

ภาคผนวก จ



เอกสารสอบเทียบเครื่องมือวิเคราะห์

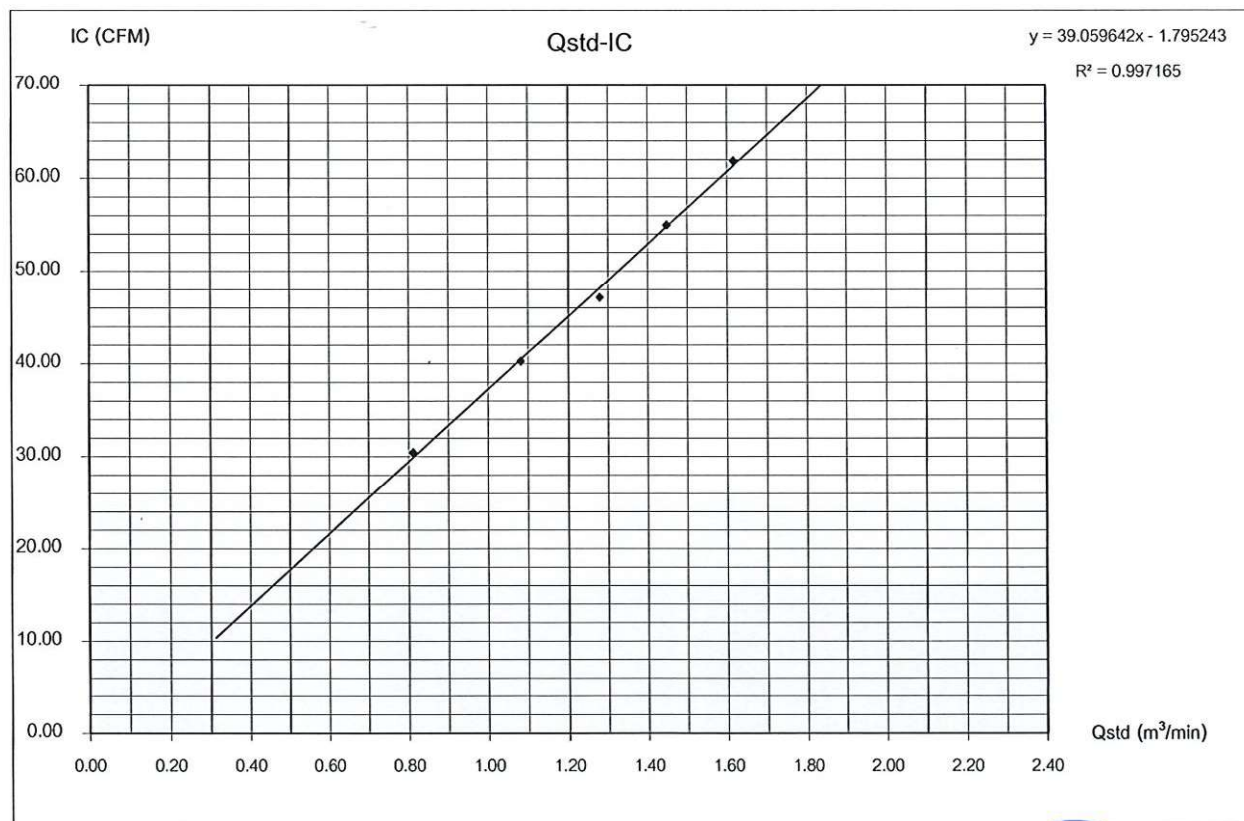
PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	May 30, 2023
A1 ทต.บ้านคลองหนึ่ง (2023-00722)				Start Time	12:11 AM
Sampler Number	PM-10 No.25	Transfer Standard Type	Orifice	Stop Time	12:21 AM
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Nigul Phokhamla
Motor Serial Number	2150	Calibrator Serial Number	3362		
Recorder Serial Number	2409				

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 = (I/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	1.4	1.4	2.8	1.64268	0.81134	31.0	30.43	308.0	757.0		
7	2.5	2.5	5.0	2.19512	1.08183	41.0	40.25	308.0	757.0		
10	3.5	3.5	7.0	2.59730	1.27876	48.0	47.12	308.0	757.0		
13	4.5	4.5	9.0	2.94507	1.44903	56.0	54.97	308.0	757.0		
18	5.6	5.6	11.2	3.28536	1.61565	63.0	61.85	308.0	757.0		
Linear Regression Y ON X : Y= mX + b							Average	308.0	757.0		
1	Slope (m)			2.04234	Linear Equation			r ²	0.997165	Pstd(mmHg)	760.0
2	Intercept (b)			-0.01435	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9985815	T _{HTP}	298.0
3	Correlation Coefficient (r)			0.99993	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)			0.96371326
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5			0.981688984

COMMENT

Andersen Instruments, Inc.



Checked By

(Mr. Prayun Detkla)
Technician

envi research
ENVIRONMENT RESEARCH & TECHNOLOGY CO., LTD.

Approved By

(Mr. Panupon Podang)
Environmental Scientist

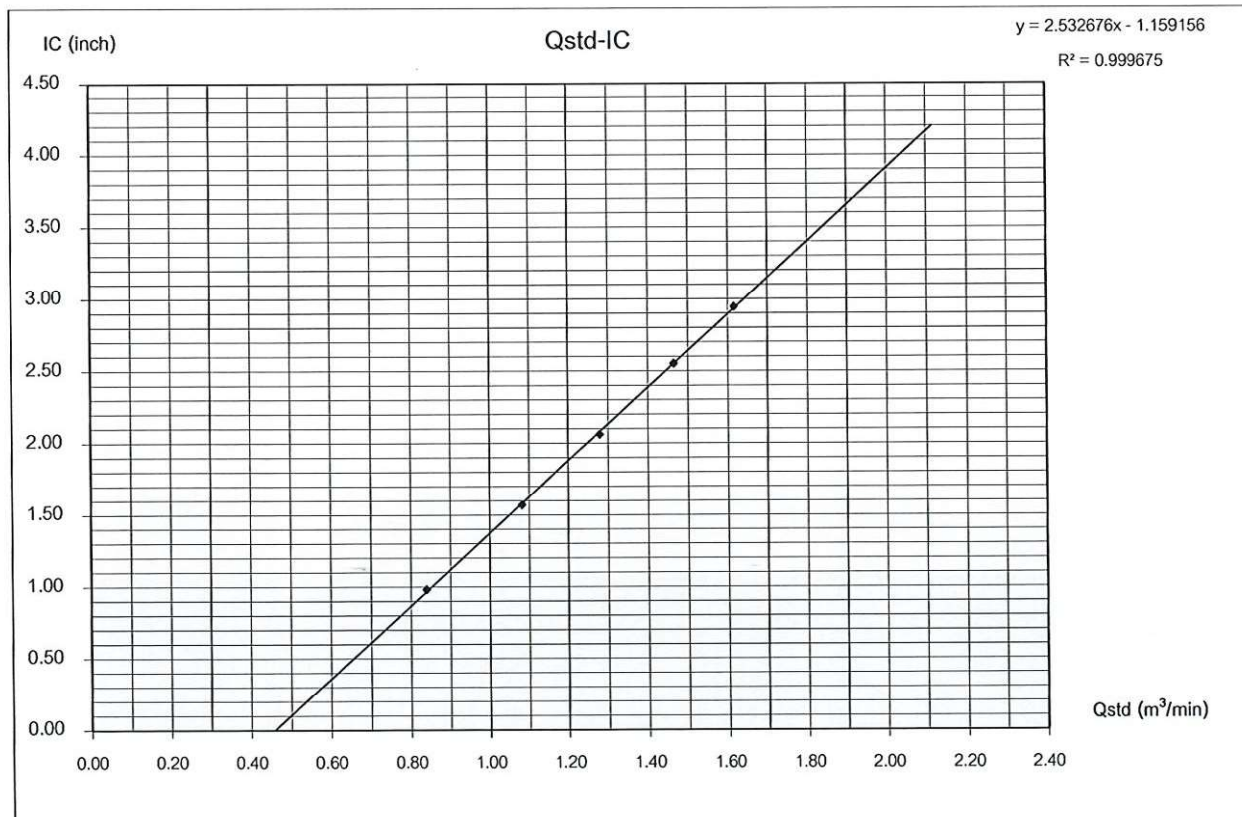
TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	May 30, 2023
A1 พ.ต.บ้านคลองหนึ่ง (2023-00722)				Start Time	12:22 AM
Sampler Number	TSP No.C17	Transfer Standard Type	Orifice	Stop Time	12:32 AM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Nigul Phokhamla
Motor Serial Number	202002	Calibrator Serial Number	3362		
Recorder Serial Number	-				

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 Indicator (inch)	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	1.70034	0.83957	1.0	0.98	308.0	757.0		
7	2.5	2.5	5.0	2.19512	1.08183	1.6	1.57	308.0	757.0		
10	3.5	3.5	7.0	2.59730	1.27876	2.1	2.06	308.0	757.0		
13	4.6	4.6	9.2	2.97761	1.46497	2.6	2.55	308.0	757.0		
18	5.6	5.6	11.2	3.28536	1.61565	3.0	2.95	308.0	757.0		
Linear Regression Y ON X : Y= mX + b							Average	308.0	757.0		
1	Slope (m)			2.04234	Linear Equation			r ²	0.999675	Pstd(mmHg)	760.0
2	Intercept (b)			-0.01435	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9998375	T _{NTP}	298.0
3	Correlation Coefficient (r)			0.99993	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.96371326	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.981688984	

COMMENT

Andersen Instruments, Inc.



Checked By

(Mr. Prayun Detkla)
Technician



Approved By

(Mr. Panupon Podang)
Environmental Scientist

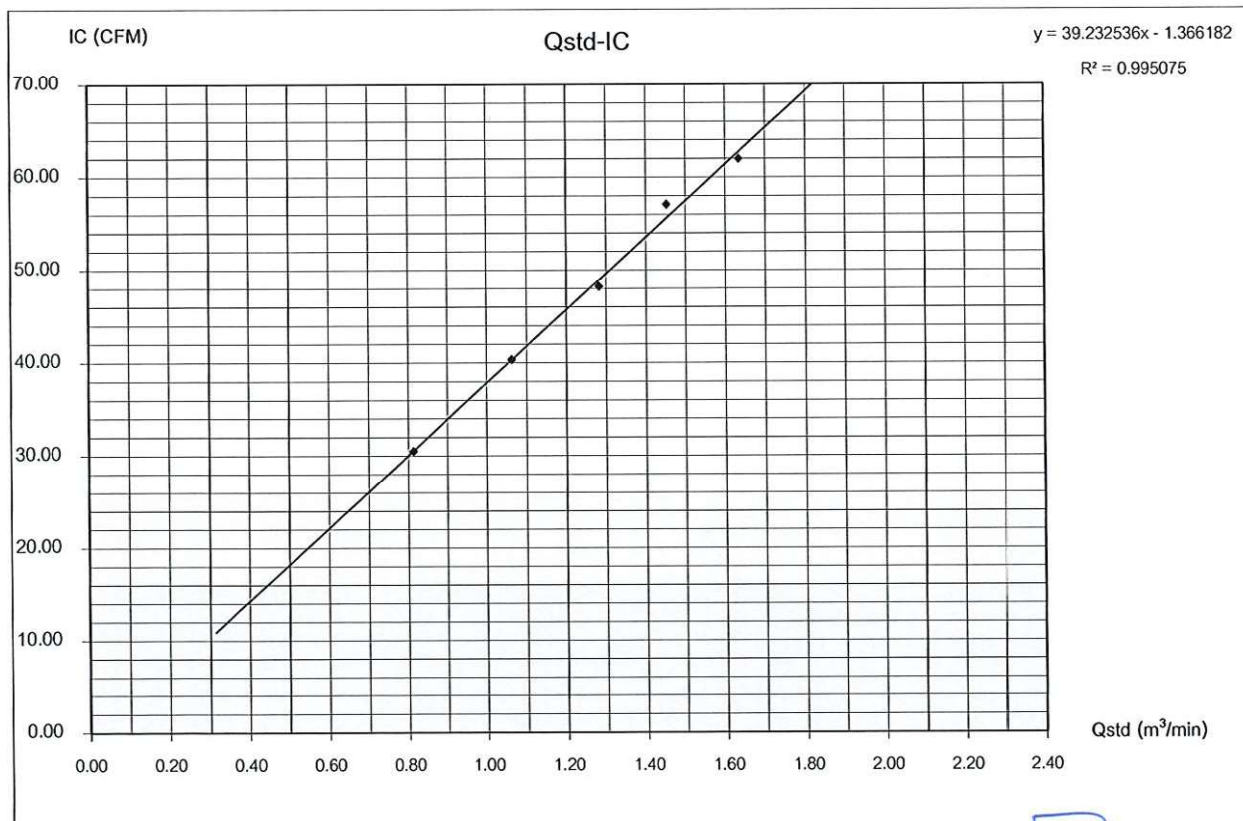
PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	May 30, 2023
A2 บ้านเลขที่ 60 (2023-00722)				Start Time	10:42 PM
Sampler Number	PM-10 No.24	Transfer Standard Type	Orifice	Stop Time	10:52 PM
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Nigul Phokhamla
Motor Serial Number	2149	Calibrator Serial Number	3362		
Recorder Serial Number	2407				

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	1.4	1.4	2.8	1.64644	0.81318	31.0	30.50	307.0	758.0		
7	2.4	2.4	4.8	2.15570	1.06253	41.0	40.34	307.0	758.0		
10	3.5	3.5	7.0	2.60325	1.28167	49.0	48.21	307.0	758.0		
13	4.5	4.5	9.0	2.95181	1.45233	58.0	57.07	307.0	758.0		
18	5.7	5.7	11.4	3.32215	1.63367	63.0	61.99	307.0	758.0		
Linear Regression Y ON X : Y= mX + b							Average	307.0	758.0		
1	Slope (m)			2.04234	Linear Equation			r ²	0.995075	Pstd(mmHg)	760.0
2	Intercept (b)			-0.01435	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9975345	T _{NTP}	298.0
3	Correlation Coefficient (r)			0.99993	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.968129607	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.983935774	

COMMENT

Andersen Instruments, Inc.



Checked By

(Mr. Prayun Detkla)
Technician

envi research
ENVIRONMENT RESEARCH & TECHNOLOGY CO., LTD.

Approved By

(Mr. Panupon Podang)
Environmental Scientist

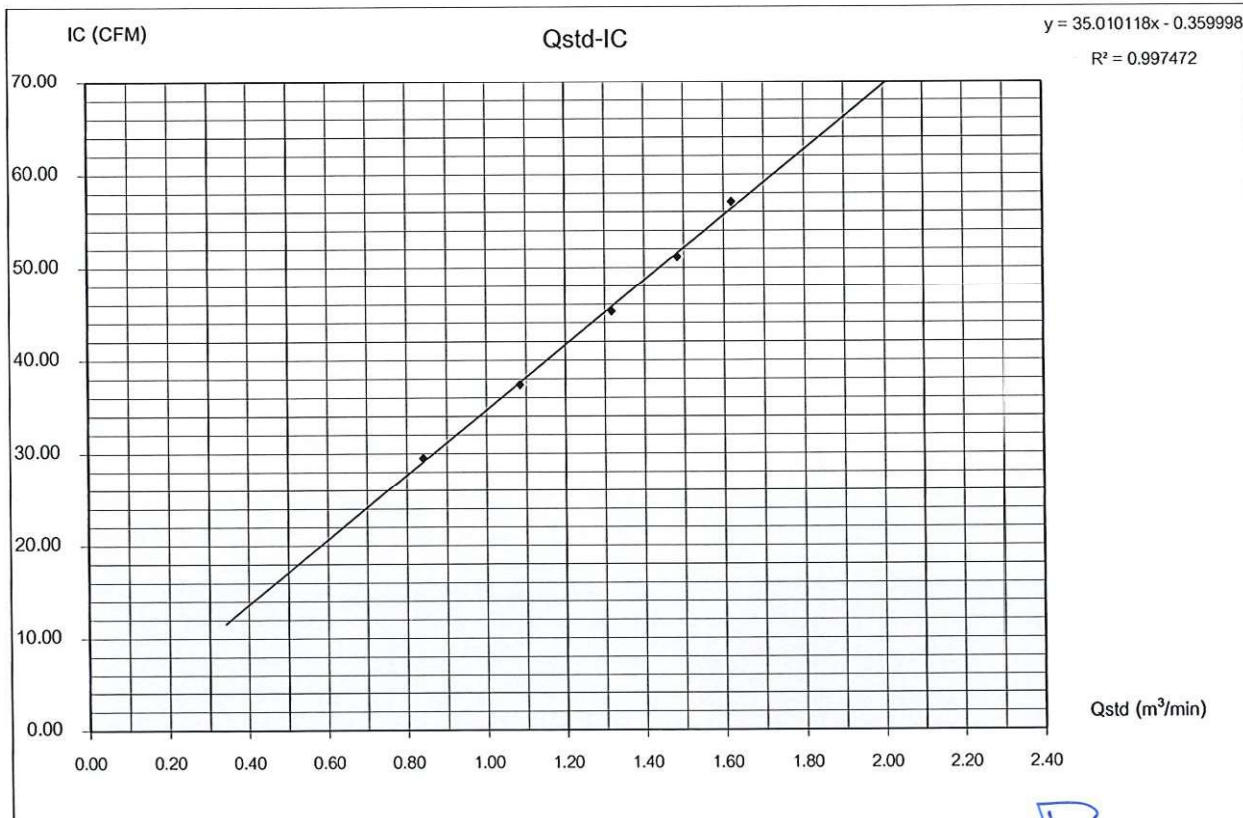
TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	May 30, 2023
A2 บ้านเลขที่ 60 (2023-00722)				Start Time	10:52 AM
Sampler Number	TSP No.A12	Transfer Standard Type	Orifice	Stop Time	11:02 AM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Nigul Phokhamla
Motor Serial Number	102930701	Calibrator Serial Number	3362		
Recorder Serial Number	610-650				

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter	
	Pressure Drop Across Orifice (mH ₂ O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	Qstd = (1/m)[(A-b)] (m ³ /min)	Sample Flow Rate Indication (ft ³ /min)	IC = I[(Pa/P _{std})(T _{std} /Ta)] ^{-1/2}	(*K = °C+273)	(mmHg)			
	Positive	Negative	ΔH ₂ O									
5	1.5	1.5	3.0	1.70423	0.84147	30.0	29.52	307.0	758.0			
7	2.5	2.5	5.0	2.20015	1.08429	38.0	37.39	307.0	758.0			
10	3.7	3.7	7.4	2.67659	1.31758	46.0	45.26	307.0	758.0			
13	4.7	4.7	9.4	3.01669	1.48410	52.0	51.16	307.0	758.0			
18	5.6	5.6	11.2	3.29288	1.61933	58.0	57.07	307.0	758.0			
Linear Regression Y ON X : Y= mX + b							Average	307.0	758.0			
1	Slope (m)			2.04234	Linear Equation			r ²	0.997472	Pstd(mmHg)	760.0	
2	Intercept (b)			-0.01435	Set Point Flow Rate (X) (m ³ /min)			1.133	r	0.9987352	T _{NTP}	298.0
3	Correlation Coefficient (r)			0.99993	Final Set Flow Rate = (I)			0	(Pa/Pstd)*(Tstd/Ta)			0.968129607
Result									C=(Pa/Pstd)*(Tstd/Ta)^0.5			0.983935774

COMMENT

Andersen Instruments, Inc.



Checked By

(Mr. Prayun Detkla)
Technician

Approved By

(Mr. Panupon Podang)
Environmental Scientist

RECALIBRATION

DUE DATE:

January 17, 2024

Certificate of Calibration

Calibration Certification Information

Cal. Date: January 17, 2023 Rootsmeter S/N: 438320 Ta: 295 °K
Operator: Jim Tisch Pa: 740.2 mm Hg
Calibration Model #: TE-5025A Calibrator S/N: 3362

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4140	3.2	2.00
2	3	4	1	0.9920	6.4	4.00
3	5	6	1	0.8930	8.0	5.00
4	7	8	1	0.8490	8.8	5.50
5	9	10	1	0.7000	12.8	8.00

Data Tabulation

Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)}$ (y-axis)
0.9795	0.6927	1.4027	0.9957	0.7042	0.8928
0.9753	0.9832	1.9837	0.9914	0.9993	1.2626
0.9732	1.0898	2.2179	0.9892	1.1077	1.4117
0.9721	1.1450	2.3261	0.9881	1.1639	1.4806
0.9668	1.3811	2.8054	0.9827	1.4039	1.7856
QSTD	m=	2.04234	QA	m=	1.27888
	b=	-0.01435		b=	-0.00913
	r=	0.99993		r=	0.99993

Calculations

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

Standard Conditions

Tstd: 298.15 °K
Pstd: 760 mm Hg

Key

ΔH: calibrator manometer reading (in H2O)
ΔP: rootsmeter manometer reading (mm Hg)
Ta: actual absolute temperature (°K)
Pa: actual barometric pressure (mm Hg)
b: intercept
m: slope

RECALIBRATION

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



Accuracy Calibration Certificate

Customer

Company: Environment Research & Technology Co., Ltd.
Address: 25/114 Moo 6, Soi Chinakert 1, Ngamwongwan Rd., Toongsongkhong
City: Lakel
Zip / Postal: 10210
State / Province: Bangkok
Order Number: 03320617856

Contact: Ramita Teengthai

Weighing Device

Manufacturer: Mettler Toledo
Model: AB204-S
Serial No.: 1123103723
Building: N/A
Floor: 4
Room: 406

Instrument Type: ERTC-L-IN-0048
Asset Number: N/A
Terminal Model: N/A
Terminal Serial No.: N/A
Terminal Asset No.: N/A

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

Procedure

Calibration Guidelines: EURAMET cg-18 v. 4.0 (11/2015)
CP19002/20

METTTLER TOLEDO Work Instruction:

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
As Left Calibration Date: 17-Jan-2023
Issue Date: 19-Jan-2023

Calibrator: Chawalit
Chawalit Mantsuloke

Approved Signatory:

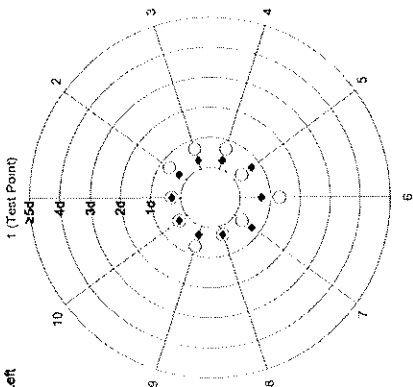
Technical Manager / Head of Calibration Center

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

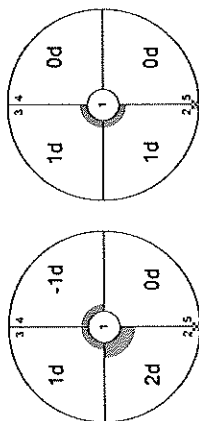


The "g" in the graph represents the readability of the range/interval in which the test was performed.
The results of this graph are based upon the absolute values of the differences from the mean value.

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



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

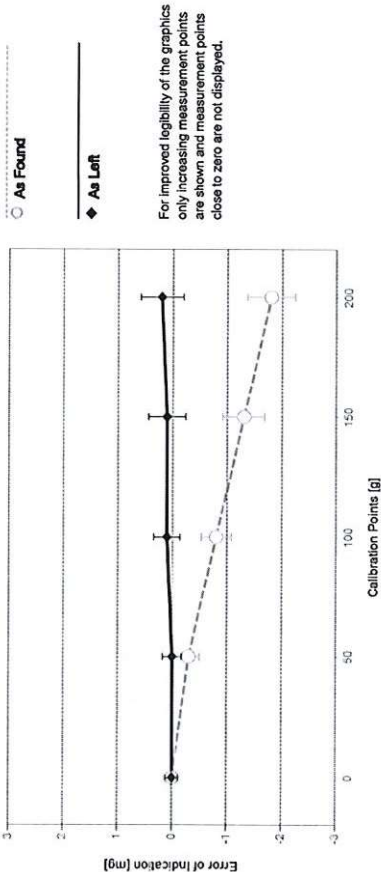
Error of Indication

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

Thermo Hygrometer

Equipment No.: INZ55
Certificate Number: 22H1503
Date of Issue: 20-Jul-2022
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

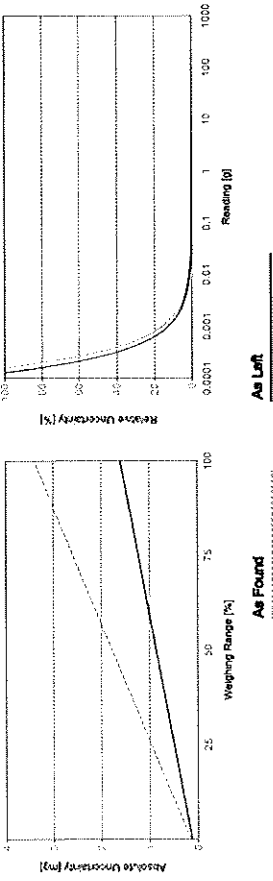
Uncertainty of Uncertainty Equation

Range	d	Max	As Found		As Left	
			U ₁ = 0.16 mg + 0.0147 mg/g · R	U ₂ = 0.13 mg + 0.00671 mg/g · R	U ₁ = 0.16 mg + 0.0147 mg/g · R	U ₂ = 0.13 mg + 0.00671 mg/g · R
1	0.0001 g	220 g				

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	
	U ₁	U ₂	U ₁	U ₂
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

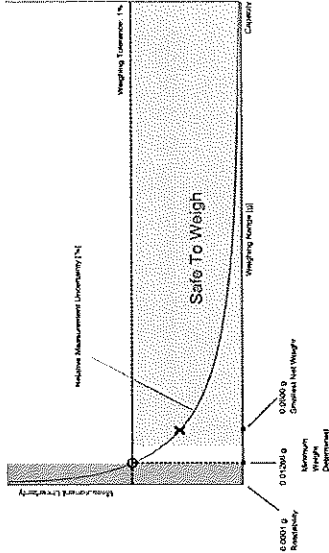
Process Requirements

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	1.85028 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	0.38728 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
Δ = Safety Factor not met

Repeatability

Test Load: 100 g

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

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

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

Eccentricity

Test Load: 100 g

Tolerance	Control Limit	As Found		As Left	
		Deviation	Result	Deviation	Result
0.1%	0.0500 g		✓		✓
0.2%	0.1000 g		✓		✓
0.5%	0.2500 g		✓		✓
1%	0.5000 g	0.00002 g	✓	0.00001 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.

Calibration Certificate



Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 20 August, 2022

Certification No. 339/22

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : Davis Instruments Inc.

Type : Weather Wizard III Product No. 7425

Serial No. : WC90504A18 ID No. : No.14

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 0600.0000 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 :

Signed :

Mr. Watcharapol Subwat

Mr. Boonad Pongsut

Mechanical Engineer



The Result of Calibration

Certification No. 339/22

20 August, 2022

Page : 2 of 2

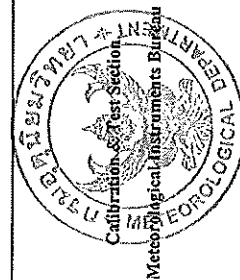
Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure Inches H2O	Vacuum Inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.2	0.82
5.00	-	-	-	4.5	0.50
7.04	-	-	-	6.3	0.74
9.02	-	-	-	8.5	0.52
11.01	-	-	-	10.3	0.71
13.01	-	-	-	12.5	0.51
15.01	-	-	-	14.3	0.71
17.02	-	-	-	16.5	0.52
20.02	-	-	-	19.2	0.82

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 :

Mr. Watcharapol Subwat

Mechanical Engineer





Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 20 August, 2022 Certification No. 340/22

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : Davis Instruments Inc.

Type : Weather Wizard III Product No. 7425

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

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

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1008.1 hPa

NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91563
 : HOOK GAGE NO 1425 Pilot 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)



Calibrated by : *Wacharapol* Signed :
 Mr. Wacharapol Subwat Mr. Pisod Promsut
 Mechanical Engineer



The Result of Calibration

Certification No. 340/22

20 August, 2022

Page : 2 of 2

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H ₂ O	Vacuum inches H ₂ O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.2	0.82
5.00	-	-	-	4.5	0.50
7.04	-	-	-	6.3	0.74
9.02	-	-	-	8.5	0.52
11.01	-	-	-	10.3	0.71
13.01	-	-	-	12.5	0.51
15.01	-	-	-	14.8	0.21
17.02	-	-	-	16.5	0.52
20.02	-	-	-	19.8	0.22

Wind Aloft Plotting Board.

U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated by :

Wacharapol

Mr. Wacharapol Subwat
 Mechanical Engineer



Sound Level Meter Calibration Report

Support Equipment Type : Sound Level Calibrator

Manufacture : BSWA TECH

Model : CA114

Serial No. : 590048

Range of Calibrator

- Sound Pressure Level : 93.9 dB.

- Frequency : 1,000 Hz.

Calibrated By : Mr.Konlayut Inkum

Calibration Date : May 30, 2023

Customer Name : บริษัท ไฟร์เทียร์ คอนซัลแตนต์ จำกัด : โครงการ นิคมอุตสาหกรรมเอเพ็กซ์กรีน อินดัสเทรียล เอสเตท
ของ บริษัท เอเพ็กซ์ ปาร์ค จำกัด

[illegible]

Checked By

Mr. Prayun Detkla
Technician

Approved By

Ms.Sutatip Im-noi
Environmental Scientist



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0768

MTC No. EEL. BP. 33/0965

CALIBRATION CERTIFICATE

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

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

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

Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : BSWA

Model : CA114

Serial No. : 590048

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 Bruel&Kjaer 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 : 16 Sep. 2022

Date of Calibration : 23 Sep. 2022

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.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. 21-65/0768

MTC No. EEL. BP. 33/0965

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

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

Acoustic Output in dB re 20 μ Pa, Corrected to Reference Conditions : 101.325 kPa, 23.0°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	93.91	-0.09	± 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	1000.5	0.5	± 1.5	$\pm 2.0\%$

3. Total distortion


Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Bruel&Kjaer 4180	1.40	± 0.50	$\pm 4.0\%$

Note : 1. No adjustment.


2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :


.....
(Mr. Weerachai Deechaiyae)

Approved by :


.....
(Mr. Prawate Kluaypa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 23 Sep. 2022

Date of Issue : 26 Sep. 2022

Ref : 2011265091604083001

End of Certificate

2 / 2

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

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