.0	756.0	—		
1	Slope (m)			2.07779	Linear Equation			r ²	0.999864	Pstd(mmHg)	760.0	
2	Intercept (b)			-0.02023	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.999932	T _{NTP}	298.15	
3	Correlation Coefficient (r)			0.99983	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.971906816		
Result									C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.985853344	

COMMENT

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Environmental Scientist

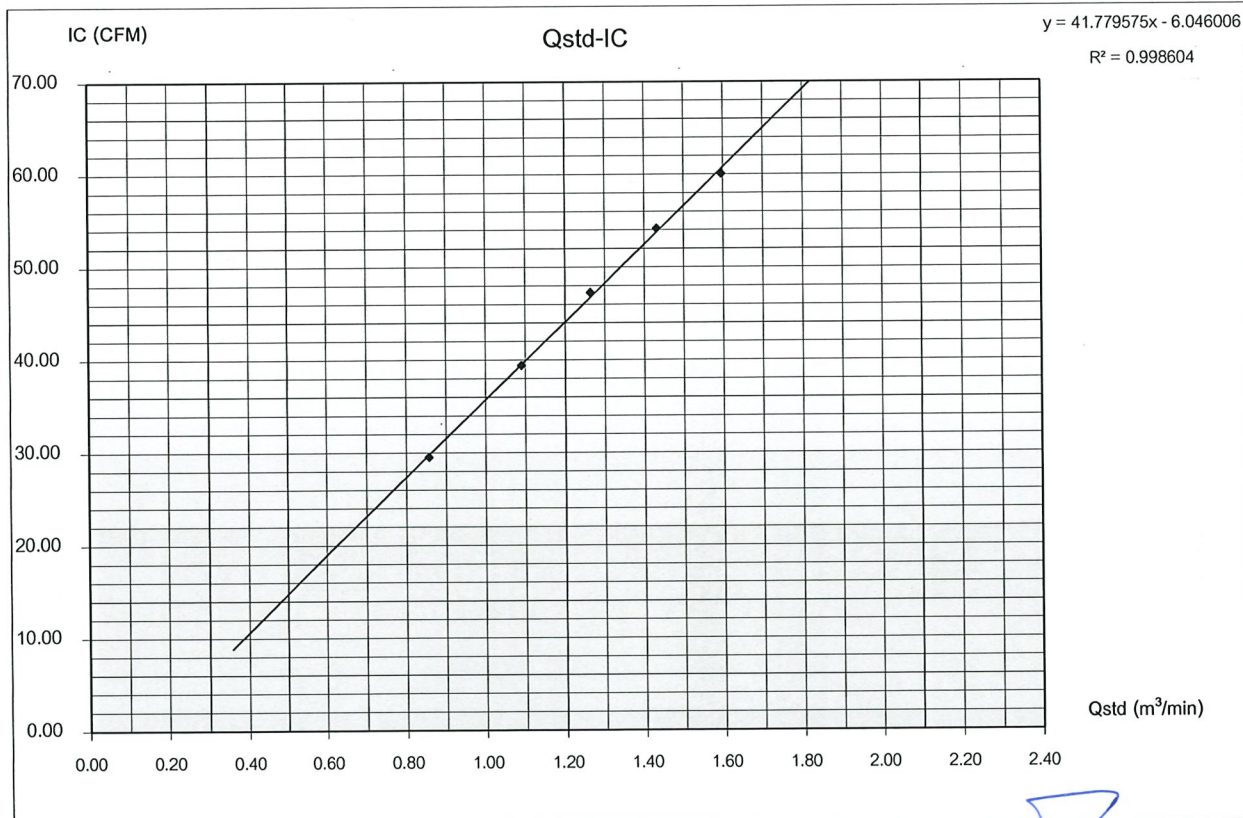
TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2022-01329, 2022-01330			Date	November 15, 2023
Sampler Location	วัดใหม่ประชาชื่น			Start Time	2:50 PM
Sampler Number	TSP No.A31	Transfer Standard Type	Orifice	Stop Time	3:00 PM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Nutapon Juisup
Motor Serial Number	57-507	Calibrator Serial Number	2913		
Recorder Serial Number	507-012				

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric	Start	Stop
	Pressure Drop Across Orifice (inH ₂ O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$	ample Flow Rate Indication	$IC = I[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$		Pressure	Meter	Meter
	Positive	Negative	ΔH ₂ O		(m ³ /min)	(ft ³ /min)		(°K = °C+273)	(mmHg)		
5	1.6	1.6	3.2	1.76121	0.85737	30.0	29.54	305.0	754.0		
7	2.6	2.6	5.2	2.24512	1.09027	40.0	39.38	305.0	754.0		
10	3.5	3.5	7.0	2.60487	1.26341	48.0	47.26	305.0	754.0		
13	4.5	4.5	9.0	2.95365	1.43127	55.0	54.15	305.0	754.0		
18	5.6	5.6	11.2	3.29493	1.59552	61.0	60.06	305.0	754.0		
Linear Regression Y ON X : Y= mX + b							Average	305.0	754.0		
1	Slope (m)			2.07779	Linear Equation			r ²	0.998604	Pstd(mmHg)	760.0
2	Intercept (b)			-0.02023	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9993018	T _{NTP}	298.0
3	Correlation Coefficient (r)			0.99983	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.969335634	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.984548442	

COMMENT

Andersen Instruments, Inc.



Checked By

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Technician



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Environmental Scientist

PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

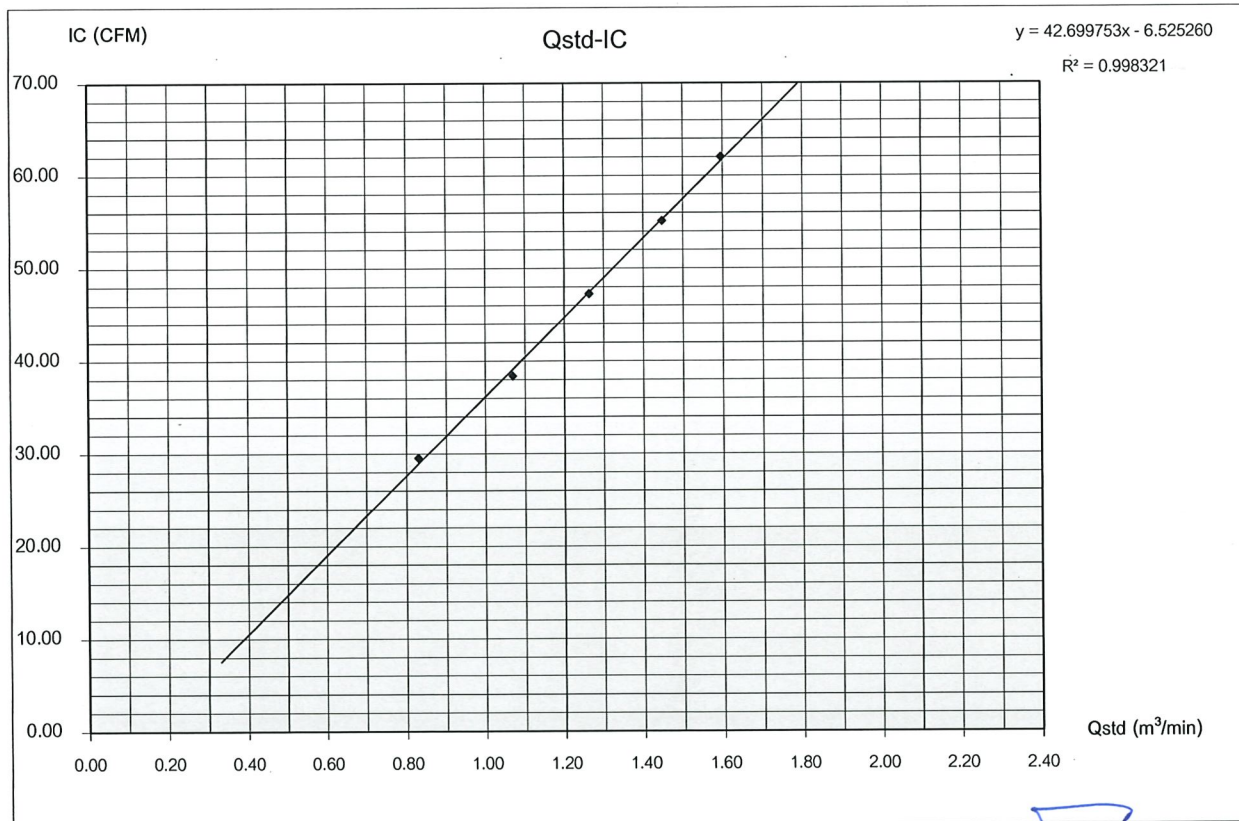
Quotation	2022-01329, 2022-01330			Date	November 15, 2023
Sampler Location	วัดใหม่ประจวบ			Start Time	3:00 PM
Sampler Number	PM-10.No12	Transfer Standard Type	Orifice	Stop Time	3:10 PM
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Nutapon Juisup
Motor Serial Number	B2012-10	Calibrator Serial Number	2913		
Recorder Serial Number	4650				

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Positive	Negative	ΔH_2O	$[\Delta H_2O(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ (m ³ /min)	ample Flow Rate Indication (ft ³ /min)	$IC = [[(Pa/P_{std})(T_{std}/T_a)]^{1/2}]$	(°K = °C+273)	(mmHg)		
5	1.5	1.5	3.0	1.70529	0.83046	30.0	29.54	305.0	754.0		
7	2.5	2.5	5.0	2.20152	1.06928	39.0	38.40	305.0	754.0		
10	3.5	3.5	7.0	2.60487	1.26341	48.0	47.26	305.0	754.0		
13	4.6	4.6	9.2	2.98628	1.44698	56.0	55.13	305.0	754.0		
18	5.6	5.6	11.2	3.29493	1.59552	63.0	62.03	305.0	754.0		
Linear Regression Y ON X : Y= mX + b							Average	305.0	754.0		

Linear Regression Y ON X: Y= mX + b					Average	305.0	754.0		
1	Slope (m)	2.07779	Linear Equation		r^2	0.998321	Pstd(mmHg)	760.0	
2	Intercept (b)	-0.02023	Set Point Flow Rate (X) (m ³ /min)	1.133	r	0.9991601	T _{NTP}	298.0	
3	Correlation Coefficient (r)	0.99983	Final Set Flow Rate = (I)	0	(Pa/Pstd)*(Tstd/Ta)	0.969335634			
Result					C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.984548442		

COMMENT

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(Mr. Panupon Podang)
Environmental Scientist

CERTIFICATE OF CALIBRATION

Certificate No. : COF-013-66

Page 1 of 2 Pages

MEASUREMENT ITEM : Top Load Orifice
MANUFACTURER : TISCH
MODEL/TYPE : TE-S025A
SERIAL NUMBER : 2913
ID NUMBER : -
CONDITION AS-RECEIVED : Used item
CUSTOMER : Environment Research & Technology Co., Ltd.
25/114 Moo 6 Soi Chinaket 1, Ngamwongwan Road,
Toongsonghong, Lakki, Bangkok 10210

RECEIVED DATE : 08 Sep 2023
MEASUREMENT DATE : 11 Sep 2023
ISSUE DATE : 13 Sep 2023

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'

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 24.5 °C and 47.7 %RH.

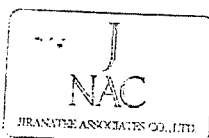
NOTED: The certificate is valid only to the item calibrated on date and place of calibration.

TABULATION OF RESULTS:

The table on next page give the measured values.

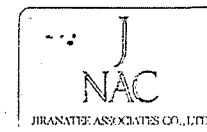
Calibrated by:

- ☒ Mr. Sorawit Thachalad
☐ Miss Jittrarn Lertsomphol



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager



MEASUREMENT RESULTS:

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

Table 1: The results of Q Standard calibration data

Plate	Flow rate m^3/min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Δp_{meter} mmHg	$\Delta p_{\text{Orifice}}$ inH ₂ O	γ	Standard Flow [Q_s] m^3/min
1	0.707	753.911	24.39	23.31	54.094	1.809	1.341	0.655
2	1.005	753.864	24.49	24.02	58.538	3.610	1.894	0.923
3	1.117	753.809	24.30	24.05	40.197	4.715	2.165	1.052
4	1.174	753.829	24.25	23.95	30.361	5.366	2.310	1.121
5	1.417	753.823	24.35	24.06	30.498	7.837	2.791	1.353

Slope (m): 2.07779
Intercept (b): -0.02023
Correlation coefficient (r): 0.99983
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	0.707	753.911	24.39	23.31	54.094	1.809	0.845	0.659
2	1.005	753.864	24.49	24.02	58.538	3.610	1.194	0.928
3	1.117	753.809	24.30	24.05	40.197	4.715	1.364	1.058
4	1.174	753.829	24.25	23.95	30.361	5.366	1.455	1.128
5	1.417	753.823	24.35	24.06	30.498	7.837	1.759	1.361

Slope (m): 1.30141
Intercept (b): -0.01275
Correlation coefficient (r): 0.99983
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
+66 2723 0382
MT-TH.ServiceSupport@mt.com



Accuracy Calibration Certificate

Customer

Company: Environment Research & Technology Co., Ltd.
Address: 25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Rd., Toongsonghong
City: Lakso Contact: Ramita Taengthai
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

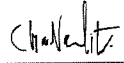
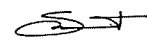
Range	Max. Capacity	Readability (d)
1	220 g	0.0001 g

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: 23.6 °C	End: 23.5 °C	Start: 34.6 %	End: 35.1 %
As Left	Start: 23.6 °C	End: 23.5 °C	Start: 35.0 %	End: 35.7 %

As Found Calibration Date: 17-Jan-2023 Calibrator: 
As Left Calibration Date: 17-Jan-2023 Chawalit Martsuloke
Issue Date: 19-Jan-2023
Approved Signatory: 
Technical Manager / Head of Calibration Center

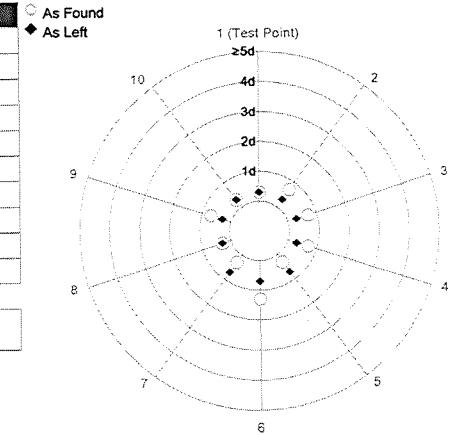
Measurement Results

Repeatability

Test Load: 100 g

	As Found	As Left
1	99.9992 g	100.0001 g
2	99.9991 g	100.0001 g
3	99.9991 g	100.0001 g
4	99.9991 g	100.0001 g
5	99.9992 g	100.0002 g
6	99.9993 g	100.0002 g
7	99.9992 g	100.0002 g
8	99.9992 g	100.0001 g
9	99.9991 g	100.0001 g
10	99.9992 g	100.0001 g

Standard Deviation	0.00007 g	0.00005 g
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The "d" in the graph represents the readability of the range/interval in which the test was performed.

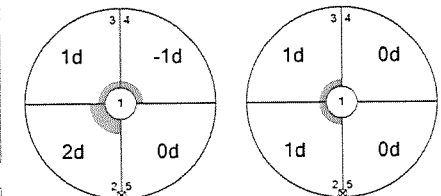
The results of this graph are based upon the absolute values of the differences from the mean value.

Eccentricity

Test Load: 100 g

Position	As Found	As Left
1	99.9991 g	100.0001 g
2	99.9993 g	100.0002 g
3	99.9992 g	100.0002 g
4	99.9990 g	100.0001 g
5	99.9991 g	100.0001 g

Maximum Deviation	0.0002 g	0.0001 g
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As Found

As Left

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

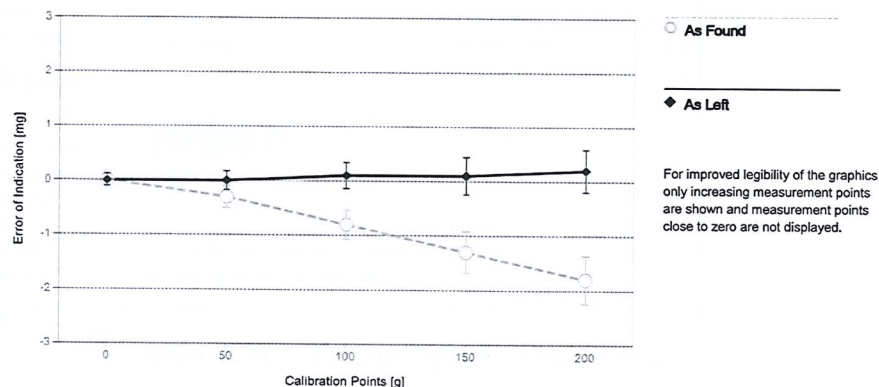
Error of Indication

As Found

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.0000 g	0.15 mg	2
2	0.0500 g	0.0500 g	0.0000 g	0.16 mg	2
3	0.1000 g	0.0999 g	-0.0001 g	0.16 mg	2
4	0.5000 g	0.4999 g	-0.0001 g	0.16 mg	2
5	1.0000 g	1.0000 g	0.0000 g	0.16 mg	2
6	5.0000 g	5.0001 g	0.0001 g	0.16 mg	2
7	10.0000 g	10.0001 g	0.0001 g	0.17 mg	2
8	50.0000 g	49.9997 g	-0.0003 g	0.20 mg	2
9	100.0000 g	99.9992 g	-0.0008 g	0.27 mg	2
10	150.0000 g	149.9987 g	-0.0013 g	0.38 mg	2
11	200.0000 g	199.9982 g	-0.0018 g	0.44 mg	2

As Left

	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	5.0001 g	0.0001 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	100.0000 g	100.0001 g	0.0001 g	0.24 mg	2
10	150.0000 g	150.0001 g	0.0001 g	0.34 mg	2
11	200.0000 g	200.0002 g	0.0002 g	0.39 mg	2



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

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

Test Equipment

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

Weight Set 1: OIML E2

Weight Set No.:	WS57	Date of Issue:	06-Jan-2022
Certificate Number:	177037	Calibration Due Date:	03-Jul-2023

Thermo Hygrometer

Equipment No.:	IN255	Date of Issue:	20-Jul-2022
Certificate Number:	22H1503	Calibration Due Date:	04-Jul-2023

Remarks

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

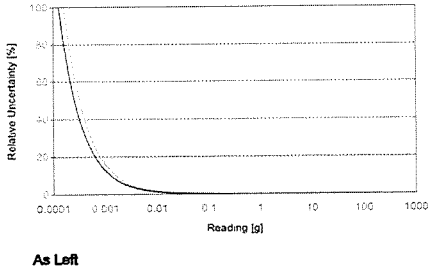
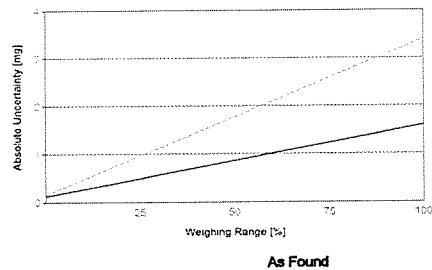
Linearization of Uncertainty Equation

Range			As Found	As Left
	d	Max		
1	0.0001 g	220 g	$U_1 = 0.16 \text{ mg} + 0.0147 \text{ mg/g} \cdot R$	$U_1 = 0.13 \text{ mg} + 0.00671 \text{ mg/g} \cdot R$

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	0.16 mg	0.73%	0.13 mg	0.59%
0.2200 g	0.16 mg	0.074%	0.13 mg	0.060%
2.2000 g	0.19 mg	0.0087%	0.14 mg	0.0066%
22.0000 g	0.48 mg	0.0022%	0.28 mg	0.0013%
220.0000 g	3.4 mg	0.0015%	1.6 mg	0.00073%



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

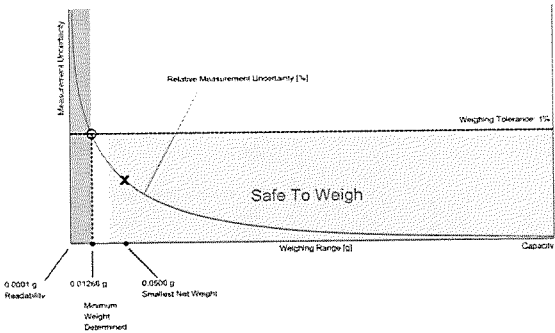
Process Requirements

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%	0.16012 g	0.32511 g	0.49518 g	0.85155 g	1.85026 g
0.2%	0.07947 g	0.16012 g	0.24199 g	0.40949 g	0.85155 g
0.5%	0.03165 g	0.06348 g	0.09550 g	0.16012 g	0.32511 g
1%	0.01580 g	0.03165 g	0.04754 g	0.07947 g	0.16012 g
2%	0.00789 g	0.01580 g	0.02372 g	0.03959 g	0.07947 g
5%	0.00316 g	0.00631 g	0.00947 g	0.01580 g	0.03165 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%	0.12735 g	0.25642 g	0.38726 g	0.65440 g	1.35584 g
0.2%	0.06346 g	0.12735 g	0.19166 g	0.32162 g	0.65440 g
0.5%	0.02533 g	0.05073 g	0.07620 g	0.12735 g	0.25642 g
1%	0.01266 g	0.02533 g	0.03802 g	0.06346 g	0.12735 g
2%	0.00633 g	0.01266 g	0.01899 g	0.03168 g	0.06346 g
5%	0.00253 g	0.00506 g	0.00759 g	0.01266 g	0.02533 g

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

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

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

Notes on minimum weight values in above table:

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

Measurement Results

Results Summary

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

✓ = Passed

✗ = Failed

⚠ = Safety Factor not met

Repeatability

Test Load: 100 g

Tolerance	Control Limit	As Found		As Left	
		Std. Deviation	Result	Std. Deviation	Result
0.1%	N/A	0.00007 g*	N/A	0.00005 g*	N/A
0.2%	0.00005 g		✗		⚠
0.5%	0.00013 g		✓		✓
1%	0.00025 g		✓		✓
2%	0.00050 g		✓		✓
5%	0.00125 g		✓		✓

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

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

Eccentricity

Test Load: 100 g

Tolerance	Control Limit	As Found		As Left	
		Deviation	Result	Deviation	Result
0.1%	0.0500 g	0.0002 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	-0.0003 g	0.0250 g	0.0500 g	0.1250 g	0.2500 g	0.5000 g	1.2500 g
100.0000 g	-0.0008 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0000 g	-0.0013 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
200.0000 g	-0.0018 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
100.0000 g	0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0000 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.

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. 285/23

Page : 1 of 3

Object : Weather Station

Manufacturer : Davis Instruments Inc.

Type : Weather Wizard III

Serial No. : WC50824A13 ID No. : No.32

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 1008.7 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

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

: Thermoschneider No.918802

Calibrated by : Watcharapol Signed :

Mr. Watcharapol Subwat

Mr. Pisod Promsut

Mechanical Engineer



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 285/23

11 August, 2023

Page : 2 of 3

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H2O	Vacuum inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.9	0.10
3.02	-	-	-	3.0	0.02
5.00	-	-	-	4.9	0.10
7.04	-	-	-	7.0	0.04
9.02	-	-	-	8.9	0.12
11.01	-	-	-	11.0	0.01
13.01	-	-	-	12.9	0.11
15.01	-	-	-	14.8	0.21
17.02	-	-	-	17.0	0.02
20.02	-	-	-	19.8	0.22

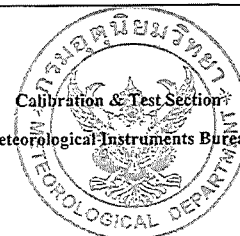
Wind Aloft Plotting Board.	
U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated by :

Watcharapol

Mr. Watcharapol Subwat

Mechanical Engineer





THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 0-2396-0156,0-2399-0469

The Result of Calibration

Certification No. 285/23

11 August, 2023

Page : 3 of 3

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
50.4	50.5	-0.1
30.2	30.2	0.0
15.4	15.5	-0.1

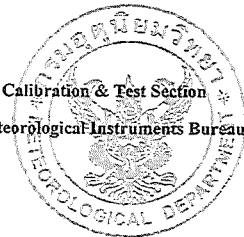
Checked by :

Watcharapol

Mr. Watcharapol Subwat

Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau





THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0003

MTC No. EEL. BP. 22/1066

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 :

Ambient Environment

Description : Sound Calibrator

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

Manufacturer : BSWA TECH

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

Model : CA114

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

Serial No. : 590048

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 2889871.

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

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

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

Date of Receipt : 3 Oct. 2023

Date of Calibration : 5 Oct. 2023

1 / 2 /
W

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

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

FM.BLMTC.002 Rev.4

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

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


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

Sound Level Meter Calibration Report

Support Equipment Type	:	Sound Level Calibrator
Manufacture	:	BSWA Technology
Model	:	CA111
Serial No.	:	590331
Range of Calibrator		
- Support Equipment Type	:	94.0
- Frequency	:	1,000 Hz.
Calibrated By	:	Mr.Sittiporn Wongkham
Calibration Date	:	November 15, 2023
Customer Name	:	บริษัท ไทยนิวเทค จำกัด

บริษัท โฟร์ไทร์ คอนสตรัคชั่น จำกัด : โครงการ โรงงานผลิตเหล็กแห่งและ
ผลิตคานเหล็กที่ผลิตจากเหล็กถลุง ของบริษัท หงซิง สตีล (ไทยแลนด์) จำกัด

[illegible]

Checked By 
.....
Mr. Prayun Detkha
Technician

Sd/-
Approved By _____
Ms.Sutatip Im-noi
Environmental Scientist

ENVIRONMENTAL RESEARCH

GRV1 RESULTS



Calibration Chart

BSWA-IV-C021-03-0048A

Sound Calibrator model CA111
Serial Number 590331
Appearance OK
Power Supply 1.5V LR6 (AA battery) x2
Sound Pressure Level 14.04 / 114.05 dB
Frequency 999.9 / 999.9 Hz
THD (@1000Hz) 0.71 / 1.33 %

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BSWA Technology Ltd.

www.bswa-tech.com

This equipment was calibrated at the following ambient conditions:

Temperature: 20 °C
Humidity: 40 %RH
Pressure: 102.5 hPa

This equipment is qualified!

C-2
Calibrated

2023-3-7

Date



Certificate of Calibration - Supplemental

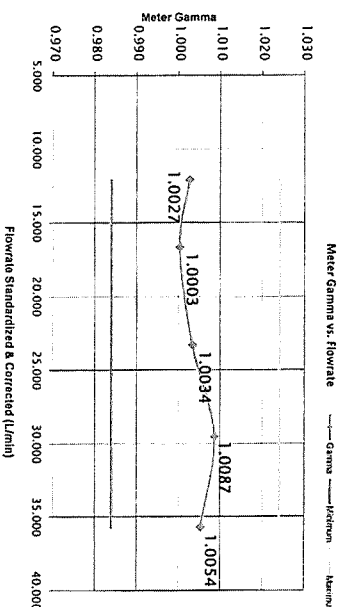
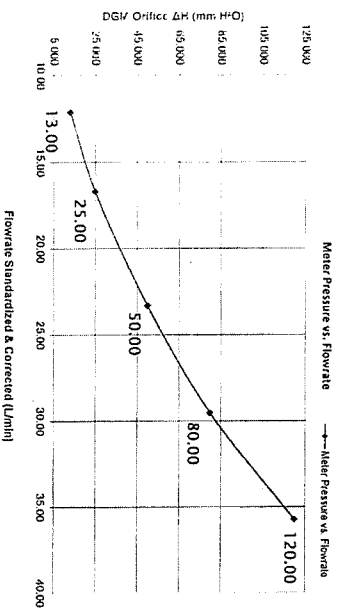
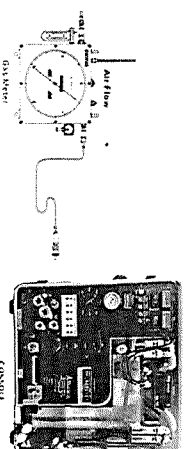
Nomenclature

- P_{atm} - Barometric Pressure
- P_{std} - Dry Gas Meter
- K_1 - Constant based on standard temp and press
- t - Run time in minutes
- P - M (Meter Pressure, gauge)
- V - Volume collected by test meter, corrected for STP
- Q_{std} - Calculated flow rate of test meter
- C - Critical orifice coefficient
- P_{ref} - Measured pressure of reference meter
- T - Temperature measured in reference meter

Equations

$$V_{std} = V * K_1 * \frac{P_{ref} * (P_{atm} + \frac{P_{std}}{13.6})}{T_{ref}}$$
$$V_{std} = \frac{K_1 * P_{ref} * (P_{atm} + \frac{P_{std}}{13.6})}{T_{ref}}$$
$$K_1 = \frac{T_{ref}}{P_{std}}$$
$$Y = \frac{V_{std}}{V_{ref}}$$
$$Q_{std} = \frac{V_{std}}{t}$$
$$MTC \Delta H = \frac{P_{ref} * (1000) * (D_{std} + \frac{P_{std}}{13.6})}{T_{ref}} * (T_{ref} + \frac{P_{std}}{13.6})^2$$

Calibration Train



Certificate of Calibration

Method 5 Pre-Test Calibration - Liters (L)

UUT Meter Console Information

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

Calibration Conditions

Bar. Pressure (mm Hg): 756.3
Ambient Temperature (°C): 24.3
Relative Humidity (%): 74.3
Altitude (m): 1.83
Bar. Pressure Corr. (mm Hg): 758.2

Factors/Conversions

Sid. Temp. (K): 293.15
Sid. Press. (mm Hg): 760
 K_1 (K/(mm Hg)): 0.3857

Reference Equipment

Calibration Meter Model: DGM-200H
Cal. Due Date: 03-Jun-23
Serial No.: 00000206
Gamma: 1.0000

UUT Meter (DGM)

Run Time (min)	Office ΔH (mm H2O)	Volume			Meter Temperature (°C)		Meter Pressure (mm Hg)	Volume (L)				Outlet Temperature (°C)	
		Initial (L)	Final (L)	Total (L)	Initial	Final		Initial	Final	Total	V_{std}	Initial	Final
0	P_{ref}	V_{ref}			T_{ref}		P_{ref}						
040.00	13.00	349453.8	349628.0	172.2	24.0	24.0	0.3	0.00	172.75	172.75	24.0	24.0	24.0
630.00	25.00	349626.0	349804.0	178.0	24.0	25.0	0.5	0.00	177.97	177.97	24.0	24.0	24.0
450.00	50.00	349804.0	349981.2	177.2	25.0	26.0	0.6	0.00	177.50	177.50	24.0	24.0	24.0
360.00	80.00	349981.2	350159.6	178.4	26.0	26.0	2.0	0.00	179.25	179.25	24.0	24.0	24.0
300.00	120.00	350159.6	350339.6	180.0	26.0	27.0	2.4	0.00	180.48	180.48	24.0	24.0	24.0

Reference Meter (WTM)

Reference Meter (L)	UUT Meter (L)	Correction Factor		ΔH @ (mm H2O)	Variance
		Value	Variance		
V_{std}	V_{ref}	ΔY	$\Delta H @$	$\Delta H @$	
170.14	169.68	12.2	-0.0014	39.2	-1.513
175.36	175.31	16.7	-0.0038	39.9	-0.780
174.94	174.36	23.3	-0.0034	40.9	0.212
177.28	175.75	29.5	-0.0087	41.1	0.428
178.67	177.71	35.7	-0.0054	42.4	1.653
			1.0041	40.7	
					Metric

Standardized Data

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ± 0.02.
Note: For ΔH, office pressure adjustment not applied to 0.072 mm at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 0.002 mm (5 mm) H₂O.

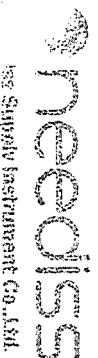
Pass/Fail Judgment: **Pass**

Calibrate By: *[Signature]*

Approved By: *[Signature]*

Date: 23 Sep 22

The statements listed and described on this certificate have been calibrated against standards traceable to the National Institute of Standards and Technology (NIST) and in reference to EPA Method 5, Section 11.3.1.



neediss Supply Instrument Co., Ltd.



Certificate of Calibration

Method 5 Console Sensor Calibration - Metric Units

Console Information

Model #: 572
Serial #: 0306016
Units: Metric

Calibration Conditions

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

Reference Devices

TC Calibrator Model: CC-VTR-SH
Reference #: 091109269
Barometer Model: 736930
Reference #: EBARODIALSPE01
Pressure Model: 718 30G
Reference #: 9543013

Temperature Display Calibration Data

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

Overall Audit Status

NIST Reference Thermocouple ID:

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

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

Calibrate By:

[Signature]

Approved By:

[Signature]

Date: 23 Sep 22

Notes

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

² For valid test results, the maximum difference between temperature and reference readings should be less than ± 5.4 °F (± 3 °C), for all thermocouples except for the stack thermocouple which should be less than $\pm 1.5\%$ absolute temperature from the reference reading and the exit thermocouple which should be less than ± 2 °F (± 1 °C) from the reference reading (EPA Method 2, Section 5.3 and EPA Method 5, Sections 6.1.1, 7-8, 1.1.8).

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

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

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

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

⁷ For valid test results, the maximum difference between console and reference vacuum readings should be less than ± 0.35 in. Hg (± 8.75 mm Hg) or 5% of full scale.



Neediss Supply Instrument Co., Ltd.



Console Sensor Calibration Data Sheet

Console Information

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

Calibration Conditions

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

Reference Devices

TC Simulator Model: CC-VTR-SH
Reference #: 091109269
Barometer Model: 736930
Reference #: EBARODIALSPE01
Digital Pressure Calibrator Model: 718 30G
Reference #: 3891001

Pressure Gauge / Manometer Calibration Data

Console Vacuum Calibration			
Reference Point	Reference Vacuum	Console Vacuum	Reference Point Status ⁵
#	in. Hg	in. Hg	Pass/Fail
1	-5.0	-5.5	PASS
2	-10.0	-10.5	PASS
3	-20.0	-20.5	PASS

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

ΔH Overall Audit Status

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

ΔP Overall Audit Status

Calibrate By:

[Signature]

Approved By:

[Signature]

Date: 23 Sep 22

Notes

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

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

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

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

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

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

⁷ For valid test results, the maximum difference between console and reference vacuum readings should be less than ± 0.35 in. Hg (± 8.75 mm Hg) or 5% of full scale.

⁸ Certify that the 3000 Thermocouple Sensors were calibrated in accordance with US EPA Methods 2 and 5, DFR 40 Part 40.



Neediss Supply Instrument Co., Ltd.



Console Sensor Audit QA Sheet

Meter Console Information (UUT)

Model #: 572
Serial #: 0306016
Units: Metric

Calibration Conditions

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

Reference Devices

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

Audit Data

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

Console Vacuum Audit

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

Calibrate By: P. Thompson

Approved By: M

Date: 23 Sep 22

Notes

¹For valid test results, the maximum difference between test and reference readings should be less than 5.4 °F (3 °C), for all thermocouples except for the stack thermocouple which should be less than 1.5% absolute temperature from the reference reading and the test thermocouple which should be less than 2°F (1 °C) from the reference reading (EPA Method 2, Section 6.3 and EPA Method 5, Sections 6.1.1-6.1.1.8)

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

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


I certify that the above Thermocouple, Barometric, and Vacuum Sensors were calibrated and audited in accordance with US EPA Methods, CFR 40 Part 50

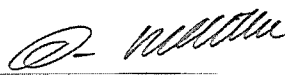


Neediss Supply Instrument Co., Ltd.

Instrument description : Flue gas Analyzer
Instrument model : Testo 350 New
Instrument serial no. : 62227989
ID no. or control no. : -
Manufacturer : Testo SE & Co. KGaA
Probe description : -
Probe model : -
Probe serial : -
Customer name : Environment Research & Technology Co., Ltd.
Customer address : 25/114 Moo 6, Soi Chinnakhet 1, Ngamwongwan Rd., Toongsonghong, Laksi, Bangkok 10210 Thailand
Total pages of certificate : 2 Pages
Receiving no. : L-230212
Receiving date. : 26-Jan-23
Parameter of calibration : Gas Calibration(Oxygen 2.498,10.04,21.02 %vol, Carbon Monoxide 80.14,309.9,1003 ppm, Nitrogen Dioxide 80.96 ppm, Nitric Oxide 150.9 ppm, Sulphur Dioxide 100.8 ppm)
Condition of UUC. : Used
Ambient condition : All of the Measurment ware caried out the stabilized labotary
Temperature : 23 ± 5 °C
Humidity : 55 ± 15 %RH
Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210
Calibration procedure no. : WI-CL-28-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurent
Multiplied by coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.
This certificate is applied only to item under test Environmental condition.
This Calibration Certificate may not be reproduced other than in full except with the permission of the Issuing laboratory.
Calibration certificates without signature and seal not valid.
This calibration certificate documents are tracebility to national standards, which realize measurement according to the International System of Units (SI).
Date of calibration : 27-Jan-23


Mr. Sedtawut Nueathong
Calibration Technician


Mrs. Nongluck Wongsettee
Technical Manager

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen (O ₂) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen (O ₂) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide (CO) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide (CO) 1003 ppm	2583/22	Linde	09-Aug-24
Nitrogen Dioxide (NO ₂) 80.96 ppm	3240/21	Linde	26-Jun-24
Nitric Oxide (NO) 150.9 ppm	2857/21	Linde	27-Jun-23
Sulphur Dioxide (SO ₂) 100.8 ppm	3507/22	Linde	9 Nov 24

Measured room conditions

Temperature : 22.1 °C Humidity : 50.5 %RH Pressure : 1012.9 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,100 ml/min Gas pressure : 1019.6 mbar

Calibration Results (without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O ₂ (%Vol)	2.498	2.47	-0.028	0.20
O ₂ (%Vol)	10.04	9.92	-0.12	0.40
O ₂ (%Vol)	21.02	21.08	0.06	0.80
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	309.9	310	0.1	6.0
CO (ppm)	1003	1004	1	12
*NO ₂ (ppm)	80.96	81.5	0.54	8.0
*NO (ppm)	150.9	152	1.1	8.0
*SO ₂ (ppm)	100.8	100	-0.8	6.0

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

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

End of Report



Certificate of Calibration

Page 1 of 2 Pages

Certificate Number : MB2-008-2023
 Equipment : Electronic Balance
 Manufacturer : Radwag
 Model : WTB2000
 Serial Number : 460684
 ID Number : Stack 3
 Max Capacity : 2000 (g)
 Resolution : 0.01 (g)

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

Customer Reference : F411 Customer : Environment Research & Technology Co., Ltd.
 CSRS No. : 00670123 25/114 Moo 6 Soi Chinaket 1, Ngamongwan Road,
 Date of Receipt : 12-Jan-23 Toongsonghong, Laksi, Bangkok 10210
 Date of Calibration : 13-Jan-23 Location : Mass Calibration Laboratory

Condition of this result of calibration

1. Reference Standard instruments :

Instruments	Model	Serial No.	Certificate No.	Due Date
Standard Weight Set (1 g to 5000 g)	N/A	N/A	22M1144	20-Jun-23

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

- Technology Promotion Association (Thailand-Japan)

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

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

Environmental Conditions :

Temperature : (20 ± 2) °C

Humidity : (50 ± 15) %

Air Pressure : (1010 ± 10) mbar

Calibrated By : Mr. Pratchaya Sanguankongvilai
 Date of Issued : 16-Jan-23

Approved Signatory :
 Mr. Panuchit Samart

FM-CL-11-05

Certificate Number : MB2-008-2023

Page 2 of 2 Pages

Calibration Result (Weight) : Without Adjustment

1. Repeatability of Reading

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

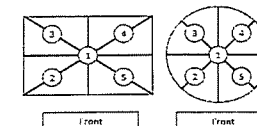
2. Error of indication from nominal value

Nominal Value (g)	Balance Reading (g)	Correction Value (g)	Uncertainty (±) (g)	factor k	Balance Reading Before Adjust (g)
Unload	0.00	0.00	0.0084	2.00	-
200	199.99	0.01	0.0085	2.00	-
400	399.98	0.02	0.0086	2.00	-
600	599.96	0.04	0.0088	2.00	-
800	799.96	0.04	0.0091	2.00	-
1000	999.96	0.04	0.0091	2.00	-
1200	1199.96	0.04	0.095	2.00	-
1400	1399.96	0.04	0.095	2.00	-
1600	1599.96	0.04	0.095	2.00	-
1800	1799.99	0.01	0.095	2.00	-
2000	2000.02	-0.02	0.095	2.00	-

3. Eccentric or off-center loading

Nominal Value (g)	Reference Position				
	Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)
1000	999.96	999.98	999.94	999.98	1000.03

Eccentric Error = 0.07 (g)



End of report



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




Cert.No.: 22CH1753

Page.: 2 of 2

Cert.No.: 22CH1753

Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Eutech
Model : pHTestr 30
Serial No. : 3015187
ID No. : NO.27
Condition As-Received: Used Item
Received Date : 27 December 2022
Calibration Date : 27 December 2022
Reference : 2212-0734WN-9
Submitted by : Environment Research & Technology Company Limited.
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,
Toongsonghong, Laksi, Bangkok 10210
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with standard
voltage calibrator and direct measurement
with certified reference material (CRM)
Calibrated by : Warakorn Lemgagtrakul
Approved by : 
() Malee Butkruea
() Saithip Meangmai
(✓) Ponpan Paipim
Issue Date : 28 December 2022

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	826588	09 July 2024
pH 6.987	CPA chem	823322	20 June 2023
pH 10.008	CPA chem	826590	09 July 2023

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.: 3015187	4.008	4.02	N/A	0.0079	2.00
	6.987	7.01	N/A	0.011	2.00
	10.008	10.02	N/A	0.011	2.05

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-

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full, except with the prior written
Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0048997


a 1142232

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



Accuracy Calibration Certificate

Customer

Company: Environment Research & Technology Co., Ltd.
Address: 25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Rd., 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

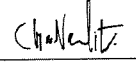
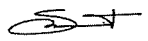
Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)
METTLER TOLEDO Work Instruction: CP/W002/20

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: 23.7 °C	End: 23.6 °C	Start: 46.5 %	End: 45.6 %

As Found Calibration Date: 17-Jan-2023
As Left Calibration Date: N/A
Issue Date: 19-Jan-2023
Calibrator: 
Chawalit Martsuloke
Approved Signatory: 
Technical Manager / Head of Calibration Center

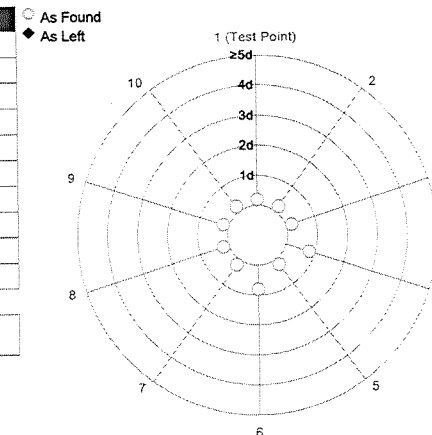
Measurement Results

Repeatability

Test Load: 100 g

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

Standard Deviation	0.00004 g	N/A
--------------------	-----------	-----



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

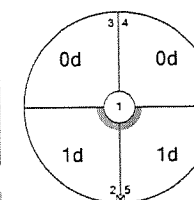
The results of this graph are based upon the absolute values of the differences from the mean value.

Eccentricity

Test Load: 100 g

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

Maximum Deviation	0.0001 g	N/A
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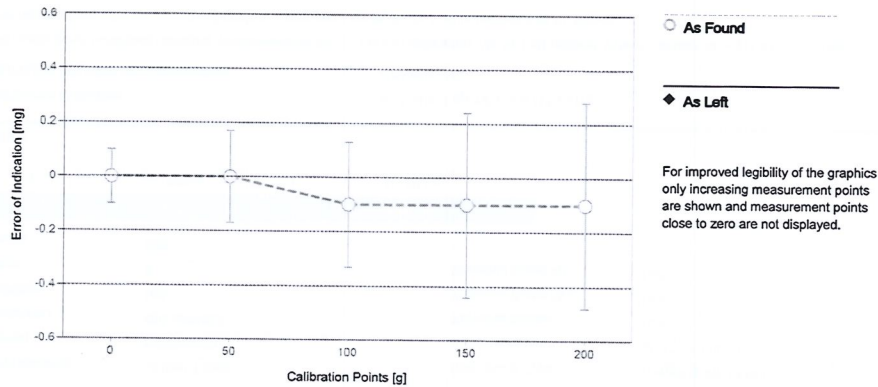
As Found

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	0.10 mg	2
2	0.0500 g	0.0500 g	0.0000 g	0.12 mg	2
3	0.1000 g	0.1000 g	0.0000 g	0.12 mg	2
4	0.5000 g	0.5000 g	0.0000 g	0.12 mg	2
5	1.0000 g	1.0000 g	0.0000 g	0.12 mg	2
6	5.0000 g	5.0000 g	0.0000 g	0.13 mg	2
7	10.0000 g	10.0001 g	0.0001 g	0.13 mg	2
8	50.0000 g	50.0000 g	0.0000 g	0.17 mg	2
9	100.0000 g	99.9999 g	-0.0001 g	0.23 mg	2
10	150.0000 g	149.9999 g	-0.0001 g	0.34 mg	2
11	200.0000 g	199.9999 g	-0.0001 g	0.38 mg	2



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

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

Test Equipment

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

Weight Set 1: OIML E2

Weight Set No.:	WS57	Date of Issue:	06-Jan-2022
Certificate Number:	177037	Calibration Due Date:	03-Jul-2023

Thermo Hygrometer

Equipment No.:	IN255	Date of Issue:	20-Jul-2022
Certificate Number:	22H1503	Calibration Due Date:	04-Jul-2023

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

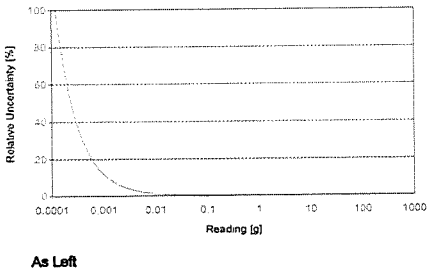
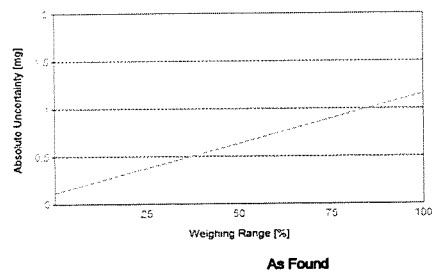
Linearization of Uncertainty Equation

	Range		As Found	As Left
	d	Max		
1	0.0001 g	220 g	U ₁ = 0.12 mg + 0.00474 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	0.12 mg	0.55%	N/A	N/A
0.2200 g	0.12 mg	0.055%	N/A	N/A
2.2000 g	0.13 mg	0.0059%	N/A	N/A
22.0000 g	0.22 mg	0.0010%	N/A	N/A
220.0000 g	1.2 mg	0.00053%	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.

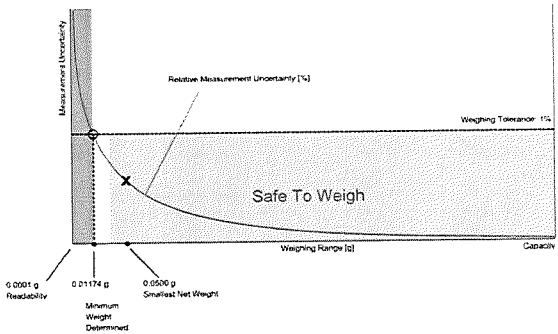
Process Requirements

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%	0.11794 g	0.23700 g	0.35721 g	0.60113 g	1.23215 g
0.2%	0.05883 g	0.11794 g	0.17733 g	0.29696 g	0.60113 g
0.5%	0.02350 g	0.04704 g	0.07063 g	0.11794 g	0.23700 g
1%	0.01174 g	0.02350 g	0.03526 g	0.05883 g	0.11794 g
2%	0.00587 g	0.01174 g	0.01762 g	0.02938 g	0.05883 g
5%	0.00235 g	0.00470 g	0.00704 g	0.01174 g	0.02350 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%	0.11794 g	0.23700 g	0.35721 g	0.60113 g	1.23215 g
0.2%	0.05883 g	0.11794 g	0.17733 g	0.29696 g	0.60113 g
0.5%	0.02350 g	0.04704 g	0.07063 g	0.11794 g	0.23700 g
1%	0.01174 g	0.02350 g	0.03526 g	0.05883 g	0.11794 g
2%	0.00587 g	0.01174 g	0.01762 g	0.02938 g	0.05883 g
5%	0.00235 g	0.00470 g	0.00704 g	0.01174 g	0.02350 g

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

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

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

Notes on minimum weight values in above table:

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

Measurement Results

Results Summary

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

✓ = Passed

✗ = Failed

⚠ = Safety Factor not met

Repeatability

Test Load: 100 g

Tolerance	Control Limit	As Found		As Left	
		Std. Deviation	Result	Std. Deviation	Result
0.1%	N/A	0.00004 g*	N/A	0.00004 g*	N/A
0.2%	0.00005 g		✓		⚠
0.5%	0.00013 g		✓		✓
1%	0.00025 g		✓		✓
2%	0.00050 g		✓		✓
5%	0.00125 g		✓		✓

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

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

Eccentricity

Test Load: 100 g

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

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

Error of Indication

As Found

		Control limits for various weighing tolerances					
Reference Value	Error	0.1%	0.2%	0.5%	1%	2%	5%
0.0000 g	0.0000 g	N/A	N/A	N/A	N/A	N/A	N/A
50.0000 g	0.0000 g	0.0250 g	0.0500 g	0.1250 g	0.2500 g	0.5000 g	1.2500 g
100.0000 g	-0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0000 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		✓	✓	✓	✓	✓	✓

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
100.0000 g	-0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0000 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. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 23TM32
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 : 4 January 2023
Calibration Date : 4 January 2023
Ambient Temperature : $(26 \pm 10) ^\circ\text{C}$
Relative Humidity : $(50 \pm 30) \%$
Calibrated by : Preecha Hlahib

Approved by : 
Approved Signatory

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

Issue Date : 16 January 2023

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 : Hot Air Oven
Condition As-Received : Used Item
Reference : 2301-0002ON-3
Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY57013823	22LM24	26 Feb 2023

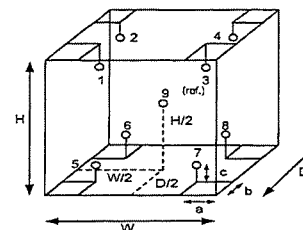
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details :		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)	28	32
REL.Humid. (%)	60	55
AC Supply (Volt)	220	221

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



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2301-0002ON-3
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 23TM32
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
104.0	104.0	104.0	0.10	0.95	1.6	0.42	2
180.0	180.0	180.0	0.29	1.8	3.3	1.1	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	104.630	103.574	103.239	103.951	104.422	104.052	103.192	104.041	104.089
180.0	179.591	179.816	178.321	179.612	181.116	179.997	178.605	179.735	179.508

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

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

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

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

UUC* : Unit Under Calibration

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

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

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



Cert. No.: 23TM31
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 : 4 January 2023
Calibration Date : 4 January 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Preecha Hlahib

Approved by :
Approved Signatory

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

Issue Date : 16 January 2023

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 : Hot Air Oven
Condition As-Received : Used Item
Reference : 2301-0002ON-2
Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY57013823	22LM24	26 Feb 2023

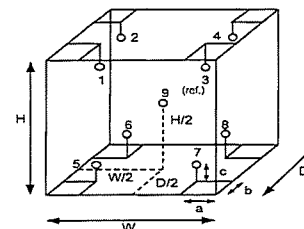
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Environment during calibration		
	Beginning	Finished
Temp. (°C)	28	32
REL.Humid. (%)	60	55
AC Supply (Volt)	220	221

Probe Installation Details :
a = 5.0 cm
b = 5.0 cm
c = 5.0 cm
Dimension of Chamber :
D = 0.40 m
W = 0.60 m
H = 0.48 m
Capacity = 0.12 m³

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



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2301-0002ON-2
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 23TM31
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
104	104	104	0.16	2.4	2.6	0.86	2
180	180	180	0.34	6.1	8.8	1.8	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
104	104.819	103.334	104.574	104.185	103.981	103.001	105.409	103.368	103.014
180	176.454	179.253	182.386	180.810	181.999	178.253	184.629	179.227	178.688

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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Malu.

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



Accuracy Calibration Certificate

Customer

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

Weighing Device

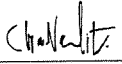
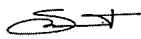
Manufacturer: Mettler Toledo Instrument Type: Weighing Instrument
Model: MS204TS/00 Asset Number: ERTC-L-IN-114
Serial No.: B547728937 Terminal Model: N/A
Building: N/A Terminal Serial No.: N/A
Floor: 5 Terminal Asset No.: N/A
Room: 504

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

Procedure

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

	Temperature		Humidity	
As Found	Start: 23.7 °C	End: 23.8 °C	Start: 45.6 %	End: 46.8 %

As Found Calibration Date: 17-Jan-2023 Calibrator: 
As Left Calibration Date: N/A Chawalit Martsuloke
Issue Date: 19-Jan-2023
Approved Signatory: 
Technical Manager / Head of Calibration Center

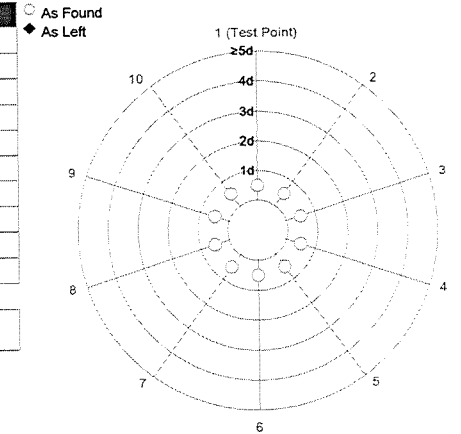
Measurement Results

Repeatability

Test Load: 100 g

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

Standard Deviation	0.00005 g	N/A
--------------------	-----------	-----



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

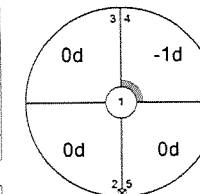
The results of this graph are based upon the absolute values of the differences from the mean value.

Eccentricity

Test Load: 100 g

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

Maximum Deviation	0.0001 g	N/A
-------------------	----------	-----



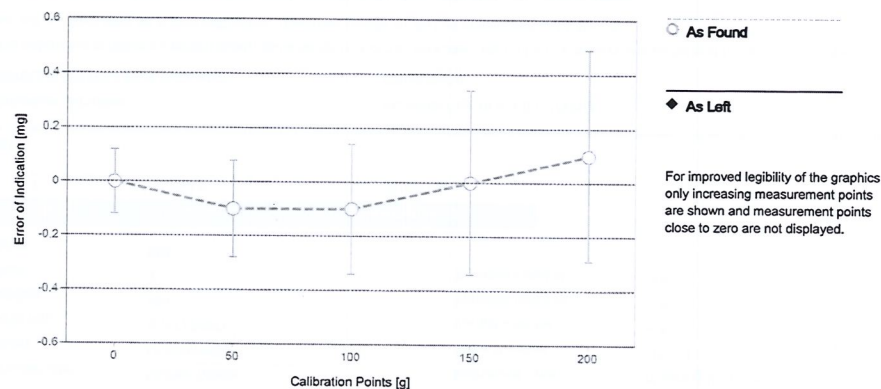
As Found

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

Error of Indication

As Found

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.0000 g	0.12 mg	2
2	0.0500 g	0.0500 g	0.0000 g	0.13 mg	2
3	0.1000 g	0.1000 g	0.0000 g	0.13 mg	2
4	0.5000 g	0.5000 g	0.0000 g	0.14 mg	2
5	1.0000 g	1.0000 g	0.0000 g	0.14 mg	2
6	5.0000 g	5.0001 g	0.0001 g	0.14 mg	2
7	10.0000 g	10.0001 g	0.0001 g	0.15 mg	2
8	50.0000 g	49.9999 g	-0.0001 g	0.18 mg	2
9	100.0000 g	99.9999 g	-0.0001 g	0.24 mg	2
10	150.0000 g	150.0000 g	0.0000 g	0.34 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.

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.:	WS57	Date of Issue:	06-Jan-2022
Certificate Number:	177037	Calibration Due Date:	03-Jul-2023

Thermo Hygrometer

Equipment No.:	IN255	Date of Issue:	20-Jul-2022
Certificate Number:	22H1503	Calibration Due Date:	04-Jul-2023

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: $3.0 \cdot 10^{-6} / K$

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

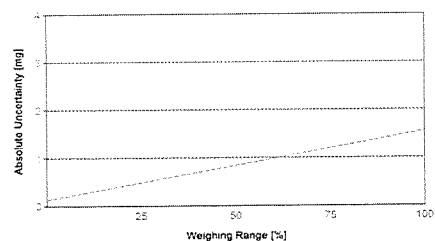
Linearization of Uncertainty Equation

	Range		As Found	As Left
	d	Max		
1	0.0001 g	220 g	$U_1 = 0.13 \text{ mg} + 0.00647 \text{ mg/g} \cdot R$	N/A

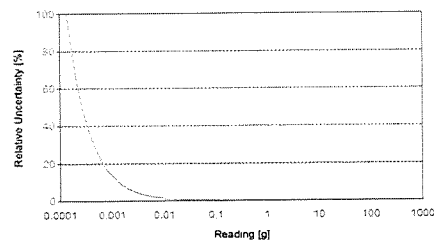
To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

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

Net Indication	As Found		As Left	
0.0220 g	0.13 mg	0.59%	N/A	N/A
0.2200 g	0.13 mg	0.060%	N/A	N/A
2.2000 g	0.14 mg	0.0066%	N/A	N/A
22.0000 g	0.27 mg	0.0012%	N/A	N/A
220.0000 g	1.6 mg	0.00071%	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.

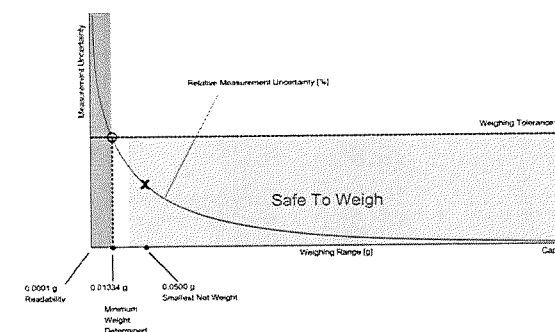
Process Requirements

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%	0.13420 g	0.27016 g	0.40792 g	0.68895 g	1.42555 g
0.2%	0.06688 g	0.13420 g	0.20196 g	0.33881 g	0.68895 g
0.5%	0.02670 g	0.05347 g	0.08031 g	0.13420 g	0.27016 g
1%	0.01334 g	0.02670 g	0.04008 g	0.06688 g	0.13420 g
2%	0.00667 g	0.01334 g	0.02002 g	0.03339 g	0.06688 g
5%	0.00267 g	0.00533 g	0.00800 g	0.01334 g	0.02670 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%	0.13420 g	0.27016 g	0.40792 g	0.68895 g	1.42555 g
0.2%	0.06688 g	0.13420 g	0.20196 g	0.33881 g	0.68895 g
0.5%	0.02670 g	0.05347 g	0.08031 g	0.13420 g	0.27016 g
1%	0.01334 g	0.02670 g	0.04008 g	0.06688 g	0.13420 g
2%	0.00667 g	0.01334 g	0.02002 g	0.03339 g	0.06688 g
5%	0.00267 g	0.00533 g	0.00800 g	0.01334 g	0.02670 g

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

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

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

Notes on minimum weight values in above table:

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

Measurement Results

Results Summary

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

✓ = Passed

✗ = Failed

⚠ = Safety Factor not met

Repeatability

Test Load: 100 g

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

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

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

Eccentricity

Test Load: 100 g

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

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

Error of Indication

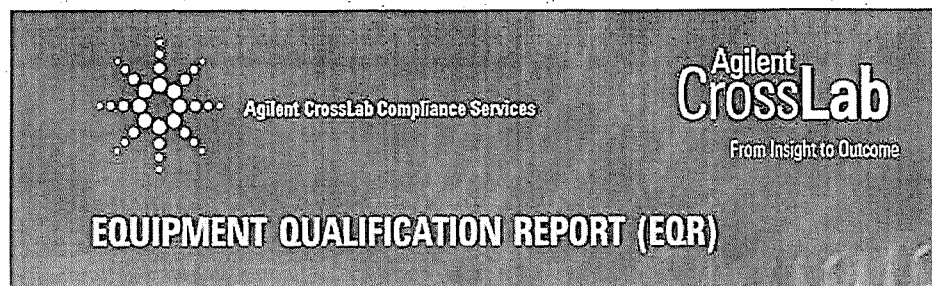
As Found

		Control limits for various weighing tolerances					
Reference Value	Error	0.1%	0.2%	0.5%	1%	2%	5%
0.0000 g	0.0000 g	N/A	N/A	N/A	N/A	N/A	N/A
50.0000 g	-0.0001 g	0.0250 g	0.0500 g	0.1250 g	0.2500 g	0.5000 g	1.2500 g
100.0000 g	-0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0000 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

		Control limits for various weighing tolerances					
Reference Value	Error	0.1%	0.2%	0.5%	1%	2%	5%
0.0000 g	0.0000 g	N/A	N/A	N/A	N/A	N/A	N/A
50.0000 g	-0.0001 g	0.0250 g	0.0500 g	0.1250 g	0.2500 g	0.5000 g	1.2500 g
100.0000 g	-0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0000 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.



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, 2022 4:16:06 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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Purpose

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

Details

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

Overall Qualification Status

Pass

Purpose

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

General Details

Service Order No./Request:	6005573434
EQP Name:	AgilentRecommended
EQP Revision:	ES.02.50
Report Type:	Report

Organization Details

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

Local Contact Details

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

Operator Details

Name:	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
-----------------------------	----------------

As Found Details

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

Revision Details

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

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

Image Details:

Was the detector calibration performed and completed successfully?

Date and Time:

November 28, 2022 4:07:22 PM

Host Name:

5CG0202NQ4

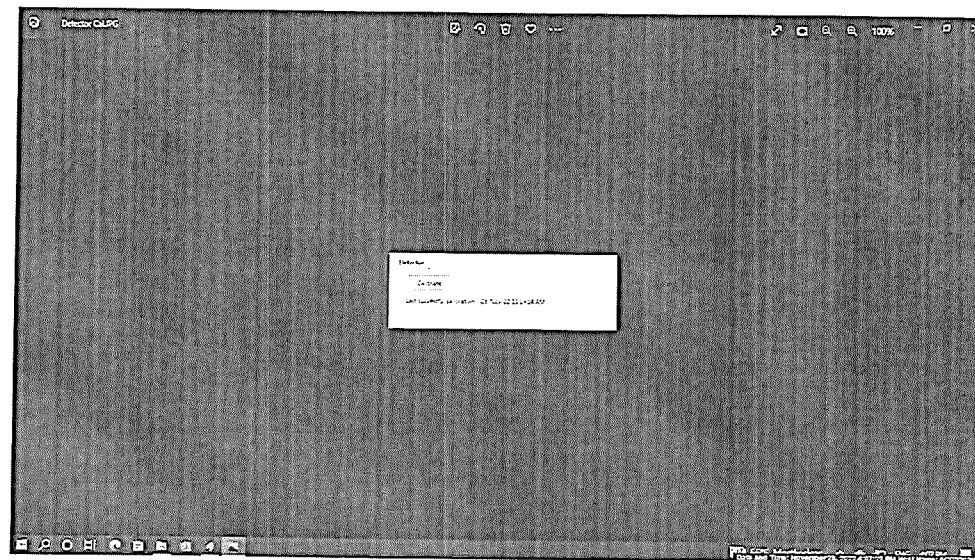


Image Details:

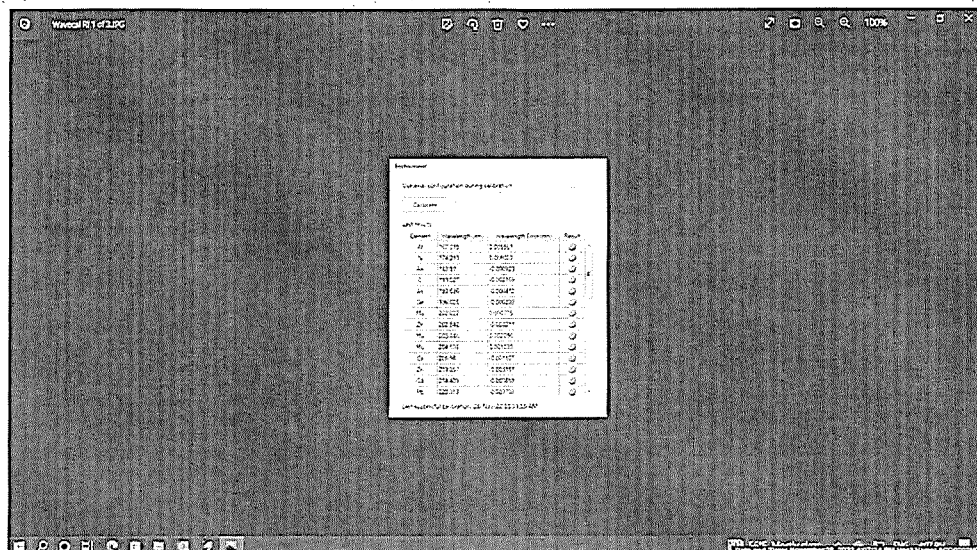
Was the instrument calibration performed and completed successfully?

Date and Time:

November 28, 2022 4:07:34 PM

Host Name:

5CG0202NQ4



Overall Test Status

Pass

Runs: 1

Purpose:

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

Configuration Details

Model/Serial No.:

G8011A

MY15330001

Results

Observed Result

Expected Result

Status

Are the Functional Tests results within acceptance criteria?

Subsystem Communications

Yes

Yes

Pass

Air Flow

Yes

Yes

Pass

Water Flow

Yes

Yes

Pass

Gas Flows

Yes

Yes

Pass

RF Generator

Yes

Yes

Pass

Camera

Yes

Yes

Pass

Optics

Yes

Yes

Pass

Are the Instrument Performance Tests results within acceptance criteria?

Resolution

Yes

Yes

Pass

Sensitivity

Yes

Yes

Pass

Precision

Yes

Yes

Pass

Overall Test Status

Pass

Runs: 1

Autosampler Operation

Purpose:

This test verifies that the autosampler operates properly.

Configuration Details

Model/Serial No.:

G8410A

AU15220240

Results

Criteria

Observed Result

Expected Result

Status

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

Yes

Yes

Pass

Overall Test Status

Pass

Runs: 1

Declaration of Change Control

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

Contents

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

Location	Category	Document Name	Page
EQR	General	Certificate of Qualification for ACE	14
EQR	General	Operator's training certificate and qualifications	15
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EQR	General	Certificate of System Qualification	17
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EQR	Material	Certificate of Analysis Wavelength calibration solution	22

G:

Document Name: Certificate of Qualification for ACE



Agilent Compliance Engine Self Qualification

Date: April 17, 2022 11:11:13 PM

Drive Serial #: 90593EBA

Platform Revision:

ACE 3.11.27

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

Document Name:

Operator's training certificate and qualifications



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



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.

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: Certificate of System Qualification



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 28-Nov-22 3:29:24 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	7.40
As (188.980 nm)	≤ 8.20	6.48
C (193.027 nm)	≤ 11.50	8.05
Mo (202.032 nm)	≤ 8.20	6.88
Cr (206.158 nm)	≤ 13.40	10.29
Zn (213.857 nm)	≤ 8.70	7.43
Pb (220.353 nm)	≤ 9.50	8.06
Co (228.615 nm)	≤ 17.20	10.85
Ba (230.424 nm)	≤ 9.40	7.87
Mn (257.610 nm)	≤ 13.30	9.47
Mn (260.568 nm)	≤ 20.30	16.41
Cr (267.716 nm)	≤ 11.00	8.93
Cu (324.754 nm)	≤ 25.00	18.01
Cu (327.395 nm)	≤ 14.20	12.72
Sr (338.071 nm)	≤ 33.50	28.00
Ba (455.403 nm)	≤ 44.00	33.09
Sr (460.733 nm)	≤ 36.00	20.22
Ba (493.408 nm)	≤ 36.00	30.03
Ba (614.171 nm)	≤ 42.00	28.64
Ar (675.283 nm)	≤ 74.00	65.29
K (766.491 nm)	≤ 80.00	61.84

Document Name: Instrument's Test Report

Sensitivity Test					
Pass					
Radial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	124.4	1263.4	89.1
Se (196.026 nm)	≥ 41.0	SRBR	74.4	903.6	112.9
Zn (213.857 nm)	≥ 1421.0	SRBR	4159.8	58879.6	199.0
Pb (220.353 nm)	≥ 46.0	SRBR	191.9	3092.4	223.5
Mn (257.610 nm)	≥ 3518.0	SRBR	12083.1	303064.1	626.5
Al (396.152 nm)	≥ 3.4	SBR	8.0	41307.1	4600.0
Ba (493.408 nm)	≥ 34.0	SBR	103.1	1275727.5	12253.3
K (766.491 nm)	≥ 1.8	SBR	3.9	111109.8	22733.2
Axial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 206.0	SRBR	250.8	3667.4	192.0
Se (196.026 nm)	≥ 159.0	SRBR	172.2	2902.2	239.1
Zn (206.200 nm)	≥ 234.0	SRBR	1360.5	17846.2	168.8
Zn (213.857 nm)	≥ 1743.0	SRBR	9129.7	200493.0	480.0
Cd (214.439 nm)	≥ 4227.0	SRBR	8255.6	156439.2	357.4
Pb (220.353 nm)	≥ 320.0	SRBR	666.7	16502.1	571.0
Mn (257.610 nm)	≥ 10625.0	SRBR	39180.3	1593731.9	1651.2
Cr (267.716 nm)	≥ 1048.0	SRBR	4862.3	176423.2	1297.2
Cu (324.754 nm)	≥ 19.0	SBR	65.7	268073.8	4020.3
Al (396.152 nm)	≥ 6.0	SBR	24.3	271032.8	10722.4
Ba (493.408 nm)	≥ 60.0	SBR	275.4	8034589.3	29068.7
K (766.491 nm)	≥ 24.0	SBR	81.9	3677804.4	44370.4

Page 2 of 3

Document Name: Instrument's Test Report

Precision Test		
Pass		
Radial		
Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 2.60	0.99
Se (196.026 nm)	≤ 2.60	1.01
Zn (213.857 nm)	≤ 1.50	0.31
Pb (220.353 nm)	≤ 2.60	0.41
Mn (257.610 nm)	≤ 1.50	0.43
Al (396.152 nm)	≤ 1.50	0.39
Ba (493.408 nm)	≤ 1.50	0.65
K (766.491 nm)	≤ 1.50	0.29
Axial		
Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 1.50	0.87
Se (196.026 nm)	≤ 1.50	0.76
Zn (206.200 nm)	≤ 1.50	0.42
Zn (213.857 nm)	≤ 1.50	0.51
Cd (214.439 nm)	≤ 1.50	0.50
Pb (220.353 nm)	≤ 1.50	0.49
Mn (257.610 nm)	≤ 1.50	0.50
Cr (267.716 nm)	≤ 1.50	0.43
Cu (324.754 nm)	≤ 1.50	0.48
Al (396.152 nm)	≤ 1.50	0.48
Ba (493.408 nm)	≤ 1.50	0.71
K (766.491 nm)	≤ 1.50	0.50

Page 3 of 3

General

Document Name: Software verification

Software Verification Report

Date: Monday, November 28, 2022 Time: 3:44:56 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

Date: November 28, 2022 4:16:06 PM
System ID: MY15330001

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: 0012183521

Product Specifications

Analyte	Starting Material	CAS #	Certified Conc.	Analyte	Starting Material	CAS #	Certified Conc.
Al	Al(NO ₃) ₃	7784-27-2	5.000 ± 0.025 mg/L	Mn	Mn	7439-96-5	5.001 ± 0.025 mg/L
As	As	7440-38-2	5.001 ± 0.025 mg/L	Mo	(NH ₄) ₂ MoO ₄	13106-76-8	5.000 ± 0.025 mg/L
Ba	Be(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	5.001 ± 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	10043-76-9	5.000 ± 0.025 mg/L
Cu	Cu	7440-50-8	5.000 ± 0.025 mg/L	Zn	Zn	7440-66-6	4.999 ± 0.025 mg/L
K	KNO ₃	7757-79-1	50.00 ± 0.25 mg/L				

Matrix: 5% HNO₃

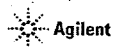
Intended Use: This solution is intended for use as a certified reference material or calibration standard for inductively coupled plasma optical emission spectroscopy (ICP-OES), inductively coupled plasma mass spectrometry (ICP-MS), atomic absorption spectroscopy (flame AAS or GFAAS), microwave plasma 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, 3103a, 3104a, 3108, 3112, 3112a, 3114, 3132, 3134, 3136, 3128, 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.

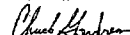
Date: November 28, 2022 4:16:06 PM
System ID: MY15330001

Document Name: Certificate of Analysis Wavelength calibration solution



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

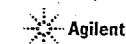
Sample lot approval:


Chuck Goudreau, Certifying Officer

Date of release: 21 January 2022
Date of expiration: 31 July 2023

Page 2 of 3

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/ads.

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 DSP 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 16560231)
- Accredited to ISO 17034 – General Requirements for the Competence of Reference Material Producers (A2LA Cert. No. 2848.01)
 - 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 (A2LA Cert. No. 2848.01)
- LSC Sonoma, 274 Abby Road, Marinwood, CA 94022

Page 3 of 3

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, 2022
 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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Date: November 28, 2022 4:16:06 PM
 System ID: MY15330001

User Name: worawit.timakul
 Hostname: SC80210127

System ID: MY15330001
 Print Date: November 28, 2022 4:16:10 PM

OQ HW ICP 5100 Envi resarc Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 28, 2022 4:02:15 PM	Audit	SessionCreated	Session	None
November 28, 2022 4:02:15 PM	Start	Configuration	Session	None
November 28, 2022 4:02:15 PM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
November 28, 2022 4:06:30 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]
November 28, 2022 4:06:32 PM	End	Configuration	Session	None
November 28, 2022 4:06:35 PM	Start	Qualification	Session	OQ
November 28, 2022 4:06:36 PM	Start	Execution	Preparation : 5100 VDV: Qualitative Test - No setpoints associated	None
November 28, 2022 4:07:38 PM	End	Execution	Preparation : 5100 VDV: Qualitative Test - No setpoints associated	Run Count : 1
November 28, 2022 4:07:39 PM	Start	Execution	Instrument Tests : 5100 VDV: Qualitative Test - No setpoints associated	None
November 28, 2022 4:08:52 PM	End	Execution	Instrument Tests : 5100 VDV: Qualitative Test - No setpoints associated	Run Count : 1

Date: November 28, 2022 4:16:06 PM
 System ID: MY15330001

User Name: worawit.timakul
 Username: GCG0231126

System ID: MY15330001
 Print Date: November 28, 2022 4:15:10 PM

OQ HW ICP 5100 Envi researc Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
November 28, 2022 4:09:01 PM	Start	Execution	Autosampler Operation : Autosampler 1 - SPS4; Qualitative Test - No setpoints associated	None
November 28, 2022 4:09:05 PM	End	Execution	Autosampler Operation : Autosampler 1 - SPS4; Qualitative Test - No setpoints associated	Run Count : 1
November 28, 2022 4:09:09 PM	End	Qualification	Session	OQ
November 28, 2022 4:09:09 PM	Start	Reporting	Session	None
November 28, 2022 4:14:49 PM	Audit	Reporting	Session	Report Generated : Certificate
November 28, 2022 4:15:27 PM	Audit	Reporting	Session	Report Signed : Certificate PDF Name: OQ HW ICP 5100 Envi researc_20221128_Certificate_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
November 28, 2022 4:15:43 PM	Audit	Reporting	Session	Report Generated : Report



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.: 22TW286

Page.: 2 of 2

Cert.No.: 22TW286

Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : YSI
Model : Pro20
Serial No. : 14L101229
ID No. : NO.4
Received Date : 27 December 2022
Test Date : 27 December 2022
Reference : 2212-0734WN-5
Submitted by : Environment Research & Technology Company Limited.
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,
Toongsonghong, Laksi, Bangkok 10210
Laboratory Condition : Temperature (25 ± 5) °C
Humidity (50 ± 20) %
Test Procedure : In - house method : CP-CH9
by Comparison Technique with Azide Modification Method
Tested by : Walalak Sirithean

Approved by :

Warakorn
Approved Signatory

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

Issue Date : 28 December 2022

Condition of this result of calibration

1. Reference Standard Instruments :

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

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

2. Standard Material :-

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

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 14L100144

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

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

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B 0303343

Warakorn

a 1142236



Intech 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



Intech 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. : MT22-6773

Page : 1 of 2

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

Description : Incubator
Manufacturer : Sanyo
Model : MIR-254
Serial No. : 1103017
Identification No. : ERTC-L-IN-066
Calibration Place : Customer Laboratory

Order No. : 3555/22
Received date : Dec 06, 2022
Calibration date : Dec 12, 2022
Environment Condition :
Temperature : (25+/-10) °C
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	MT22-5466	Oct 06, 2023

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 : Mr.Jiraphan Sreebannasarn
Issue date : Dec 19, 2022

Approved by : (Mr.Choophong Khumdet)

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

Certificate No. : MT22-6773

Page : 2 of 2

Function : Temperature measurement

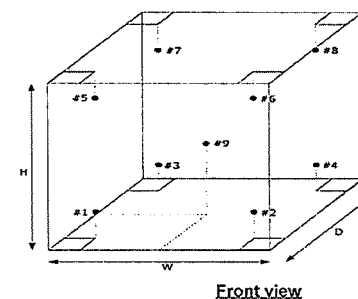
Result : Without adjustment

Calibration point : 20 °C

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	19.634	19.407	19.345	19.258	19.687	19.616	19.630	19.542	19.568	0.65

Setting temperature (°C)	Indicating Temperature (°C)	Measured stability (+/- °C)	Measured uniformity (°C)	Overall variation (°C)
20.0	20 to 20.2	0.51	0.87	1.5



#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.



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert. No.: 23TM3
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 ห้องปฏิบัติการบ่มอาหารเลี้ยงเชื้อ
Received Order : 4 January 2023
Calibration Date : 5 January 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Krisda Malee
Approved by :
() Pornthippa Tameyakul
() Malee Butkruea
() Suwit Imjai
Issue Date : 16 January 2023

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 : 2301-0002ON-5
Procedure Used :-

Cert. No.: 23TM3
Page : 2 of 3

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

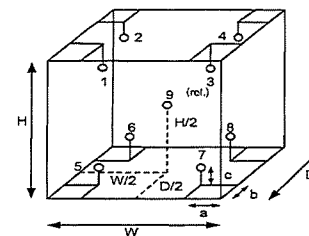
Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34970A	MY44073381	22LM78/1	12 May 2023

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

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source
Fresh air setting : Close



Probe Installation Details :	Dimension of Chamber :
a = 5.0 cm	D = 0.40 m
b = 5.0 cm	W = 0.56 m
c = 5.0 cm	H = 0.73 m
	Capacity = 0.16 m ³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	24	26
REL.Humid. (%)	50	51
AC Supply (Volt)	220	221

Position :	Ref. Std. ID No.:
1	1RTD-2/1
2	1RTD-2/2
3	22-01RTD-03
4	1RTD-2/4
5	1RTD-2/5
6	1RTD-2/6
7	1RTD-2/7
8	1RTD-2/8
9 (ref.)	1RTD-2/9



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2301-0002ON-5
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 23TM3
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (± °C)	Coverage Factor <i>k</i>
35.0	35.0	35.0	0.026	0.30	0.33	0.30	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
35.0	35.132	35.177	35.048	35.188	35.186	35.131	35.154	35.144	35.334

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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Madu

Personal Pump Calibration Report

Equipment Type	: Personal Pump
Equipment Range	: 0.005 – 5.0 L/min
Calibration Range	: 0.01 – 3.0 L/min
Calibration Type	: DryCal Bubble Type
Volume for Calibration	: 1.7 L/min, 2.0 L/min
Calibrated By	: Mr.Anuwat Ruangon
Calibration Date	: November 17, 2023
Customer Name	: บริษัท ไฟร์เทียร์ คอนซัลแตนต์ จำกัด : โครงการ โรงงานผลิตเหล็กแท่งและผลิตภัณฑ์เหล็กที่ผลิตจากเหล็กถลุง ของบริษัท หยงซิง สตีล (ไทยแลนด์) จำกัด

[illegible]

Checked By

Mr. Prayun Detkla
Technician

Approved By

Ms.Sutatip Im-noi
Environmental Scientist



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

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/Pressure Transducer/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 : Terasak Panna

(Mr.Terasak Panna)

Approved by : Kirana Luanghirun

(Ms.Kirana Luanghirun)

Director

Mechanical Engineering Standards Laboratory

Ref. 201326608230323001

Issued Date 8 September 2023

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

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FM.BLMTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

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

Office

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



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

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

Request No.23-66/0663

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.

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

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Office/Laboratory

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




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



Cert.No.: 23MM1
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 : 4 January 2023
Calibration Date : 4 January 2023
Ambient Temperature : 15 °C to 40 °C
Relative Humidity : 30 % to 90 %
Calibrated by : Krisda Malee
Approved by : 
(/) Pornthippa Tameyakul
(/) Malee Butkruea
() Suwit Imjai
Issue Date : 16 January 2023

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 : 2301-0002ON-10
Procedure used :-

Cert.No.: 23MM1
Page: 2 of 3

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-0009-21	03 Feb 2023

- 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 Internal 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)	(± mg)	(k)
2.5	2.500008	-0.000008	0.026	2.00
5	5.000007	-0.000007	0.027	2.00

After Adjustment :

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

Applied Weight	Standard Deviation
(g)	of Reading (g)
2.5	0.0000007
5	0.0000007





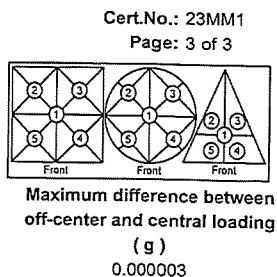
Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2301-0002ON-10

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
(g)	(g)	(g)	(g)	(g)
+0.000002	+0.000005	+0.000004	+0.000002	+0.000003



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	0.0060	2.11
0.014	0.014002	-0.000002	0.0060	2.00
0.015	0.015001	-0.000001	0.0060	2.00
0.5	0.499995	+0.000005	0.013	2.00
1	1.000001	-0.000001	0.016	2.00
1.5	1.500001	-0.000001	0.020	2.00
2	1.999996	+0.000004	0.020	2.00
2.5	2.500001	-0.000001	0.026	2.00
3	3.000004	-0.000004	0.026	2.00
4	3.999997	+0.000003	0.027	2.00
5	5.000002	-0.000002	0.027	2.00

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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Malu.



Request No. 22-67 / 0024

MTC No. PSL-H 0007 / 67

Certificate of Calibration

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

Item : Thermo-Hygrometer (Thermal Environment Monitor)

Model /Type : hs-32

Serial Number : MCD050029

Manufacturer : METROSONICS

Date of Request : 11 October 2023

Date of Calibration : 25 October 2023

The certifies the above equipment was calibrated in accordance with the recognised International Standard ISO/IEC 17025:2017 and the operation according to procedure no. WI.CP.18.

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

Calibrated by :

(Ms. Panit Thummasri)

Approved by :

(Mr. Kamchai Singhapiwat)
Director

Photometry and Temperature Standards Laboratory

Ref. No : 2012266101104034003

Issued Date : 6 November 2023

Page 1 of 4

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E-mail : sumalee@tistr.or.th



Request No. 22-67 / 0024

MTC No. PSL-H 0007 / 67

Description of Unit Under Calibration :

Customer : Environment Research & Technology Company Limited

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

Item : Thermo-Hygrometer (Thermal Environment Monitor)

Serial Number : MCD050029

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

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

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

Reference Standard :

Digital Thermometer with Sensor, Model : F250H, S/N : 9345 008 2331, Sensor RTD Probe No. RTD-01 and RTD-02 which was calibrated by Industrial Metrology and Testing Service Centre, Certificate No. PSL-T 0976/66.

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

Calibration Procedure :

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

Support Equipment :

Temperature & Humidity Controlled Chamber, Model : 9141-5110, S/N : 1205101

Adjustments : NONE

Page 2 of 4

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Request No. 22-67 / 0024

MTC No. PSL-H 0007 / 67

Results of Calibration :- (☒) Without Adjustment (☐) After Adjustment

Table : Temperature Measurement @ Wet Bulb

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
30.1	30.0	0.1	0.50
35.1	34.8	0.3	0.50
40.1	39.7	0.4	0.51

Table : Temperature Measurement @ Dry Bulb

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
30.1	30.1	0.0	0.50
35.1	34.9	0.2	0.50
40.1	39.8	0.3	0.50

Page 3 of 4

P.T.

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Request No. 22-67 / 0024

MTC No. PSL-H 0007 / 67

Results of Calibration :-

Table : Temperature Measurement @ Globe Bulb

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
30.1	29.9	0.2	0.50
35.1	34.7	0.4	0.50
40.1	39.6	0.5	0.50

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

...end of certificate...

Page 4 of 4

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



Certificate of Calibration

Customer

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

Certificate No : 23-TPM-463

Request No : Req-2023-1989

Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature

Instrument Name : Area Heat Stress Monitor

Manufacturer : Quest Technologies

Model : QT-34

Serial Number : TED050028

Resolution : 0.1 °C

ID Number : -

Range Calibration : 30 °C to 40 °C

Type of Sensor : RTD

Sensor Diameter (mm) : 4.5

Calibration Position (mm) : 67.5

Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 3 °C

Humidity : 55 %RH ± 15 %RH

Received Date : 15 September 2023

Calibrated Date : 29 September 2023

Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

Reference Standard : Digital Thermometer with Sensor, Manufacturer: GINGO/GINGO, Model: GT11/ RTD100, SN:
08000057, ID: 02-TPM Which was calibrated on 27 Febuary 2023, Calibration Certificate No. : QR23-
0494

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

Note

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

Approved By :

Mr. Noppadon Luangari

Technical Manager

Issue Date :

29 September 2023



Calibration Note

UUC Adjustment : Not Adjust

Certificate No : 23-TPM-463

Request No : Req-2023-1989

Page : 2/2

Result of Calibration :

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
WET	30.035	30.0	0.0	0.13
	35.038	35.0	0.0	0.13
	40.039	40.0	0.0	0.13
DRY	30.036	30.0	0.0	0.13
	35.035	35.0	0.0	0.13
	40.038	40.0	0.0	0.13
GLOBE	30.034	29.9	+ 0.1	0.13
	35.038	34.9	+ 0.1	0.13
	40.039	39.9	+ 0.1	0.13

End of Certificate

Calibrated By :

Mr. Sittichok Jirapukdeessakul

Request No. 22-66 / 0716

MTC No. PSL-H 0336 / 66

Certificate of Calibration

Customer : Envilab Co.,Ltd.
540, 540/1 Soi Bangkhæ7 , Bangkhæ ,Bangkok ,10160

Item : Thermo-Hygrometer (Area Heat Stress Monitor)

Model /Type : hs-32

Serial Number : MCG080057


Manufacturer : METROSONICS

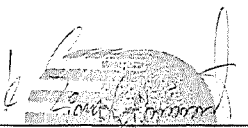
Date of Request : 24 July 2023

Date of Calibration : 18 August 2023

The certifies the above equipment was calibrated in accordance with the recognised International Standard ISO/IEC 17025:2017 and the operation according to procedure no. WI.CP.18.

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

Calibrated by :

(Ms. Panit Thummasri)

Approved by :

(Mr. Kamchai Singhapiwat)
Director
Photometry and Temperature Standards Laboratory

Ref. No : 2012266072402904001

Issued Date : 24 August 2023

Page 1 of 4

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E-mail : sumalee@tistr.or.th

Request No. 22-66 / 0716

MTC No. PSL-H 0336 / 66

Description of Unit Under Calibration :

Customer : Envilab Co.,Ltd.

Address : 540, 540/1 Soi Bangkhæ7 , Bangkhæ ,Bangkok ,10160

Item : Thermo-Hygrometer (Area Heat Stress Monitor)

Serial Number : MCG080057

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

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

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

Reference Standard :

Digital Thermometer with Sensor, Model : F250H, S/N : 9345 008 2331, Sensor RTD Probe No. RTD-01 and RTD-02 which was calibrated by Industrial Metrology and Testing Service Centre, Certificate No. PSL-T 0976/66.

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

Calibration Procedure :

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

Support Equipment :

Temperature & Humidity Controlled Chamber, Model : 9141-5110, S/N : 1205101

Adjustments : NONE

Page 2 of 4

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Request No. 22-66 / 0716

MTC No. PSL-H 0336 / 66

Results of Calibration :- (/) Without Adjustment () After Adjustment

Table : Temperature Measurement @ Wet Bulb

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
30.1	30.5	-0.4	0.50
35.0	35.1	-0.1	0.50
40.1	40.1	0.0	0.50

Table : Temperature Measurement @ Dry Bulb

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
30.1	30.5	-0.4	0.50
35.0	35.1	-0.1	0.50
40.1	40.2	-0.1	0.50

Request No. 22-66 / 0716

MTC No. PSL-H 0336 / 66

Results of Calibration :-

Table : Temperature Measurement @ Globe Bulb

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
30.1	30.4	-0.3	0.50
35.0	35.1	-0.1	0.50
40.1	40.1	0.0	0.50

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

...end of certificate...



Request No. 22-66 / 0198

MTC No. PSL-H 0079 / 66

Certificate of Calibration

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

Item : Thermo-Hygrometer (Thermal Environment Monitor)

Model /Type : hs-32

Serial Number : MCF010006

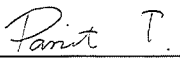
Manufacturer : METROSONICS

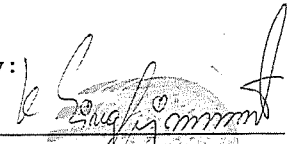
Date of Request : 4 January 2023

Date of Calibration : 18 January 2023

The certifies the above equipment was calibrated in accordance with the recognised International Standard ISO/IEC 17025:2017 and the operation according to procedure no. WI.CP.18.

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

Calibrated by :

(Ms. Panit Thummasri)

Approved by :

(Mr. Kamchai Singhapiwat)
Director

Photometry and Temperature Standards Laboratory

Ref. No : 2012266010400020001

Issued Date : 10 February 2023

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E-mail : sumalee@tistr.or.th



Request No. 22-66 / 0198

MTC No. PSL-H 0079 / 66

Description of Unit Under Calibration :

Customer : Environment Research & Technology Company Limited

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

Item : Thermo-Hygrometer (Thermal Environment Monitor)

Serial Number : MCF010006

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

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

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

Reference Standard :

Digital Thermometer with Sensor, Model : F250H, S/N : 9345 008 2331, Sensor RTD Probe No. RTD-01 and RTD-02 which was calibrated by Industrial Metrology and Testing Service Centre, Certificate No. PSL-T 0786/65.

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

Calibration Procedure :

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

Support Equipment :

Temperature & Humidity Controlled Chamber, Model : 9141-5110, S/N : 1205101

Adjustments : NONE

Page 2 of 4

P.T.

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

Request No. 22-66 / 0198

MTC No. PSL-H 0079 / 66

Results of Calibration :- (/) Without Adjustment () After Adjustment

Table : Temperature Measurement @ Wet Bulb

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
30.0	29.9	0.1	0.50
35.0	34.9	0.1	0.50
39.9	39.8	0.1	0.50

Table : Temperature Measurement @ Dry Bulb

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
30.0	29.9	0.1	0.50
35.0	35.0	0.0	0.50
39.9	39.9	0.0	0.50

Request No. 22-66 / 0198

MTC No. PSL-H 0079 / 66

Results of Calibration :-

Table : Temperature Measurement @ Globe Bulb

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
30.0	29.8	0.2	0.50
35.0	34.7	0.3	0.50
39.9	39.7	0.2	0.50

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

...end of certificate...



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



Certificate of Calibration

Certificate No. : 23PH299

Page : 1 of 2

Cert. No.: 23PH299

Page.: 2 of 2

Equipment : Digital Lux Meter

Manufacturer: Exttech

Model : 407026

Serial No.: 048599

ID No.: -

Condition As-Received: Used Item

Received Date: 02 June 2023

Calibration Date: 08 June 2023

Reference: 2306-0067DN

Submitted by: Environment Research & Technology Company Limited.

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

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

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

Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Photometry & Encoder	LMguide 9,6 m	120RC003	DL-0064-22	20 Jul 2025
2) High-accuracy Irradiance Standard	OL FEL-U	F-1470	TP-1037-22	24 Jul 2023

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

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

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


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

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

-National Institute of Metrology Thailand (NIMT)

-National Institute of Metrology (Thailand), NSC-ONSC Accredited No. Calibration 0144

Calibrated by : Nivat Nitas
Issue Date : 15 June 2023

Approved Signatory : 
[] Phalinee Prabpaipal
[] Chatchawan Khunpiluek
[x] Nuntawat Khamchai

Result of calibration:- (*) Without adjustment () After adjustment

Function : Illuminance Measurement	Range :	2000	lx
Standard Value	UUC* Reading	Error	Uncertainty
(lx)	(lx)	(lx)	(± lx)
0	0	0	0.60
15	11	-4	0.60
100	98	-2	1.3
500	498	-2	6.5
1000	1000	0	13
1500	1454	-46	20
1900	1760	-140	25

Function : Illuminance Measurement	Range :	20000	lx
Standard Value	UUC* Reading	Error	Uncertainty
(lx)	(lx)	(lx)	(± lx)
2000	1830	-170	26
3000	2650	-350	39
4000	3480	-520	52
5000	4290	-710	65

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

Light source factor setting mode : L

UUC* = Unit Under Calibration.

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Sound Level Meter Calibration Report

Support Equipment Type : Sound Level Calibrator

Manufacture : BSWA Technology

Model : CA115

Serial No. : 470205

Range of Calibrator

- Support Equipment Type : 113.9

- Frequency : 1,000 Hz.

Calibrated By : Ms.Rawipa Jarana

Calibration Date : November 18, 2023

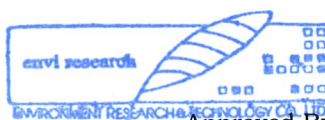
Customer Name : บริษัท โฟร์เทียร์ คอนซัลแตนต์ จำกัด :

โครงการโรงงานผลิตเหล็กแท่งและผลิตภัณฑ์เหล็กที่ผลิตจากเหล็กถลุง
ของบริษัท หยงซึง สตีล (ไทยแลนด์) จำกัด

[illegible]

Checked By

Mr. Prayun Detkla
Technician



Approved By

Ms.Sutatip Im-noi

Environmental Scientist



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0210

MTC No. EEL. BP. 122/0166

CALIBRATION CERTIFICATE

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

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

Model : CA115

Serial No. : 470205

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) kPa

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

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

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

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

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

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

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

Calibration Procedure: CP-102-04 based on IEC 60942-2003. The sound pressure level of instrument was measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 12 Jan. 2023

Date of Calibration : 18 Jan. 2023

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

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

FM.BLMTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0210

MTC No. EEL. BP. 122/0166

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

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

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	113.93	-0.07	± 0.10	± 0.75 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	1000.1	0.1	± 1.5	± 2.0 %

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	0.88	± 0.50	± 4.0 %

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

N. N. P. S.
(Mr. Nuttapong Niljrusvanit)

Approved by :



(Mr. Prawate Khuaypa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 18 Jan. 2023

Date of Issue : 20 Jan. 2023

Ref : 2011266011200119008

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End of Certificate

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