



## ภาคผนวก จ

### เอกสารสอบเทียบเครื่องมือวิเคราะห์

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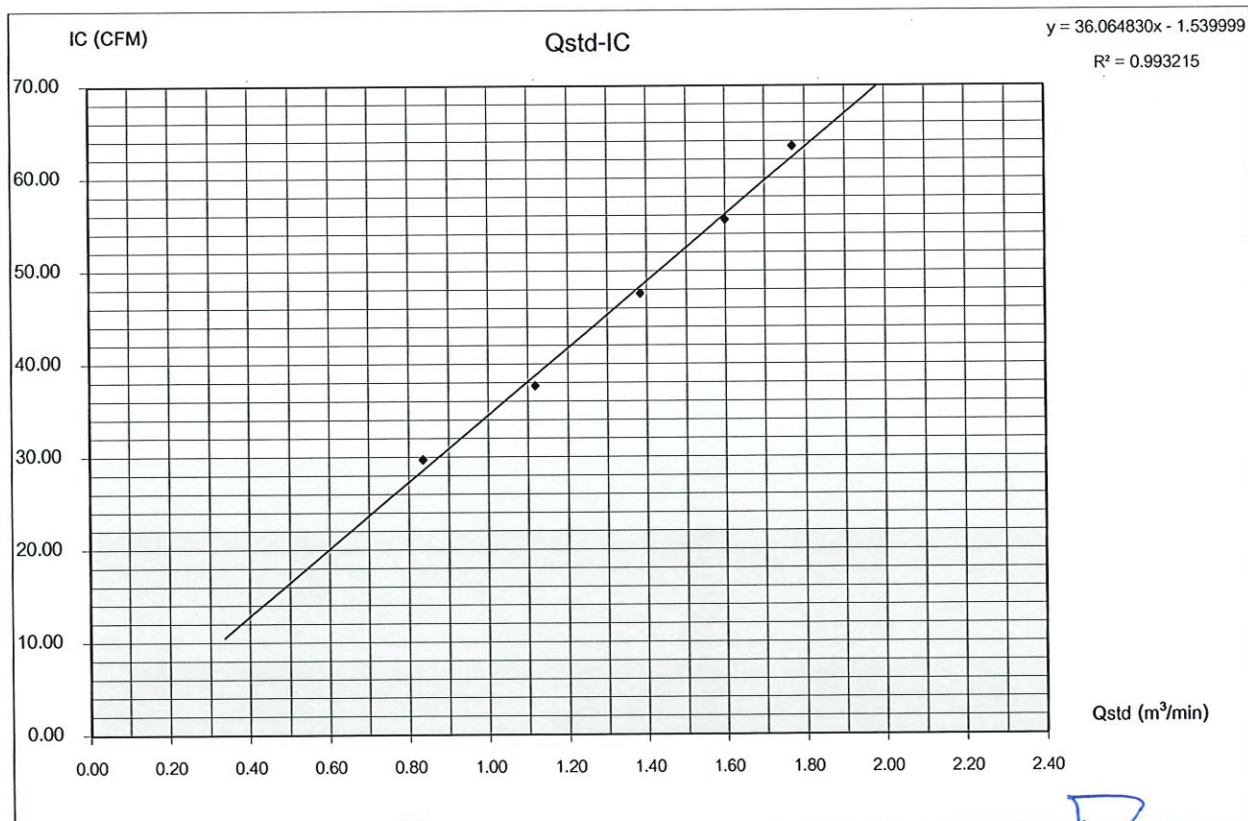
# TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2023-01857	Date	December 20, 2023
Sampler Location	วัดเขาโพธิ์	Start Time	3:20 PM
Sampler Number	TSP No.A25	Transfer Standard Type	Orifice
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A
Motor Serial Number	2142	Calibrator Serial Number	2914
Recorder Serial Number	2397	Calibrated By	Mr. Watcharin Charunsitthangkun

Plate No.	(Delta H)			( A )	( X )	( I )	( Y )	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH <sub>2</sub> O)			[ΔH <sub>2</sub> O(Pa/P <sub>std</sub> )(T <sub>std</sub> /Ta)] <sup>1/2</sup>	Qstd = (1/m)[(A-b)] ( m <sup>3</sup> /min )	Sample Flow Rate Indication ( ft <sup>3</sup> /min )	IC = [((Pa/P <sub>std</sub> )(T <sub>std</sub> /Ta)] <sup>1/2</sup>	(°K = °C+273)	( mmHg )		
	Positive	Negative	ΔH <sub>2</sub> O								
5	1.5	1.5	3.0	1.71770	0.83528	30.0	29.75	303.0	760.0		
7	2.7	2.7	5.4	2.30454	1.11759	38.0	37.69	303.0	760.0		
10	4.1	4.2	8.3	2.85710	1.38341	48.0	47.60	303.0	760.0		
13	5.5	5.6	11.1	3.30406	1.59843	56.0	55.54	303.0	760.0		
18	6.8	6.8	13.6	3.65726	1.76834	64.0	63.47	303.0	760.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	760.0		
1	Slope ( m )			2.07871	Linear Equation			r <sup>2</sup>	0.993215	Pstd(mmHg)	760.0
2	Intercept ( b )			-0.01861	Set Point Flow Rate ( X ) (m <sup>3</sup> /min)		1.133	r	0.9966017	T <sub>NTP</sub>	298.0
3	Correlation Coefficient ( r )			0.99984	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)		0.98349835	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.991714853	

## COMMENT

Andersen Instruments, Inc.



Checked By

( Mr. Prayun Detkla )  
Technician



Approved By

( Mr. Panupon Podang )  
Environmental Scientist

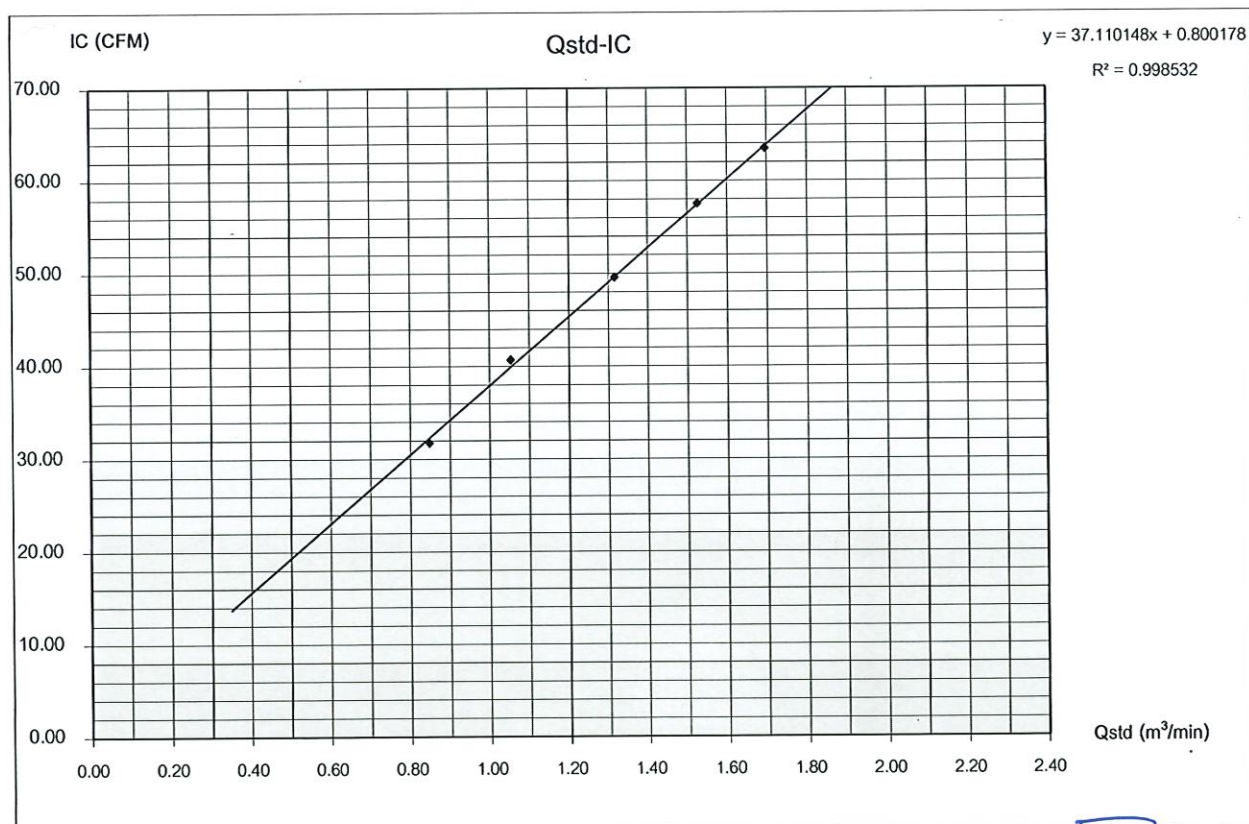
## PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2023-01857			Date	December 20, 2023
Sampler Location	วัดเขาโพธิ์			Start Time	3:10 PM
Sampler Number	PM-10 No.25	Transfer Standard Type	Orifice	Stop Time	3:20 PM
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Watcharin Charunsitthangkun
Motor Serial Number	2151	Calibrator Serial Number	2914		
Recorder Serial Number	2409				

Plate No.	(Delta H)			( A )	( X )	( I )	( Y )	Temperature	Barometric Pressure	Start Meter	Stop Meter	
	Pressure Drop Across Orifice (inH <sub>2</sub> O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	Qstd = (1/m)[(A-b)] ( m <sup>3</sup> /min )	Sample Flow Rate Indication ( ft <sup>3</sup> /min )	$IC = \{[(Pa/P_{std})(T_{std}/Ta)]^{1/2}\}^2$	(*K = °C+273)	( mmHg )			
	Positive	Negative	ΔH <sub>2</sub> O									
5	1.5	1.6	3.1	1.74609	0.84894	32.0	31.73	303.0	760.0			
7	2.4	2.4	4.8	2.17274	1.05419	41.0	40.66	303.0	760.0			
10	3.7	3.8	7.5	2.71592	1.31550	50.0	49.59	303.0	760.0			
13	5.0	5.1	10.1	3.15172	1.52514	58.0	57.52	303.0	760.0			
18	6.2	6.3	12.5	3.50624	1.69569	64.0	63.47	303.0	760.0			
Linear Regression Y ON X : Y= mX + b							Average	303.0	760.0			
1	Slope ( m )			2.07871	Linear Equation			r <sup>2</sup>	0.998532	Pstd(mmHg)	760.0	
2	Intercept ( b )			-0.01861	Set Point Flow Rate ( X ) ( m <sup>3</sup> /min)		1.133	r	0.9992657	T <sub>HTP</sub>	298.0	
3	Correlation Coefficient ( r )			0.99984	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)		0.98349835		
Result									C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.991714853	

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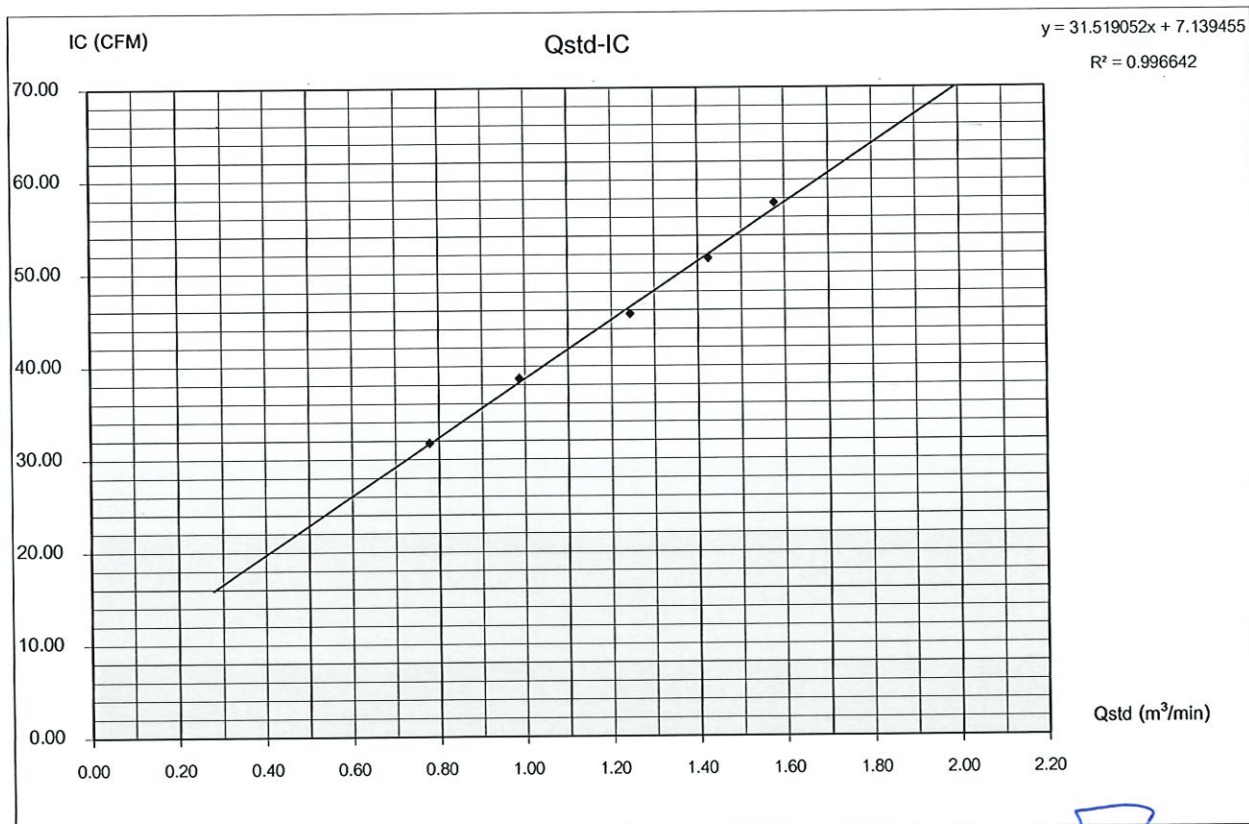
# TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2023-01857			Date	December 20, 2023	
Sampler Location	วัดนาบดอง			Start Time	1:50 PM	
Sampler Number	TSP No.A21	Transfer Standard Type	Orifice	Stop Time	2:00 PM	
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Watcharin Charunsitthangkun	
Motor Serial Number	2216	Calibrator Serial Number	2914			
Recorder Serial Number	2398					

Plate No.	(Delta H)			( A )	( X )	( I )	( Y )	Temperature	Barometric Pressure	Start Meter	Stop Meter	
	Pressure Drop Across Orifice (inH <sub>2</sub> O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ ( m <sup>3</sup> /min )	Sample Flow Rate Indicator ( ft <sup>3</sup> /min )	$IC = I[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	(°K = °C+273)	( mmHg )			
5	1.3	1.3	2.6	1.59909	0.77822	32.0	31.73	303.0	760.0			
7	2.1	2.1	4.2	2.03241	0.98668	39.0	38.68	303.0	760.0			
10	3.3	3.4	6.7	2.56699	1.24385	46.0	45.62	303.0	760.0			
13	4.4	4.4	8.8	2.94190	1.42421	52.0	51.57	303.0	760.0			
18	5.4	5.4	10.8	3.25911	1.57680	58.0	57.52	303.0	760.0			
Linear Regression Y ON X : Y= mX + b							Average	303.0	760.0			
1	Slope ( m )			2.07871	Linear Equation			r <sup>2</sup>	0.996642	Pstd(mmHg)	760.0	
2	Intercept ( b )			-0.01861	Set Point Flow Rate ( X ) ( m <sup>3</sup> /min )	1.133		r	0.9983196	T <sub>NTP</sub>	298.0	
3	Correlation Coefficient ( r )			0.99984	Final Set Flow Rate = ( I )	0		(Pa/Pstd)*(Tstd/Ta)		0.98349835		
Result									C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.991714853	

## COMMENT

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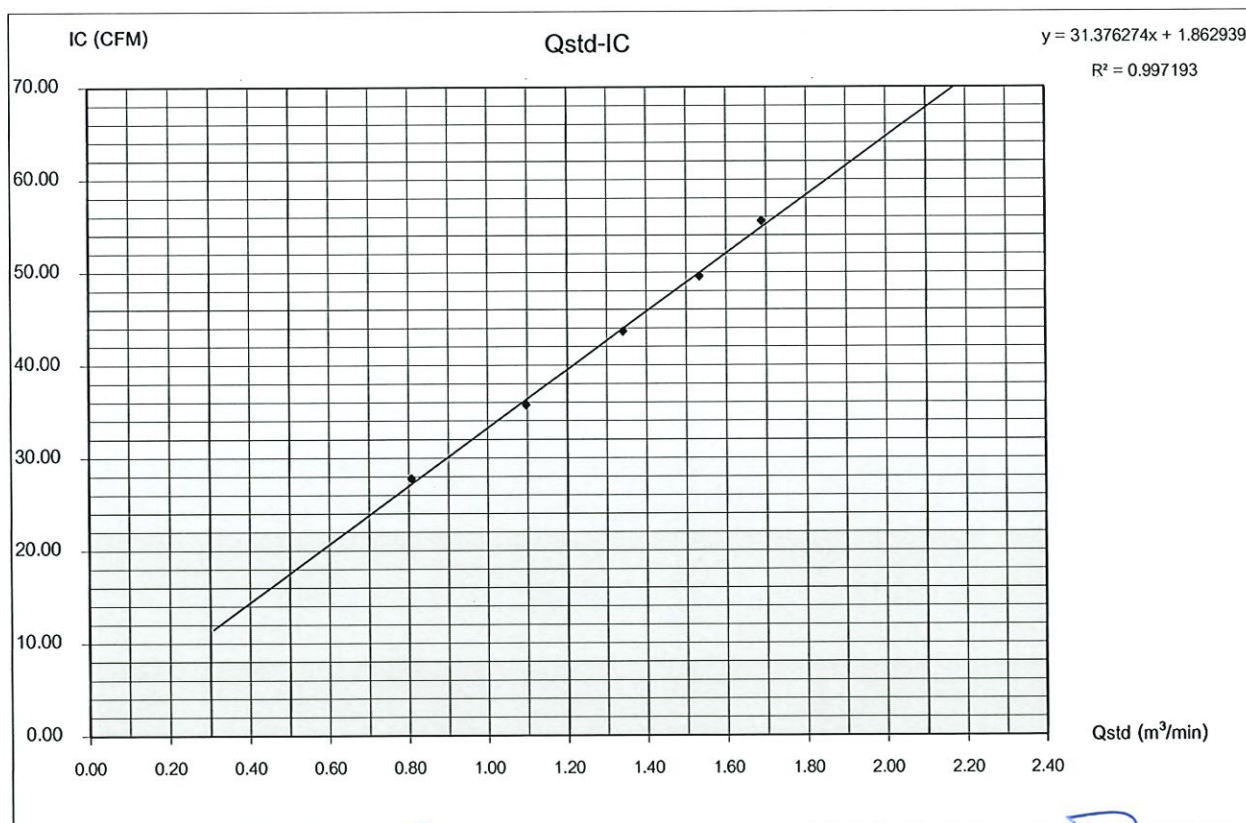
## PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2023-01857			Date	December 20, 2023
Sampler Location	วัดนาบตอง			Start Time	2:00 PM
Sampler Number	PM-10 No.26	Transfer Standard Type	Orifice	Stop Time	2:10 PM
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Watcharin Charunsitthangkun
Motor Serial Number	610-643	Calibrator Serial Number	2914		
Recorder Serial Number	R0411-004				

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH <sub>2</sub> O)			[ΔH <sub>2</sub> O(Pa/P <sub>std</sub> )(T <sub>std</sub> /Ta)] <sup>1/2</sup>	Qstd = (1/m)[(A-b)] (m <sup>3</sup> /min)	Sample Flow Rate Indicator (ft <sup>3</sup> /min)	IC = I[(Pa/P <sub>std</sub> )(T <sub>std</sub> /Ta)] <sup>1/2</sup>	(^°K = ^°C+273)	(mmHg)		
	Positive	Negative	ΔH <sub>2</sub> O								
5	1.4	1.4	2.8	1.65946	0.80726	28.0	27.77	303.0	760.0		
7	2.6	2.6	5.2	2.26146	1.09687	36.0	35.70	303.0	760.0		
10	3.9	3.9	7.8	2.76971	1.34137	44.0	43.64	303.0	760.0		
13	5.1	5.1	10.2	3.16728	1.53263	50.0	49.59	303.0	760.0		
18	6.2	6.2	12.4	3.49219	1.68893	56.0	55.54	303.0	760.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	760.0		
1	Slope ( m )			2.07871	Linear Equation			r <sup>2</sup>	0.997193	Pstd(mmHg)	760.0
2	Intercept ( b )			-0.01861	Set Point Flow Rate ( X ) (m <sup>3</sup> /min)		1.133	r	0.9985955	T <sub>NTP</sub>	298.0
3	Correlation Coefficient ( r )			0.99984	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)		0.98349835	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.991714853	

### COMMENT

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( Mr. Panupon Podang )

Environmental Scientist



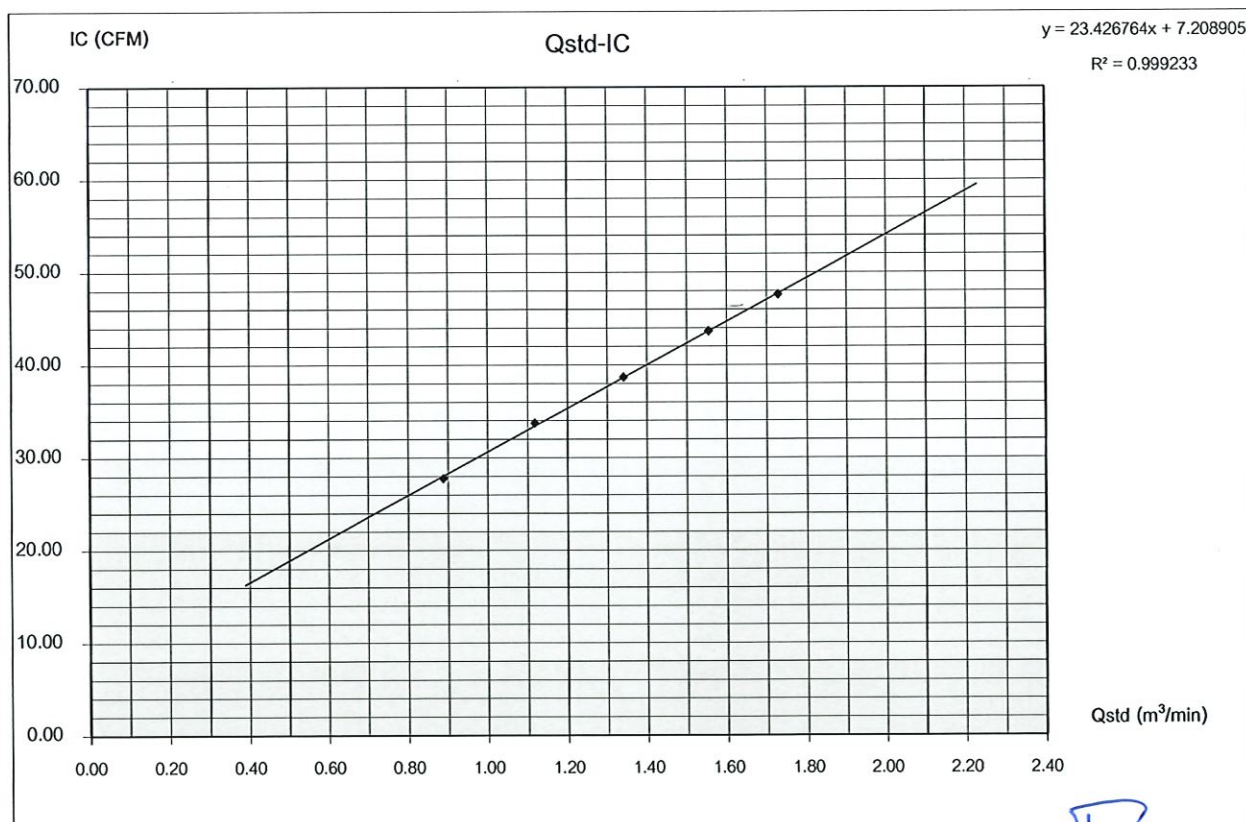
# TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2023-01857			Date	December 20, 2023
Sampler Location	วัดบางปลา			Start Time	12:00 PM
Sampler Number	TSP No.A8	Transfer Standard Type	Orifice	Stop Time	12:10 PM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Watcharin Charunsitthangkun
Motor Serial Number	902	Calibrator Serial Number	2914		
Recorder Serial Number	11452				

Plate No.	(Delta H)			( A )	( X )	( I )	( Y )	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH <sub>2</sub> O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	Qstd = (1/m)((A-b)) ( m <sup>3</sup> /min )	sample Flow Rate Indication ( ft <sup>3</sup> /min )	$IC = I[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$ (*K = °C+273)	303.0	760.0		
	Positive	Negative	ΔH <sub>2</sub> O								
5	1.7	1.7	3.4	1.82863	0.88865	28.0	27.77	303.0	760.0		
7	2.7	2.7	5.4	2.30454	1.11759	34.0	33.72	303.0	760.0		
10	3.9	3.9	7.8	2.76971	1.34137	39.0	38.68	303.0	760.0		
13	5.2	5.3	10.5	3.21352	1.55487	44.0	43.64	303.0	760.0		
18	6.5	6.5	13.0	3.57568	1.72910	48.0	47.60	303.0	760.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	760.0		
1	Slope ( m )			2.07871	Linear Equation			r <sup>2</sup>	0.999233	Pstd(mmHg)	760.0
2	Intercept ( b )			-0.01861	Set Point Flow Rate ( X ) ( m <sup>3</sup> /min)		1.133	r	0.9996164	T <sub>NTP</sub>	298.0
3	Correlation Coefficient ( r )			0.99984	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)		0.98349835	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.991714853	

COMMENT

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( Mr. Panupon Podang )

Environmental Scientist

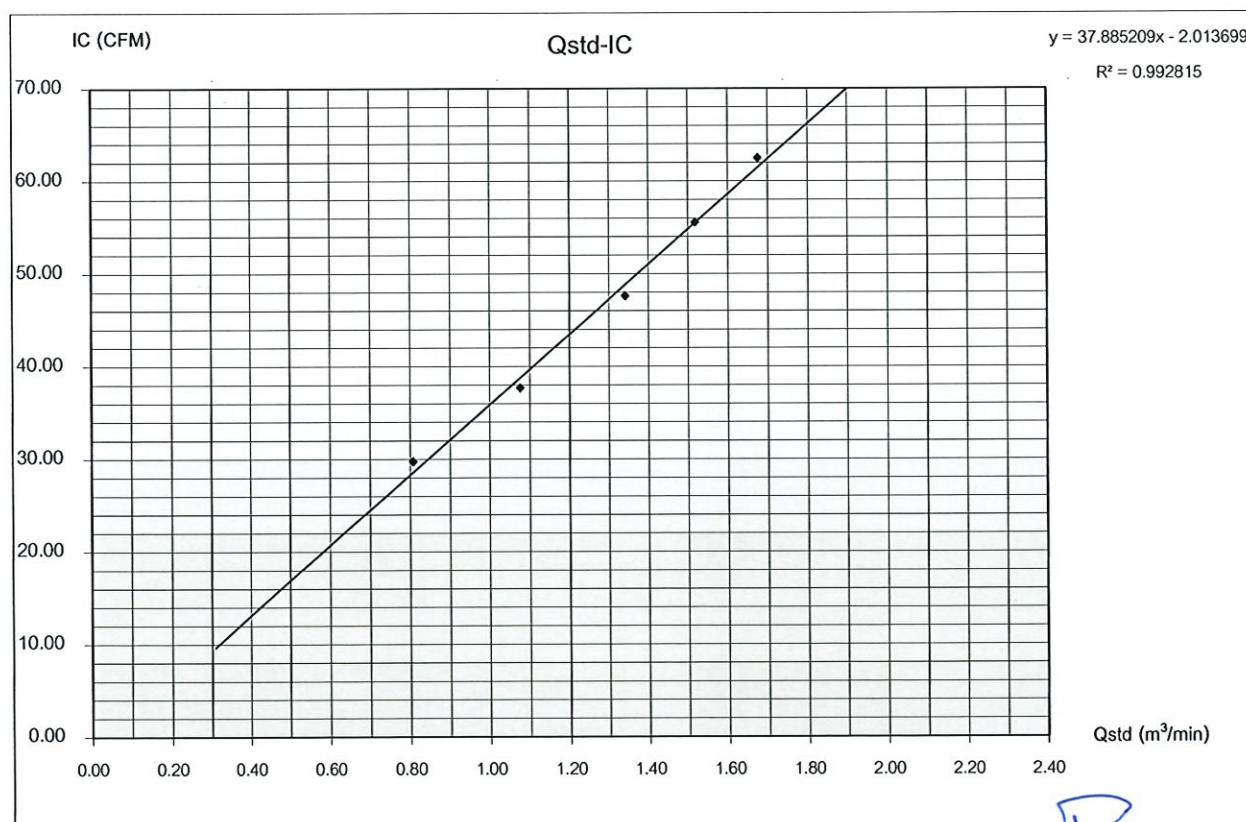
# PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2023-01857			Date	December 20, 2023
Sampler Location	วัดบางนา			Start Time	11:50 AM
Sampler Number	PM-10 No.21	Transfer Standard Type	Orifice	Stop Time	12:00 PM
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Watcharin Charunsithangkun
Motor Serial Number	2132	Calibrator Serial Number	2914		
Recorder Serial Number	2392				

Plate No.	(Delta H)			( A )	( X )	( I )	( Y )	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH <sub>2</sub> O)			[ΔH <sub>2</sub> O(Pa/P <sub>std</sub> )(T <sub>std</sub> /Ta)] <sup>1/2</sup>	Qstd = (1/m)[(A-b)] ( m <sup>3</sup> /min )	Sample Flow Rate Indication ( ft <sup>3</sup> /min )	IC = I[(Pa/P <sub>std</sub> )(T <sub>std</sub> /Ta)] <sup>1/2</sup>	(*K = °C+273)	( mmHg )		
	Positive	Negative	ΔH <sub>2</sub> O								
5	1.4	1.4	2.8	1.65946	0.80726	30.0	29.75	303.0	760.0		
7	2.5	2.5	5.0	2.21754	1.07574	38.0	37.69	303.0	760.0		
10	3.9	3.9	7.8	2.76971	1.34137	48.0	47.60	303.0	760.0		
13	5.0	5.0	10.0	3.13608	1.51762	56.0	55.54	303.0	760.0		
18	6.1	6.1	12.2	3.46391	1.67533	63.0	62.48	303.0	760.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	760.0		
1	Slope ( m )			2.07871	Linear Equation			r <sup>2</sup>	0.99815	Pstd(mmHg)	760.0
2	Intercept ( b )			-0.01861	Set Point Flow Rate ( X ) (m <sup>3</sup> /min)		1.133	r	0.9990746	T <sub>NTP</sub>	298.0
3	Correlation Coefficient ( r )			0.99984	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)			0.98349835
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5			0.991714853

## COMMENT

Andersen Instruments, Inc.



Checked By

*Prayun*  
( Mr. Prayun Detkla )  
Technician



Approved By

*Panupon*  
( Mr. Panupon Podang )  
Environmental Scientist



# TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2023-01857			Date	December 20, 2023
Sampler Location	วัดหนองจันทน์			Start Time	10:50 AM
Sampler Number	TSP No.A29	Transfer Standard Type	Orifice	Stop Time	11:00 AM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Watcharin Charunsitthangkun
Motor Serial Number	2014-02	Calibrator Serial Number	2914		
Recorder Serial Number	2135				

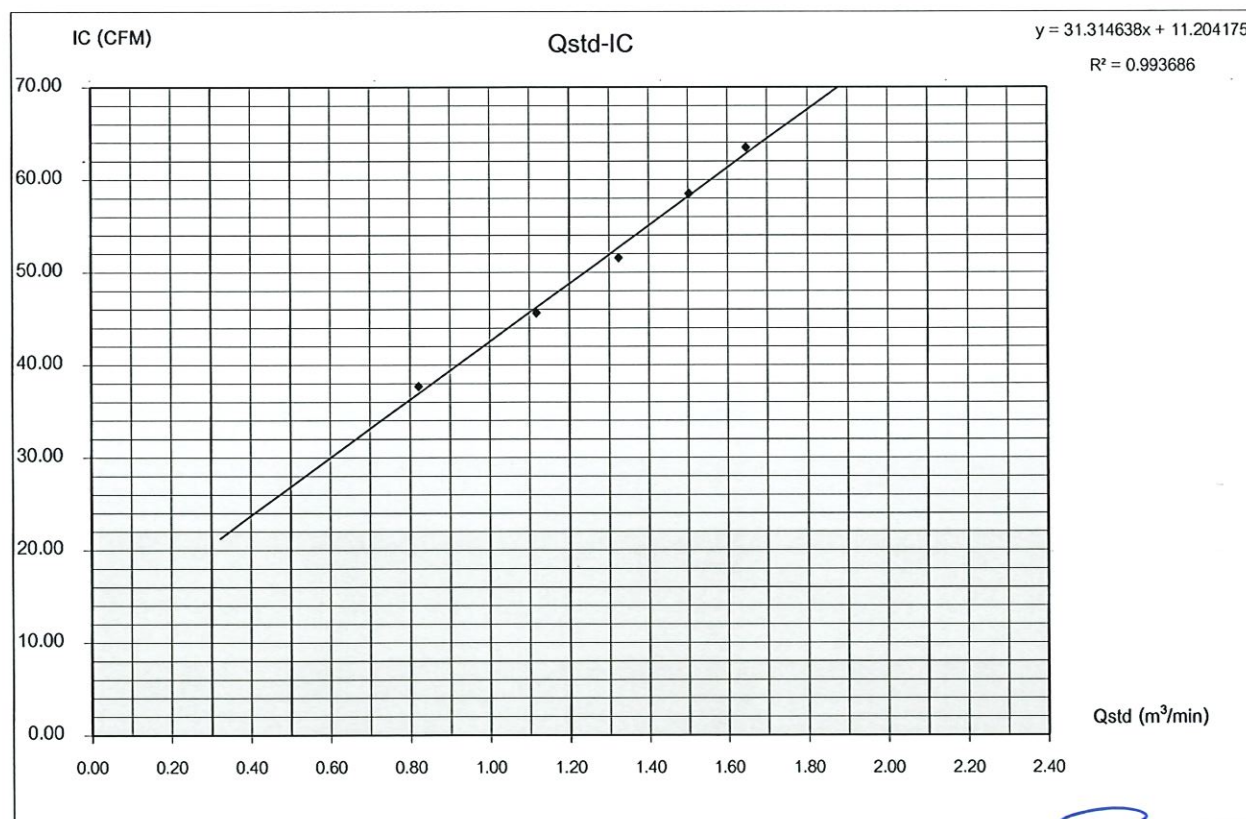
Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Positive	Negative	$\Delta H_2O$	$[\Delta H_2O(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ ( $m^3/min$ )	Sample Flow Rate Indication ( $ft^3/min$ )	$IC = \{[(Pa/P_{std})(T_{std}/T_a)]^{1/2}\}^{1/2}$	( $^{\circ}K = ^{\circ}C + 273$ )	(mmHg)		
5	1.4	1.5	2.9	1.68883	0.82139	38.0	37.69	303.0	760.0		
7	2.7	2.7	5.4	2.30454	1.11759	46.0	45.62	303.0	760.0		
10	3.8	3.8	7.6	2.73397	1.32418	52.0	51.57	303.0	760.0		
13	4.9	4.9	9.8	3.10456	1.50246	59.0	58.51	303.0	760.0		
18	5.9	5.9	11.8	3.40665	1.64778	64.0	63.47	303.0	760.0		

Linear Regression Y ON X :  $Y = mX + b$

			Average				
1	Slope ( m )	2.07871	Linear Equation		$r^2$	0.993686	Pstd(mmHg)
2	Intercept ( b )	-0.01861	Set Point Flow Rate ( X ) ( $m^3/min$ )	1.133	r	0.996838	T <sub>HTP</sub>
3	Correlation Coefficient ( r )	0.99984	Final Set Flow Rate = ( I )	0	(Pa/Pstd)*(Tstd/Ta)	0.98349835	
Result					$C = (Pa/Pstd)*(Tstd/Ta)^{0.5}$	0.991714853	

COMMENT

Andersen Instruments, Inc.



Checked By

*Prayun*  
( Mr. Prayun Detkla )  
Technician



Approved By

*Panupon*  
( Mr. Panupon Podang )  
Environmental Scientist



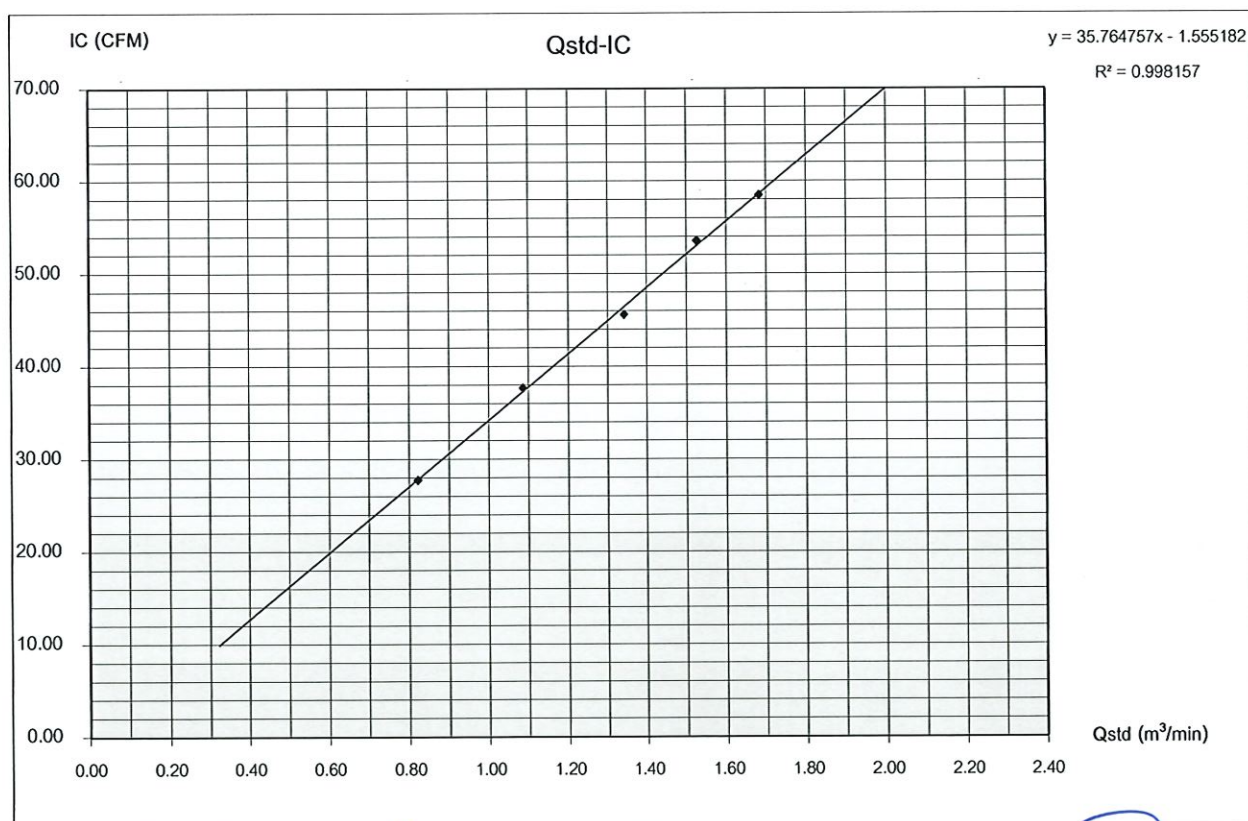
# PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2023-01857	Date	December 20, 2023
Sampler Location	วัดหนองนกัณนา	Start Time	10:50 AM
Sampler Number	PM-10 No.11	Transfer Standard Type	Orifice
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A
Motor Serial Number	610-643	Calibrator Serial Number	2914
Recorder Serial Number	R0411-004	Calibrated By	Mr. Watcharin Charunsilthangkun

Plate No.	(Delta H)			( A )	( X )	( I )	( Y )	Temperature	Barometric Pressure	Start Meter	Stop Meter	
	Pressure Drop Across Orifice (inH <sub>2</sub> O)			$[\Delta H_2O(Pa/P_{113})(T_{113}/Ta)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$	sample Flow Rate Indication	$IC = I[(Pa/P_{113})(T_{113}/Ta)]^{1/2}$					
	Positive	Negative	ΔH <sub>2</sub> O		( m <sup>3</sup> /min )	( ft <sup>3</sup> /min )		(°K = °C+273)	( mmHg )			
5	1.4	1.5	2.9	1.68883	0.82139	28.0	27.77	303.0	760.0			
7	2.6	2.5	5.1	2.23961	1.08636	38.0	37.69	303.0	760.0			
10	3.9	3.9	7.8	2.76971	1.34137	46.0	45.62	303.0	760.0			
13	5.0	5.1	10.1	3.15172	1.52514	54.0	53.55	303.0	760.0			
18	6.1	6.2	12.3	3.47808	1.68214	59.0	58.51	303.0	760.0			
Linear Regression Y ON X : Y= mX + b							Average	303.0	760.0			
1	Slope ( m )			2.07871	Linear Equation			r <sup>2</sup>	0.998157	Pstd(mmHg)	760.0	
2	Intercept ( b )			-0.01861	Set Point Flow Rate ( X ) (m <sup>3</sup> /min)		1.133	r	0.9990781	T <sub>NTP</sub>	298.0	
3	Correlation Coefficient ( r )			0.99984	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)		0.98349835		
Result									C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.991714853	

## COMMENT

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Technician

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Environmental Scientist

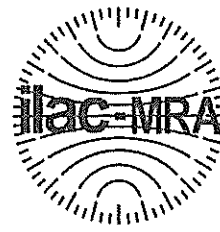


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63/14-15, 67/35-36  
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Bangkok 10600(Thailand)  
Tel: +6608680812  
Mobile: +66863999453  
E-mail: jnac-calibration@jiranatee.com  
Web site: www.jiranatee.com

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

Flow measurement laboratory  
Calibration services department.



## CERTIFICATE OF CALIBRATION

Certificate No. : COF-006-66

Page 1 of 2 Pages

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

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

### ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

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

### CALIBRATION CONDITION:

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

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

### TABULATION OF RESULTS:

The table on next page give the measured values.

### Calibration procedure:

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

### Traceability:

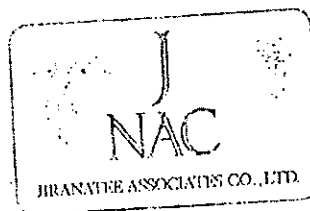
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the VSL (National Metrology Institute of Netherlands) via Certificate number: G2211901

### Uncertainty of Measurement:

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

Calibrated by:

- ☒ Mr. Sorawit Thachalad  
☐ Miss Jitraporn Lertsomphol



Approved signatory: .....

Mr. Parinya Booncharoen  
Calibration Department Manager





JIRANATEE ASSOCIATES CO.,LTD.

Continuation of Certificate of Calibration Number COF-006-66

Page 2 of 2 Pages

#### 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	$\Delta p_{meter}$ mmHg	$\Delta p_{Orifice}$ inH <sub>2</sub> O	$\gamma$	Standard Flow [ $Q_s$ ] $m^3/min$
1	0.699	755.476	24.24	23.40	53.510	1.786	1.334	0.649
2	1.000	755.470	24.17	23.68	58.170	3.598	1.894	0.921
3	1.111	755.481	24.19	23.60	40.793	4.682	2.160	1.050
4	1.167	755.465	23.87	23.48	31.004	5.323	2.305	1.118
5	1.411	755.522	24.29	23.78	30.145	7.846	2.796	1.352

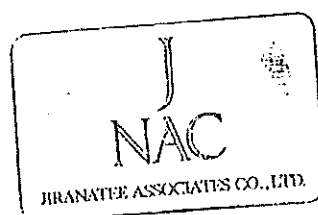
Slope ( $m$ ): 2.07871  
Intercept ( $b$ ): -0.01861  
Correlation coefficient ( $r$ ): 0.99984  
Uncertainty ( $k=2$ ): 0.015  $m^3/min$

Table 2: The results of  $Q$  actual calibration data

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

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

\*\*\*End of Certificate of Calibration\*\*\*



Mettler-Toledo (Thailand) Ltd.  
846/4 - 846/5 Lasalle Rd., Bangna Tai Sub-District  
Bangna District, Bangkok 10260  
+66 2723 0382  
MT-TH.ServiceSupport@mtl.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: 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: Chawalit Martsuloke  
As Left Calibration Date: 17-Jan-2023  
Issue Date: 19-Jan-2023  
Approved Signatory: [Signature]  
Technical Manager / Head of Calibration Center

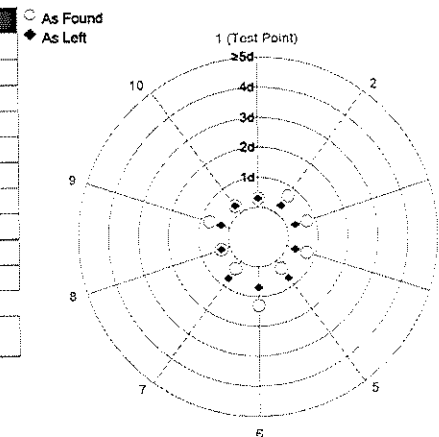
## Measurement Results

### 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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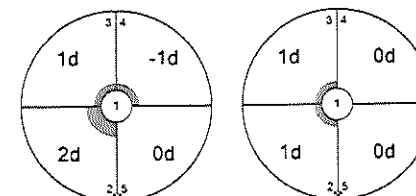
The "1d" in the graph represents the readability of the range/interval in which the test was performed.  
The results of this graph are based upon the absolute values of the differences from the mean value.

### 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.



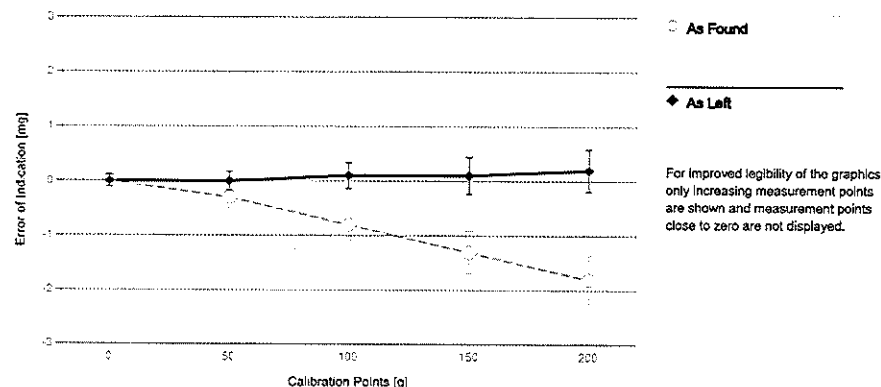
Error of Indication

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

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

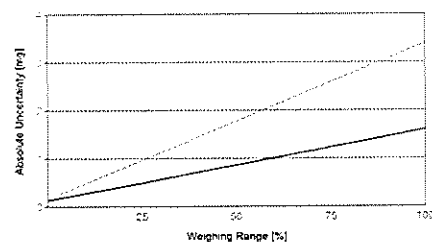
### Linearization of Uncertainty Equation

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

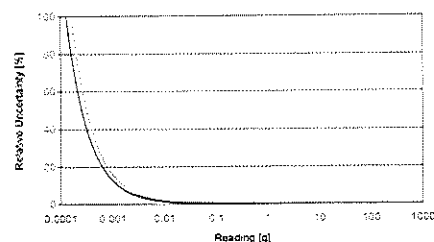
To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

### 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%



As Found



As Left

# GWP® Certificate



As  
Found



As  
Left



The weighing device meets the given process requirements.

The weighing device meets the given process requirements.

Tests Performed: ☒ As Found ☒ As Left

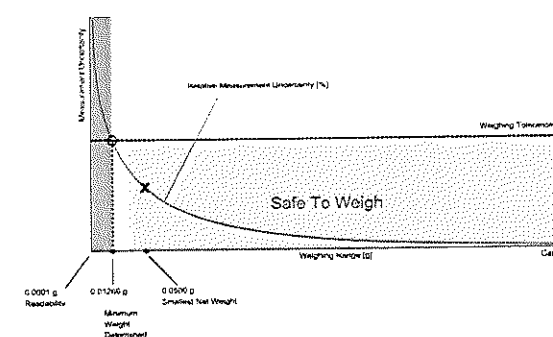
## Process Requirements

Weighing Tolerance: 1%

Smallest Net Weight: 0.0500 g

Safety Factor: 2

### Safe Weighing Range




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



## Minimum Weight


### As Found Minimum Weight Table

Minimum weights for different weighing tolerances and safety factors					
Tolerance	Safety Factor				
	1	2	3	5	10
0.1%	0.16012 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. 284/23

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : Davis Instruments Inc.

Type : Weather Wizard III Product No. 7425

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

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

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1008.5 hPa

### NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91563

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

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

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

Serial Number 110730029 (sensor 120629586)

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

Calibrated by :

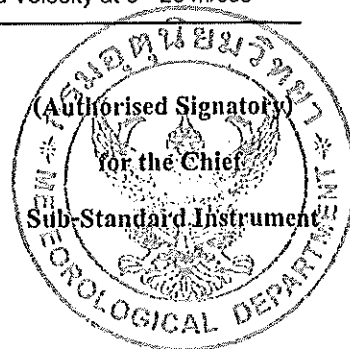
*Watchapol*

Mr. Watchapol Subwat

Mechanical Engineer

Signed :

*Pisod Promsut*  
Mr. Pisod Promsut







# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Certification No. 284/23

11 August, 2023

Page : 2 of 2

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacumm	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.5	0.50
7.04	-	-	-	6.7	0.34
9.02	-	-	-	8.5	0.52
11.01	-	-	-	10.7	0.31
13.01	-	-	-	12.5	0.51
15.01	-	-	-	14.7	0.31
17.02	-	-	-	16.5	0.52
20.02	-	-	-	19.7	0.32

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

Calibrated by :

Wacharapol

Mr. Watcharapol Subwat

Mechanical Engineer



# THAI METEOROLOGICAL DEPARTMENT



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

## Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 12 September, 2023

Certification No. 352/23

Page : 1 of 4

Object : Weather Station

Manufacturer : Davis Instruments Inc.

Type : Vantage Pro 2 ID No. : No.22

Serial No. : Display AS160105011 Transmitter AS160105019

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 1011.5 hPa

### NATIONAL STANDARD WIND TUNNEL :

Micromanometer Theodor Friedrichs FC014 Serial No. 9310119

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

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

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

Serial Number 110730029 (sensor 120629586)

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

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

: Thermoschneider No.918602

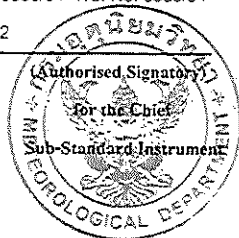
Calibrated by : *Watchapol*

Signed :

Mr. Watchapol 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. 352/23

12 September, 2023

Page : 2 of 4

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	0.9	0.10
3.02	-	-	-	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	-	-	-	15.0	0.01
17.02	-	-	-	16.9	0.12
20.02	-	-	-	20.0	0.02

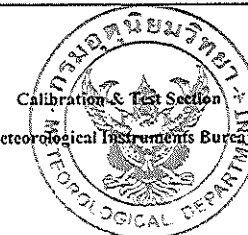
Wind Aloft Plotting Board.	
US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated by :

*Watchapol*

Mr. Watchapol Subwat

Mechanical Engineer





## THAI METEOROLOGICAL DEPARTMENT

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

### The Result of Calibration

Certification No. 352/23

12 September, 2023

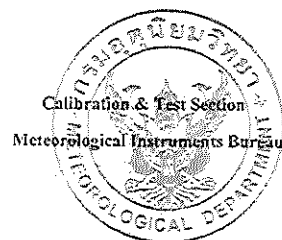
Page : 3 of 4

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
50.2	50.2	0.0
30.4	30.3	0.1
15.6	15.5	0.1

Checked by :

*Watchapol*

Mr. Watchapol Subwat  
Mechanical Engineer



Date of Issue 12 September, 2023

Certification No. 352/23

Page: 4 of 4

### ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชี่ห้อ Davis Instruments แบบ TIPPING  
BUCKET Product No.7342.026 Mfg. Code. AS.160105019 ทำการสอบเทียบกับแก้ววัดฝน  
แบบแก้วดวง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON No.  
71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.01 in./TIP)



ลงชื่อ..... *วิรัชพล ทรัพย์วัฒน์* .....

(นายวิรัชพล ทรัพย์วัฒน์)

วิศวกรชำนาญการ





# 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 12 April, 2023

Certification No. 159/23

Page : 1 of 3

Object : Weather Station

Manufacturer : Davis Instruments

Type : Vantage Pro2 ID No. : No.26

Serial No. : Display AS160202003 Transmitter AS160202003

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 1008.6 hPa

NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91563

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

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

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

Serial Number 110730029 (sensor 120629586)

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

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

: testo, testo 645 Serial No. 02848057 : Thermoschneider No.918802

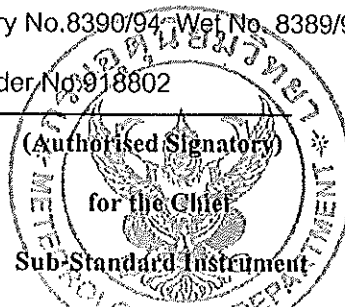
Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

Signed :

Mr. P. Isobd Promsut





# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Certification No. 159/23

12 April, 2023

Page : 2 of 3

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H <sub>2</sub> O	Vacumm inches H <sub>2</sub> O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.9	0.10
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.9	0.10
7.00	-	-	-	6.7	0.30
9.02	-	-	-	8.9	0.12
11.01	-	-	-	10.7	0.31
13.01	-	-	-	13.0	0.01
15.01	-	-	-	14.7	0.31
17.02	-	-	-	17.0	0.02
20.02	-	-	-	19.7	0.32

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

Calibrated by :

Watarapoc

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. 159/23

12 April, 2023

Page : 3 of 3

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
50.1	50.1	0.0
30.2	30.2	0.0
15.8	15.9	-0.1

Checked by :

Mr. Watcharapol Subwat  
Mechanical Engineer







# THAI METEOROLOGICAL DEPARTMENT

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

## Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 20 August, 2022

Certification No. 341/22

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : Davis Instruments Inc.

Type : Weather Wizard III Product No. 7425

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

Customer : Environment Research & Technology Company Limited.

25/113-114 Moo 6 Soi Chinaket 1, Ngamwongwan Road,

Toongsonghong, Laksi, Bangkok 10210.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1007.8 hPa

NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91563

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

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

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

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

: Standard Velocity at 20 m/sec

Calibrated by :

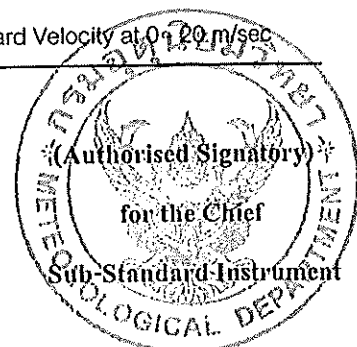
*Watchapol*

Mr. Watchapol Subwat

Mechanical Engineer

Signed :

*Pisood Promsut*  
Mr. Pisood Promsut





# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Certification No. 341/22

20 August, 2022

Page : 2 of 2

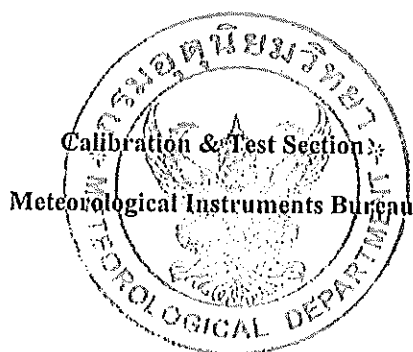
Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H <sub>2</sub> O	Vacuum inches H <sub>2</sub> O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.5	0.50
7.04	-	-	-	6.7	0.34
9.02	-	-	-	8.5	0.52
11.01	-	-	-	10.8	0.21
13.01	-	-	-	12.5	0.51
15.01	-	-	-	14.8	0.21
17.02	-	-	-	17.0	0.02
20.02	-	-	-	19.8	0.22

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

Calibrated by :

Watcharapol

Mr. Watcharapol Subwat  
Mechanical Engineer









THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0064

MTC No. EEL. BP. 121/1066

## CALIBRATION CERTIFICATE

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

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

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

### Instrument Calibrated :

Description : Precision Acoustic Calibrator

Manufacturer : Larson Davis

Model : CAL200

Serial No. : 3606

### Ambient Environment

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

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

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

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

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

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

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

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

6. Audio Analyzer Panasonic VP-7722A S/N 041477D122.

7. Condenser Microphone B&K 4180 S/N 2633526.

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

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

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

Date of Receipt : 30 Oct. 2023

Date of Calibration : 31 Oct. 2023

1/3

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

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

FM.BL.MTC.002 Rev.4

#### Head Office

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

Tel. (66) 0 2577 9000

Fax. (66) 0 2577 9009

E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

#### Office/Laboratory

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,  
Amphoe Muang, Changwat Samutprakan 10280, Thailand

Tel. (66) 0 2323 1672-80 ext. 115, 116

Fax. (66) 0 2323 9165

E-mail : mtc@tistr.or.th

#### Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand

Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217

Fax. (66) 0 2579 8592

E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0064

MTC No. EEL. BP. 121/1066

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

Nominal Output of Unit Under Test = 94 dB re 20 $\mu$ Pa at 1000 Hz

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer4180	93.42	-0.58	$\pm 0.10$	$\pm 0.40$ dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer4180	1000.4	0.4	$\pm 1.5$	$\pm 1.0\%$

3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer4180	1.80	$\pm 0.50$	$\pm 3.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

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

Date of Calibration : 31 Oct. 2023

2 / 3

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FM.BL.MTC.002 Rev.4

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

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

Office  
196 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand  
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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0064

MTC No. EEL. BP. 121/1066

Nominal Output of Unit Under Test = 114 dB re 20 $\mu$ Pa at 1000 Hz

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	113.45	-0.55	$\pm 0.10$	$\pm 0.40$ dB

2. Frequency

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

3. Total Distortion


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

Note : 1. No adjustment.


2. The calibrator pressure correction was not included.

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

Calibrated by :

  
(Mr. Weerachai Decchaiyae)

Approved by :

  
(Mr. Prawate Kluaypa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 31 Oct. 2023

Date of Issue : 1 Nov. 2023

Ref : 2011266103004305003

End of Certificate

3 / 3

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

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35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,  
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