



## ภาคผนวก จ

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### เอกสารสอบเทียบเครื่องมือวิเคราะห์



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## เอกสารสอบเทียบเครื่องมือวิเคราะห์ บริษัท เอ็นไวรอนเมนต์ รีเสิร์ช แอนด์ เทคโนโลยี จำกัด

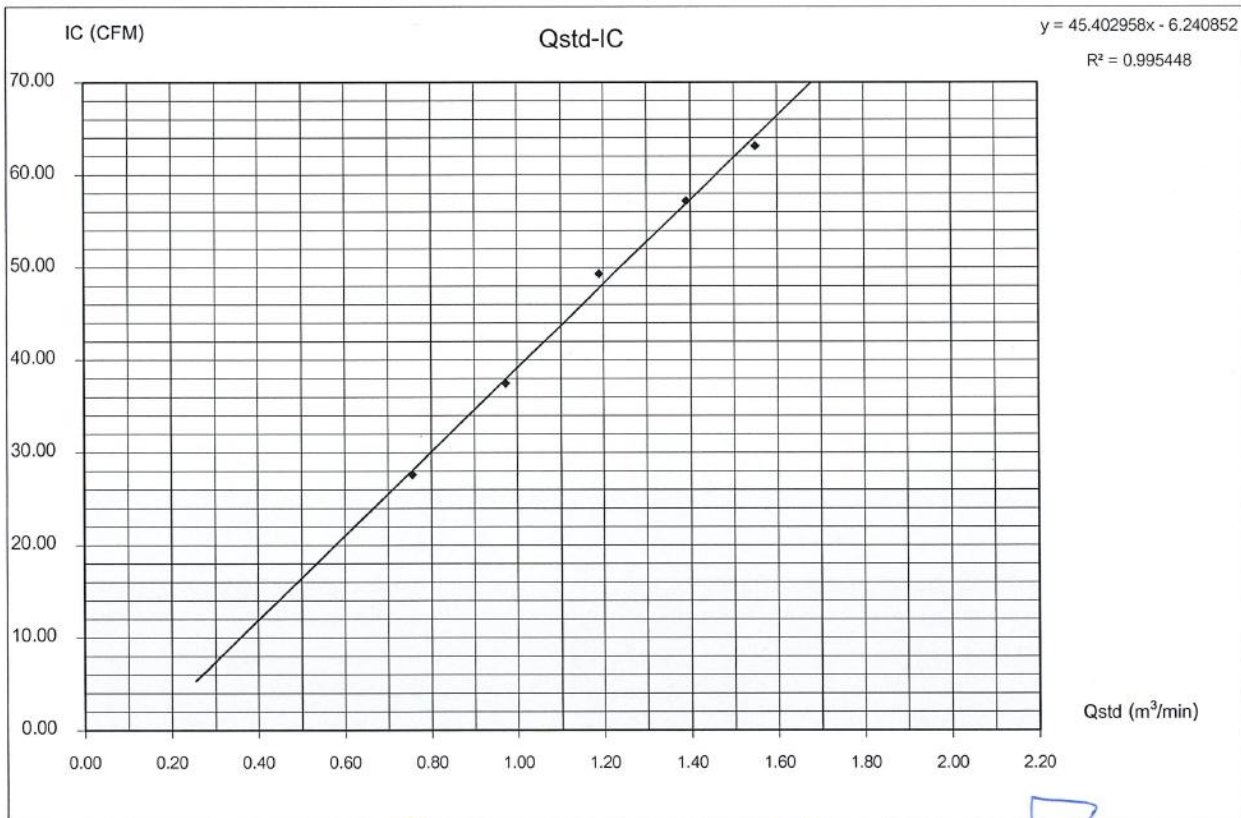
## TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	June 12, 2023
โรงเรียนบ้านบุเขียว(2023-00767)				Start Time	3:52 PM
Sampler Number	TSP No.A9	Transfer Standard Type	Orifice	Stop Time	4:02 PM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Prayun Detkla
Motor Serial Number	16119	Calibrator Serial Number	3362		
Recorder Serial Number	7137				

Plate No.	(Delta H)			( A )	( X )	( I )	( Y )	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH <sub>2</sub> O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	$Q_{std} = \{1/m\}[(A-b)]$	Sample Flow Rate Indication	$IC = I[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$				
	Positive	Negative	$\Delta H_2O$		( m <sup>3</sup> /min )	( ft <sup>3</sup> /min )		(°K = °C+273)	( mmHg )		
5	1.2	1.2	2.4	1.52825	0.75531	28.0	27.62	303.0	752.0		
7	2.0	2.0	4.0	1.97296	0.97306	38.0	37.49	303.0	752.0		
10	3.0	3.0	6.0	2.41638	1.19017	50.0	49.32	303.0	752.0		
13	4.1	4.1	8.2	2.82485	1.39017	58.0	57.22	303.0	752.0		
18	5.1	5.1	10.2	3.15057	1.54965	64.0	63.13	303.0	752.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	752.0		
1	Slope ( m )			2.04234	Linear Equation			r <sup>2</sup>	0.995448	Pstd(mmHg)	760.0
2	Intercept ( b )			-0.01435	Set Point Flow Rate ( X ) (m <sup>3</sup> /min)		1.133	r	0.9977214	T <sub>NTP</sub>	298.0
3	Correlation Coefficient ( r )			0.99993	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)		0.973145736	
Result								C=-(Pa/Pstd)*(Tstd/Ta)^0.5		0.986481493	

### COMMENT

Andersen Instruments, Inc.



Checked By

( Mr. Prayun Detkla )  
Technician



Approved By

( Mr. Panupon Podang )  
Environmental Scientist

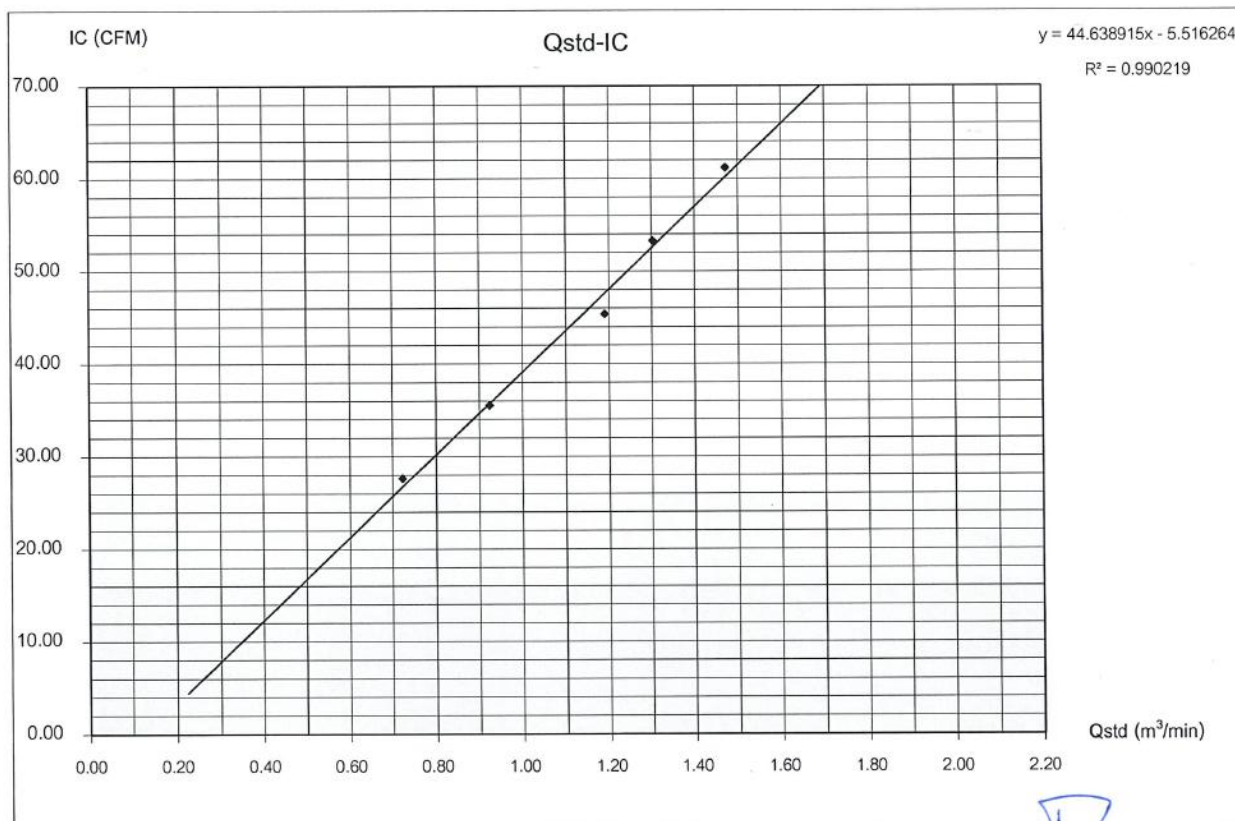
# PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	June 12, 2023
โรงเรียนบ้านบุเตี๋ย(2023-00767)				Start Time	3:42 PM
Sampler Number	PM-10 No.29	Transfer Standard Type	Orifice	Stop Time	3:52 PM
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Prayun Detkla
Motor Serial Number	2210	Calibrator Serial Number	3362		
Recorder Serial Number	2614				

Plate No.	(Delta H)			( A ) [ΔH <sub>2</sub> O(Pa/P <sub>std</sub> )(T <sub>std</sub> /Ta)] <sup>1/2</sup>	( X ) Qstd = (1/m)/[(A-b)] ( m <sup>3</sup> /min )	( I ) ample Flow Rate Indicaio ( ft <sup>3</sup> /min )	( Y ) IC = I/[(Pa/P <sub>std</sub> )(T <sub>std</sub> /Ta)] <sup>1/2</sup>	Temperature (°K = °C+273)	Barometric Pressure ( mmHg )	Start Meter	Stop Meter
	Positive	Negative	ΔH <sub>2</sub> O								
5	1.1	1.1	2.2	1.46319	0.72345	28.0	27.62	303.0	752.0		
7	1.8	1.8	3.6	1.87172	0.92348	36.0	35.51	303.0	752.0		
10	3.0	3.0	6.0	2.41638	1.19017	46.0	45.38	303.0	752.0		
13	3.6	3.6	7.2	2.64701	1.30309	54.0	53.27	303.0	752.0		
18	4.6	4.6	9.2	2.99215	1.47208	62.0	61.16	303.0	752.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	752.0		
1	Slope ( m )			2.04234	Linear Equation			r <sup>2</sup>	0.990219	Pstd(mmHg)	760.0
2	Intercept ( b )			-0.01435	Set Point Flow Rate ( X ) (m <sup>3</sup> /min)		1.133	r	0.9950975	T <sub>NTP</sub>	298.0
3	Correlation Coefficient ( r )			0.99993	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)		0.973145736	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.986481493	

## COMMENT

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( Mr. Prayun Detkla )  
Technician



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( Mr. Panupon Podang )  
Environmental Scientist



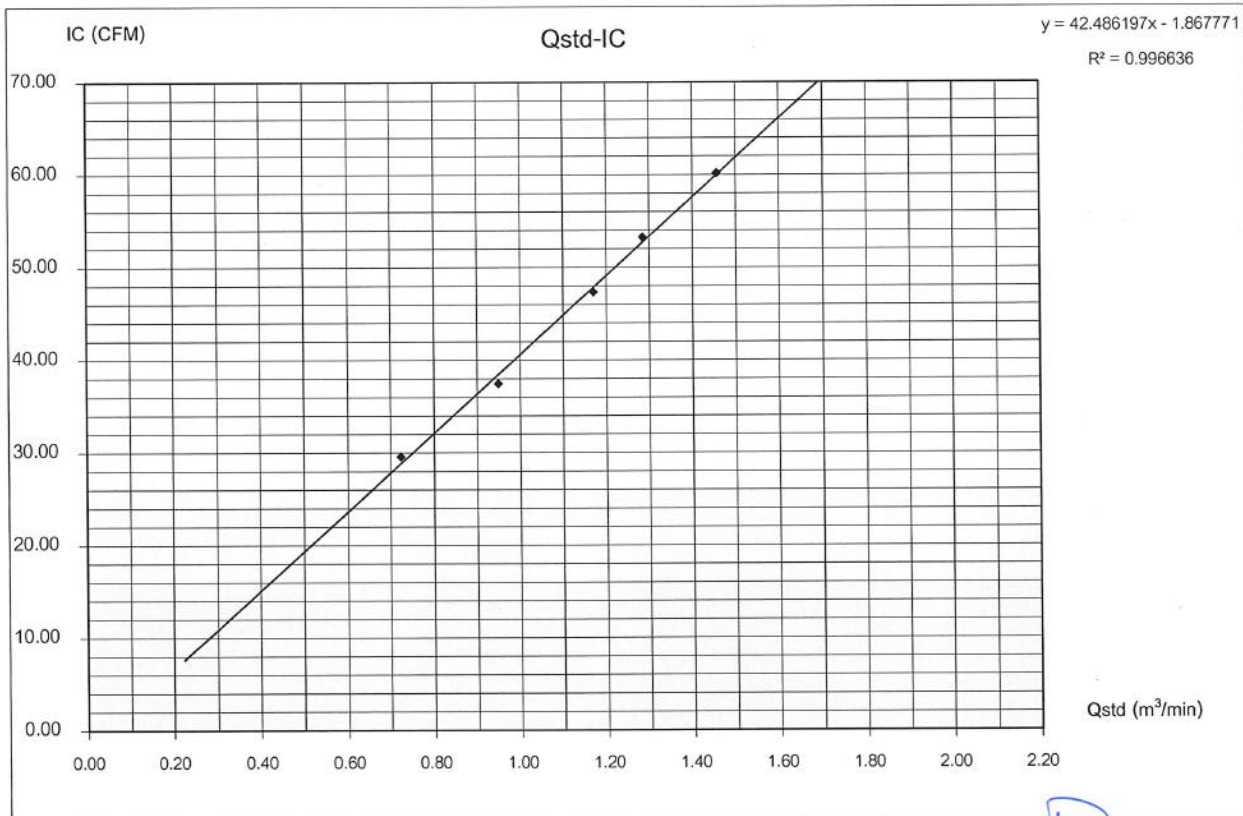
## TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	June 12, 2023
โรงเรียนบ้านหนองโคก(2023-00767)				Start Time	12:05 PM
Sampler Number	TSP No.A31	Transfer Standard Type	Orifice	Stop Time	12:15 PM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Prayun Detkla
Motor Serial Number	57-507	Calibrator Serial Number	3362		
Recorder Serial Number	507-012				

Plate	(Delta H)			( A )	( X )	( I )	( Y )	Temperature	Barometric	Start	Stop
No.	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)]	ample Flow Rate Indication	IC = [(Pa/P <sub>std</sub> )(T <sub>std</sub> /Ta)] <sup>1/2</sup>	(*K = °C+273)	Pressure	Meter	Meter
	Positive	Negative	ΔH <sub>2</sub> O								
5	1.1	1.1	2.2	1.46319	0.72345	30.0	29.59	303.0	752.0		
7	1.9	1.9	3.8	1.92301	0.94860	38.0	37.49	303.0	752.0		
10	2.9	2.9	5.8	2.37576	1.17028	48.0	47.35	303.0	752.0		
13	3.5	3.5	7.0	2.60998	1.28496	54.0	53.27	303.0	752.0		
18	4.5	4.5	9.0	2.95944	1.45607	61.0	60.18	303.0	752.0		
Linear Regression: Y ON X : Y= mX + b							Average	303.0	752.0		
1	Slope ( m )			2.04234	Linear Equation			r <sup>2</sup>	0.996636	Pstd(mmHg)	760.0
2	Intercept ( b )			-0.01435	Set Point Flow Rate ( X ) ( m <sup>3</sup> /min)		1.133	r	0.9983166	T <sub>NTP</sub>	298.0
3	Correlation Coefficient ( r )			0.99993	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)		0.973145736	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.986481493	

COMMENT

Andersen Instruments, Inc.



Checked By

( Mr. Prayun Detkla )

Technician

envi research  
ENVIRONMENT RESEARCH & TECHNOLOGY CO., LTD.

Approved By

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Environmental Scientist

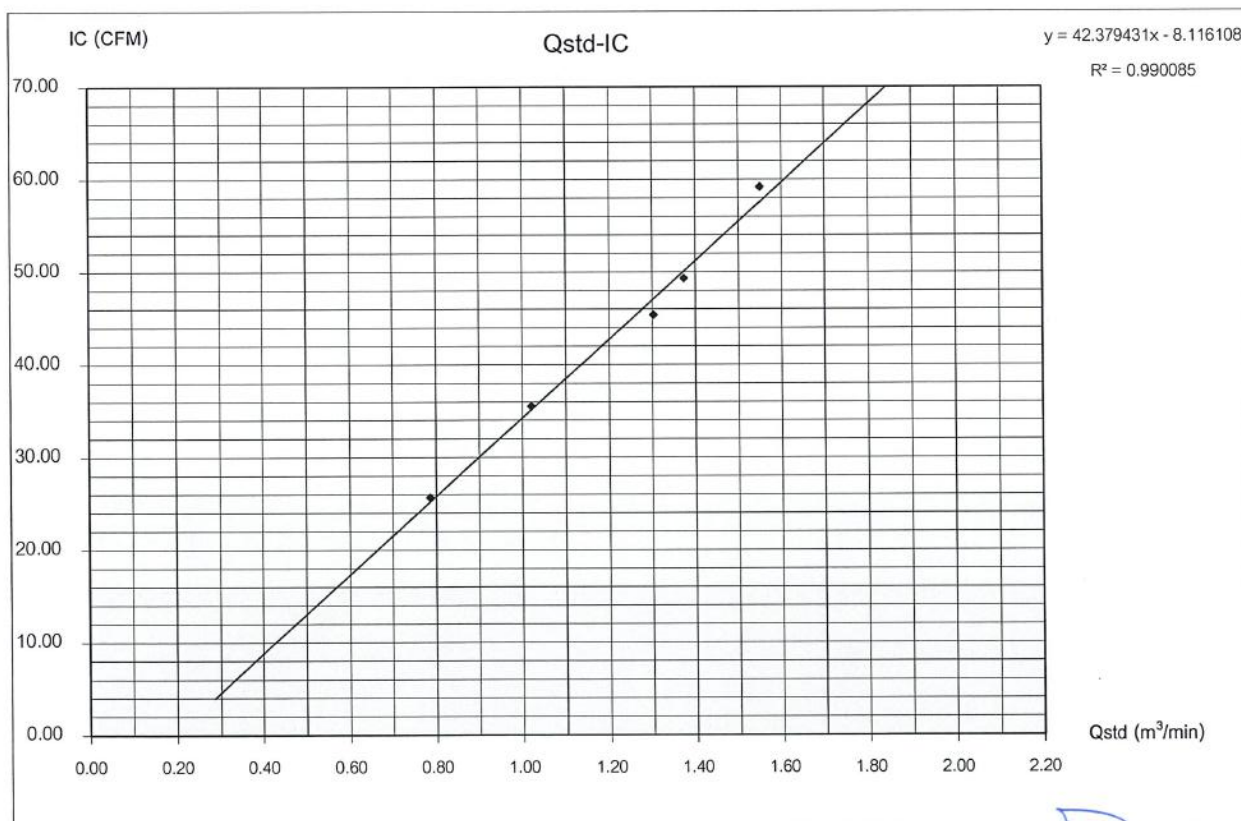
## PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	June 12, 2023
โรงเรียนบ้านหนองโดน (2023-00767)				Start Time	11:55 AM
Sampler Number	PM-10 No.25	Transfer Standard Type	Orifice	Stop Time	12:05 PM
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Prayun Detkla
Motor Serial Number	2150	Calibrator Serial Number	3362		
Recorder Serial Number	2409				

Plate No.	(Delta H)			( A )	( X )	( I )	( Y )	Temperature	Barometric	Start	Stop
	Pressure Drop Across Orifice (inH <sub>2</sub> O)										
	Positive	Negative	ΔH <sub>2</sub> O	( m <sup>3</sup> /min )	( ft <sup>3</sup> /min )	(°K = °C+273)	Pressure	Meter	Meter		
5	1.3	1.3	2.6	1.59065	0.78587	26.0	25.65	303.0	752.0		
7	2.2	2.2	4.4	2.06926	1.02021	36.0	35.51	303.0	752.0		
10	3.6	3.6	7.2	2.64701	1.30309	46.0	45.38	303.0	752.0		
13	4.0	4.0	8.0	2.79019	1.37320	50.0	49.32	303.0	752.0		
18	5.1	5.1	10.2	3.15057	1.54965	60.0	59.19	303.0	752.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	752.0		
1	Slope ( m )			2.04234	Linear Equation			r <sup>2</sup>	0.990085	Pstd(mmHg)	760.0
2	Intercept ( b )			-0.01435	Set Point Flow Rate ( X ) (m <sup>3</sup> /min)		1.133	r	0.9950302	T <sub>NTP</sub>	298.0
3	Correlation Coefficient ( r )			0.99993	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)			0.973145736
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5			0.986481493

— COMMENT

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Environmental Scientist



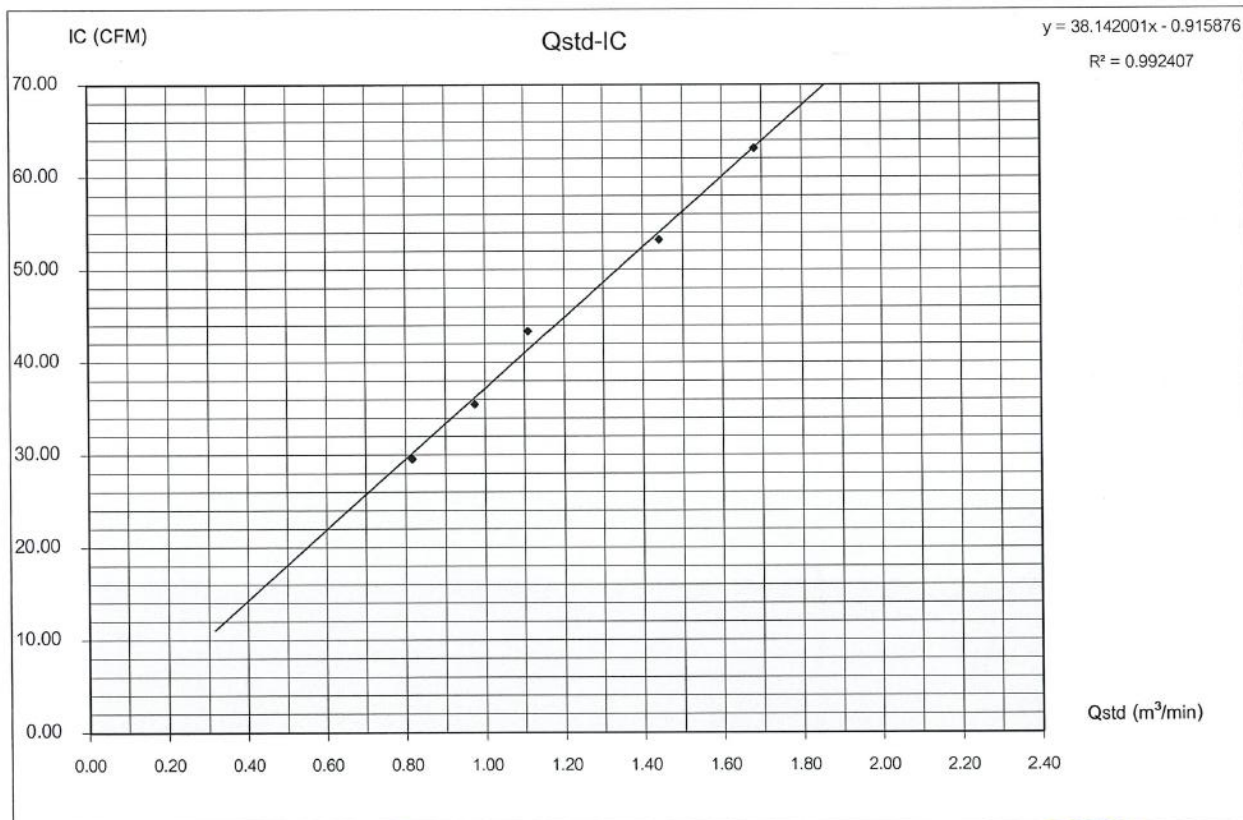
# TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	June 12, 2023
โรงเรียนวัดหนองไผ่ล้อม(2023-00767)				Start Time	2:51 PM
Sampler Number	TSP No.A6	Transfer Standard Type	Orifice	Stop Time	3:01 PM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Prayun Detkla
Motor Serial Number	2012-01	Calibrator Serial Number	3362		
Recorder Serial Number	3140				

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 Indication ( ft <sup>3</sup> /min )	$IC = I/[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	(°K = °C+273)	( mmHg )		
	Positive	Negative	ΔH <sub>2</sub> O								
5	1.4	1.4	2.8	1.65070	0.81527	30.0	29.59	303.0	752.0		
7	2.0	2.0	4.0	1.97296	0.97306	36.0	35.51	303.0	752.0		
10	2.6	2.6	5.2	2.24952	1.10847	44.0	43.41	303.0	752.0		
13	4.4	4.4	8.8	2.92638	1.43988	54.0	53.27	303.0	752.0		
18	6.0	6.0	12.0	3.41727	1.68024	64.0	63.13	303.0	752.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	752.0		
1	Slope ( m )			2.04234	Linear Equation			r <sup>2</sup>	0.992407	Pstd(mmHg)	760.0
2	Intercept ( b )			-0.01435	Set Point Flow Rate ( X ) ( m <sup>3</sup> /min)		1.133	r	0.9961963	T <sub>NTP</sub>	298.0
3	Correlation Coefficient ( r )			0.99993	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)		0.973145736	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.986481493	

## COMMENT

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( Mr. Prayun Detkla )  
Technician



Approved By

( Mr. Panupon Podang )  
Environmental Scientist

Signature of Mr. Panupon Podang

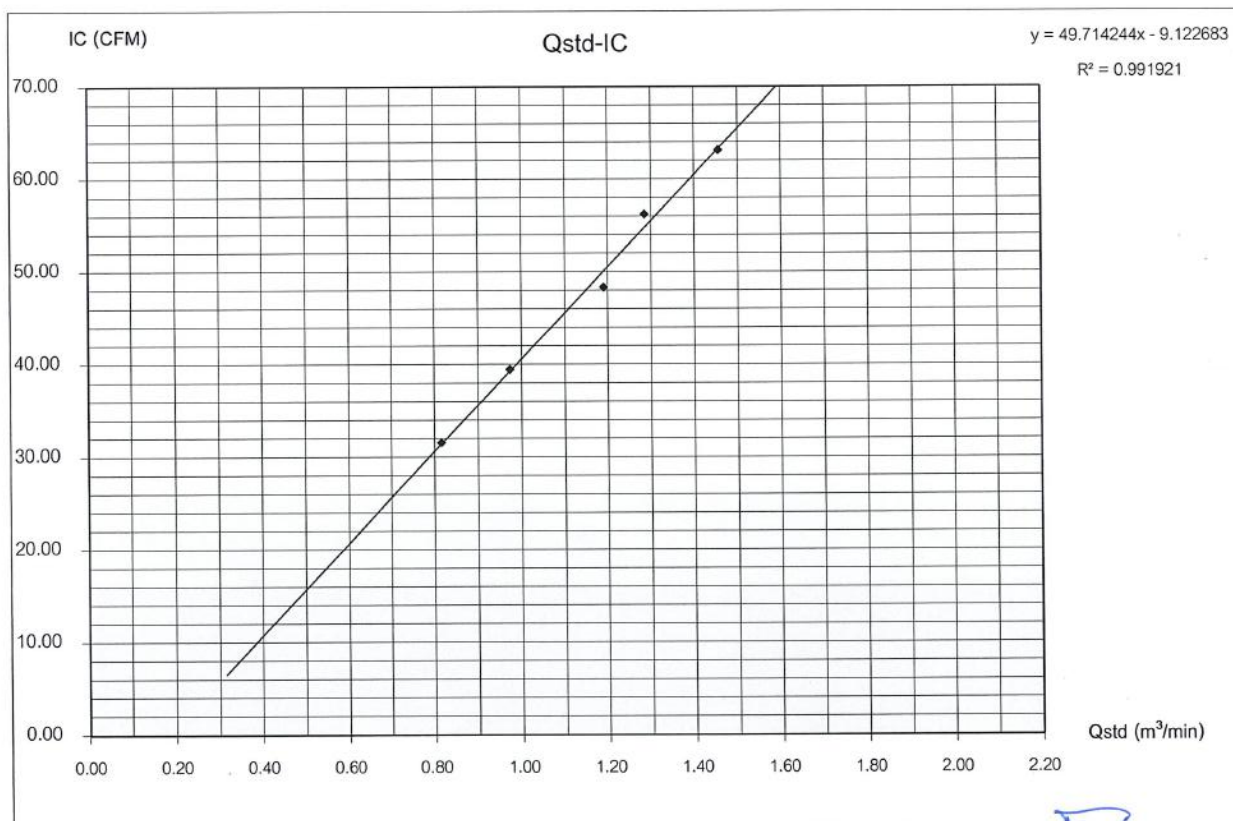
# PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location		Date	
โรงเรียนวัดหนองไผ่ล้อม(2023-00767)		June 12, 2023	
Sampler Number	PM-10 No.22	Transfer Standard Type	Orifice
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A
Motor Serial Number	2138	Calibrator Serial Number	3362
Recorder Serial Number	2389	Calibrated By	
		Mr. Prayun Detkla	

Plate No.	(Delta H)			( A )	( X )	( I )	( Y )	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH <sub>2</sub> O)			$[\Delta H_o(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ ( m <sup>3</sup> /min )	ample Flow Rate Indication ( ft <sup>3</sup> /min )	$IC = I[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	(°K = °C+273)	( mmHg )		
	Positive	Negative	ΔH <sub>2</sub> O								
5	1.4	1.4	2.8	1.65070	0.81527	32.0	31.57	303.0	752.0		
7	2.0	2.0	4.0	1.97296	0.97306	40.0	39.46	303.0	752.0		
10	3.0	3.0	6.0	2.41638	1.19017	49.0	48.34	303.0	752.0		
13	3.5	3.5	7.0	2.60998	1.28496	57.0	56.23	303.0	752.0		
18	4.5	4.5	9.0	2.95944	1.45607	64.0	63.13	303.0	752.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	752.0		
1	Slope ( m )			2.04234	Linear Equation			r <sup>2</sup>	0.991921	Pstd(mmHg)	760.0
2	Intercept ( b )			-0.01435	Set Point Flow Rate ( X ) (m <sup>3</sup> /min)		1.133	r	0.9959523	T <sub>NTP</sub>	298.0
3	Correlation Coefficient ( r )			0.99993	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)		0.973145736	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.986481493	

## COMMENT

Andersen Instruments, Inc.



Checked By

( Mr. Prayun Detkla )  
Technician



Approved By

( Mr. Panupon Podang )  
Environmental Scientist



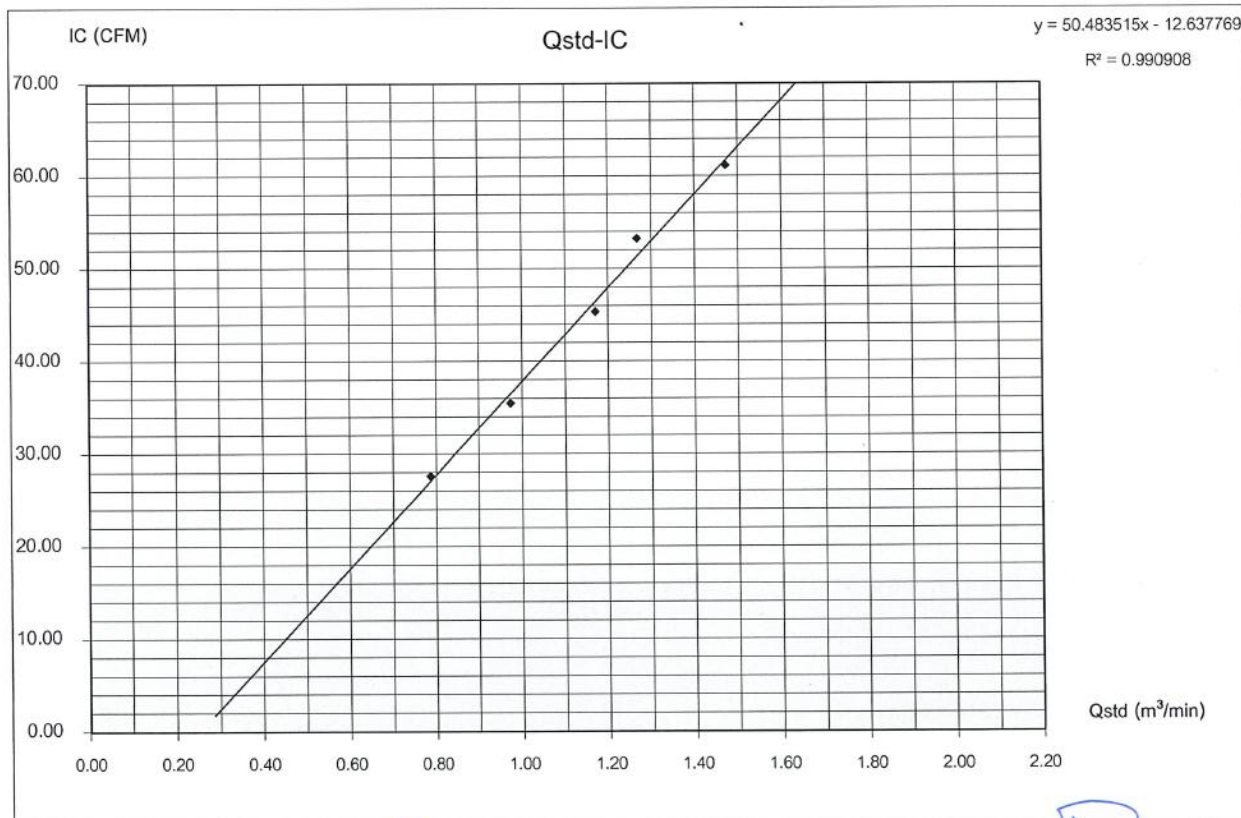
# TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	June 12, 2023
วัดบ้านแก่ง(2023-00767)				Start Time	1:17 PM
Sampler Number	TSP No.A24	Transfer Standard Type	Orifice	Stop Time	1:27 PM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Prayun Detkla
Motor Serial Number	2151	Calibrator Serial Number	3362		
Recorder Serial Number	2412				

Plate No.	(Delta H)			( A )	( X )	( I )	( Y )	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH <sub>2</sub> O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$	Sample Flow Rate Indication	$IC = I[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	(°K = °C+273)	( mmHg )		
	Positive	Negative	ΔH <sub>2</sub> O		( m <sup>3</sup> /min )	( ft <sup>3</sup> /min )					
5	1.3	1.3	2.6	1.59065	0.78587	28.0	27.62	303.0	752.0		
7	2.0	2.0	4.0	1.97296	0.97306	36.0	35.51	303.0	752.0		
10	2.9	2.9	5.8	2.37576	1.17028	46.0	45.38	303.0	752.0		
13	3.4	3.4	6.8	2.57243	1.26658	54.0	53.27	303.0	752.0		
18	4.6	4.6	9.2	2.99215	1.47208	62.0	61.16	303.0	752.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	752.0		
1	Slope ( m )			2.04234	Linear Equation			r <sup>2</sup>	0.990908	Pstd(mmHg)	760.0
2	Intercept ( b )			-0.01435	Set Point Flow Rate ( X ) (m <sup>3</sup> /min)		1.133	r	0.9954436	T <sub>NTP</sub>	298.0
3	Correlation Coefficient ( r )			0.99993	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)		0.973145736	
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.986481493	

COMMENT

Andersen Instruments, Inc.



Checked By

( Mr. Prayun Detkla )  
Technician



Approved By

( Mr. Panupon Podang )  
Environmental Scientist



# PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

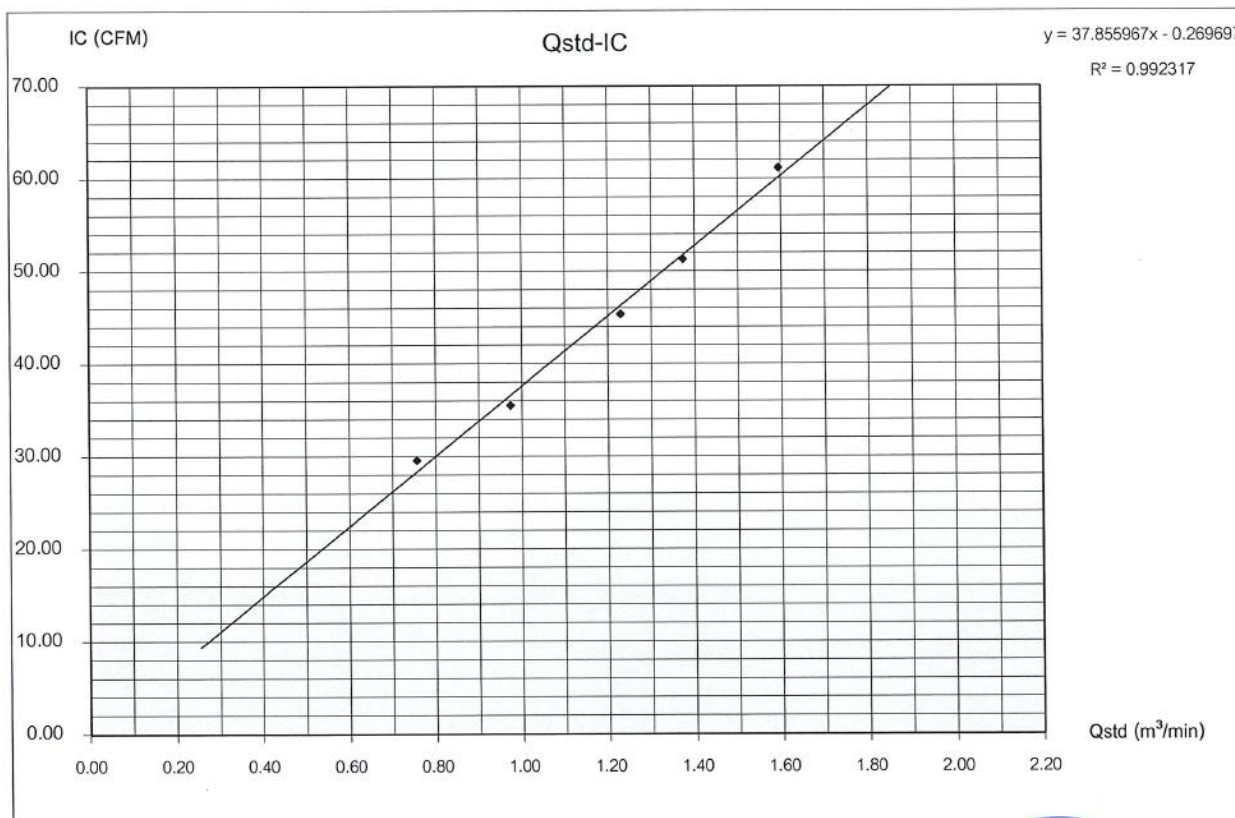
Sampler Location				Date	June 12, 2023
วัดบ้านแก่ง(2023-00767)				Start Time	1:28 PM
Sampler Number	PM-10 No.24	Transfer Standard Type	Orifice	Stop Time	1:38 PM
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Prayun Detkla
Motor Serial Number	2149	Calibrator Serial Number	3362		
Recorder Serial Number	2407				

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH <sub>2</sub> O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/T_a)]^{1/2}$			$IC = I[(Pa/P_{std})(T_{std}/T_a)]^{1/2}$				
	Positive	Negative	$\Delta H_2O$		(m <sup>3</sup> /min)	(ft <sup>3</sup> /min)		(°K = °C+273)	(mmHg)		
5	1.2	1.2	2.4	1.52825	0.75531	30.0	29.59	303.0	752.0		
7	2.0	2.0	4.0	1.97296	0.97306	36.0	35.51	303.0	752.0		
10	3.2	3.2	6.4	2.49562	1.22897	46.0	45.38	303.0	752.0		
13	4.0	4.0	8.0	2.79019	1.37320	52.0	51.30	303.0	752.0		
18	5.4	5.4	10.8	3.24191	1.59438	62.0	61.16	303.0	752.0		
Linear Regression Y ON X : Y= mX + b								Average	303.0	752.0	

1	Slope ( m )	2.04234	Linear Equation					r <sup>2</sup>	0.9923317	Pstd(mmHg)	760.0
2	Intercept ( b )	-0.01435	Set Point Flow Rate ( X ) (m <sup>3</sup> /min)				1.133	r	0.9961585	T <sub>NTP</sub>	298.0
3	Correlation Coefficient ( r )	0.99993	Final Set Flow Rate = ( I )				0	(Pa/Pstd)*(Tstd/Ta)		0.973145736	
Result								C=(Pa/Pstd)*(Tstd/Ta)*0.5		0.986481493	

## 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 H <sub>2</sub> O)
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
<b>QSTD</b>	m=	<b>2.04234</b>	<b>QA</b>	m=	<b>1.27888</b>
	b=	<b>-0.01435</b>		b=	<b>-0.00913</b>
	r=	<b>0.99993</b>		r=	<b>0.99993</b>

## Calculations

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

## Standard Conditions

Tstd:	298.15 °K
Pstd:	760 mm Hg
<b>Key</b>	
ΔH: calibrator manometer reading (in H <sub>2</sub> O)	
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

## Calibration Data of NOx Analyzer

### Analyzer Performance Test

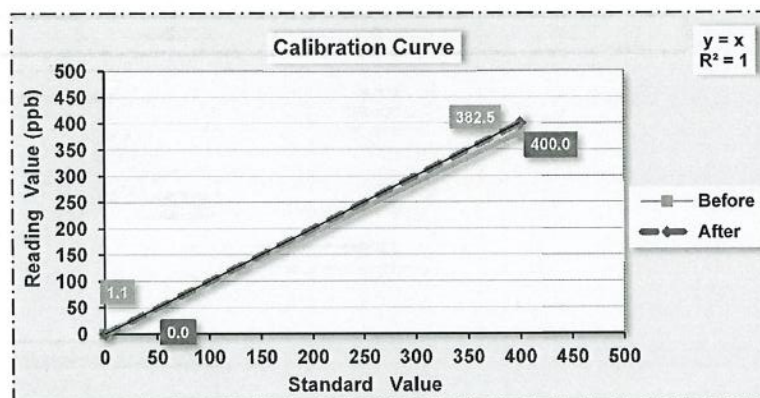
Equipment	Gas Analyzer ( NOx )	Customer Name	โพธิ์เขียว คอนกรีตแดนดี
Manufacture	HORIBA	Location	Envi Research
Model	APNA-370	Quotation	2023-00767
Serial No.	EYC70000	Calibration Date	May 31, 2023
Analyzer Unit	ppb	Time	1:47 PM

### Instruments for Calibration

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

### Single Point Calibration

Standard Gas	Standard Gas Value	Analyzer Value								% Abs Error
		NO <sub>x</sub> ( ppb )		NO ( ppb )		NO <sub>2</sub> ( ppb )		Stability		
		Before	After	Before	After	Before	After	Before	After	
Zero	0	0.8	0.0	1.1	0.0	-0.3	0.0	-	-	-
Span	400	383.7	400.0	382.5	400.0	1.2	0.0	-	-	4.4



### STATUS TEST AND VALIDATION OF NOx ANALYZER MODEL APNA-370

Parameter	Unit	Observed Value		Nominal Range
		Before Adjust	After Adjust	
Range	ppb	500	500	0 - 500 Standard
Signal NO	mV	2.3	3.7	Voltage of the measured NO value
Signal NOx	mV	5.3	4.9	Voltage of the measured NOx value
Detector	°C	86.2	86.4	43 °C ± 5 °C
Ambient	kPa	101.2	100.9	Current atmospheric pressure
DC 24V	V	23.9	23.9	24V ±0.5
DC 5V	V	5.0	5.0	5V ±0.5
NO Slope	-	1.09710	1.17990	0.50000 - 2.0000
NOx Slope	-	1.00880	1.18680	0.50000 - 2.0000

Calibrate By :

(MR.PANUPON PODANG)  
May 31, 2023



Checked By :

(MS.SUTAPIM IM-NOI)  
May 31, 2023



## Calibration Data of NOx Analyzer

### Analyzer Performance Test

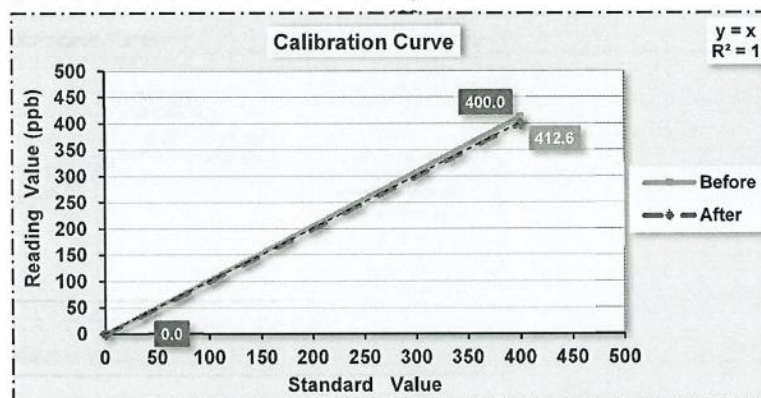
Equipment	Gas Analyzer ( NOx )	Customer Name	โพธิ์ชัย คอนซัลแตนต์
Manufacture	HORIBA	Location	Envi Research
Model	APNA-370	Quotation	2023-00767
Serial No.	U9LS50WU	Calibration Date	May 3, 2023
Analyzer Unit	ppb	Time	11:18 AM

### Instruments for Calibration

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

### Single Point Calibration

Standard Gas	Standard Gas Value	Analyzer Value								% Abs Error
		NO <sub>x</sub> ( ppb )		NO ( ppb )		NO <sub>2</sub> ( ppb )		Stability		
		Before	After	Before	After	Before	After	Before	After	
Zero	0	-0.4	0.0	-0.4	0.0	0.0	0.0	-	-	-
Span	400	417.1	400.0	412.6	400.0	4.5	0.0	-	-	3.2



### STATUS TEST AND VALIDATION OF NOx ANALYZER MODEL APNA-370

Parameter	Unit	Observed Value		Nominal Range
		Before Adjust	After Adjust	
Range	ppb	500	500	0 - 500 Standard
Signal NO	mV	0.6	0.2	Voltage of the measured NO value
Signal NOx	mV	3.4	3.0	Voltage of the measured NOx value
Detector	°C	41.7	41.6	43 °C ± 5 °C
Ambient	kPa	101.3	101.2	Current atmospheric pressure
DC 24V	V	23.5	23.5	24V ±0.5
DC 5V	V	5.0	5.0	5V ±0.5
NO Slope	-	1.59630	1.56220	0.50000 - 2.0000
NOx Slope	-	1.60120	1.53850	0.50000 - 2.0000

Calibrate By :

(MR.PANUPON PODANG)  
May 3, 2023



Checked By :

(MS.SUTATIP IM-NOI)  
May 3, 2023

## Calibration Data of NOx Analyzer

### Analyzer Performance Test

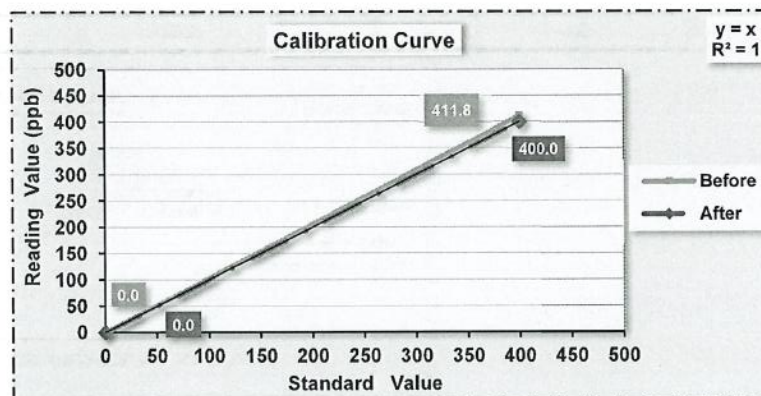
Equipment	Gas Analyzer ( NOx )	Customer Name	โพธิ์เพชร คอนซัลแตนต์
Manufacture	HORIBA	Location	Envi Research
Model	APNA-370	Quotation	2023-00767
Serial No.	VLR55LT4	Calibration Date	May 3, 2023
Analyzer Unit	ppb	Time	3:00 PM

### Instruments for Calibration

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

### Single Point Calibration

Standard Gas	Standard Gas Value	Analyzer Value								% Abs Error
		NO <sub>x</sub> ( ppb )		NO ( ppb )		NO <sub>2</sub> ( ppb )		Stability		
		Before	After	Before	After	Before	After	Before	After	
Zero	0	-0.4	0.0	0.0	0.0	-0.4	0.0	-	-	-
Span	400	422.2	400.0	411.8	400.0	10.4	0.0	-	-	3.0



### STATUS TEST AND VALIDATION OF NOx ANALYZER MODEL APNA-370

Parameter	Unit	Observed Value		Nominal Range
		Before Adjust	After Adjust	
Range	ppb	500	500	0 - 500 Standard
Signal NO	mV	1.0	1.3	Voltage of the measured NO value
Signal NOx	mV	14.2	13.5	Voltage of the measured NOx value
Detector	°C	41.7	41.8	43 °C ± 5 °C
Ambient	kPa	101.6	101.5	Current atmospheric pressure
DC 24V	V	23.7	23.7	24V ±0.5
DC 5V	V	5.0	5.0	5V ±0.5
NO Slope	-	0.74750	0.69380	0.50000 - 2.0000
NOx Slope	-	0.79470	0.71900	0.50000 - 2.0000

Calibrate By :

(MR.PANUPON PODANG)  
May 3, 2023



Checked By :

(MS.SUTATIP IM-NOI)  
May 3, 2023



## Calibration Data of NOx Analyzer

### Analyzer Performance Test

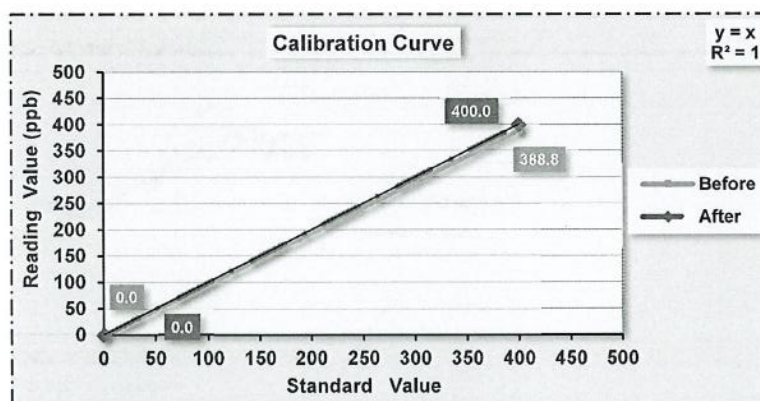
Equipment	Gas Analyzer ( NOx )	Customer Name	โพธิ์เพชร คอนซัลแตนต์
Manufacture	HORIBA	Location	Envi Research
Model	APNA-370	Quotation	2023-00767
Serial No.	YCPL4HTM	Calibration Date	May 30, 2023
Analyzer Unit	ppb	Time	1:15 PM

### Instruments for Calibration

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

### Single Point Calibration

Standard Gas	Standard Gas Value	Analyzer Value								% Abs Error
		NO <sub>x</sub> ( ppb )		NO ( ppb )		NO <sub>2</sub> ( ppb )		Stability		
		Before	After	Before	After	Before	After	Before	After	
Zero	0	-0.2	0.0	0.0	0.0	-0.2	0.0	-	-	-
Span	400	385.5	400.0	388.8	400.0	-3.3	0.0	-	-	2.8



### STATUS TEST AND VALIDATION OF NOx ANALYZER MODEL APNA-370

Parameter	Unit	Observed Value		Nominal Range
		Before Adjust	After Adjust	
Range	ppb	500	500	0 - 500 Standard
Signal NO	mV	0.5	0.7	Voltage of the measured NO value
Signal NOx	mV	4.1	4.7	Voltage of the measured NOx value
Detector	°C	41.6	41.6	43 °C ± 5 °C
Ambient	kPa	100.9	100.9	Current atmospheric pressure
DC 24V	V	23.5	23.5	24V ±0.5
DC 5V	V	5.0	5.0	5V ±0.5
NO Slope	-	1.13360	1.19490	0.50000 - 2.0000
NOx Slope	-	1.07590	1.17460	0.50000 - 2.0000

Calibrate By :

(MR.PANUPON PODANG)  
May 30, 2023



Checked By :

(MS.SUTATIP IM-NOI)  
May 30, 2023

## Calibration Data of SO<sub>2</sub> Analyzer

### Analyzer Performance Test

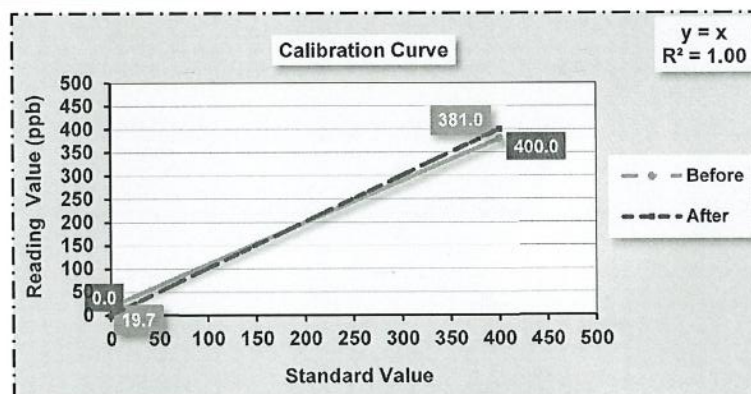
Equipment	Gas Analyzer ( SO <sub>2</sub> )	Customer Name	โพธิ์เกียรติ์ คอนซัลแตนต์
Manufacture	Thermo	Location	Envi Research
Model	43C	Quotation	2023-00767
Serial No.	73379-373	Calibration Date	May 16, 2023
Analyzer Unit	ppb	Time	2:01 PM

### Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300	0165
Standard Gas Components	CO = 4.516 ppm		
Cylinder No : EB0123013	NO = 55.3 ppm		
Expire Date : Oct 22, 2027	SO <sub>2</sub> = 54.9 ppm		

### Single Point Calibration

Standard Gas	Standard Gas Value	Analyzer Value ( ppb )		Stability		% Abs Error
		Before	After	Before	After	
Zero	0	19.7	0.0	-	-	-
Span	400	381.0	400.0	-	-	4.8



### STATUS TEST AND VALIDATION OF SO<sub>2</sub> ANALYZER MODEL 43C

Parameter	Display As	Unit	Observed Value		Nominal Range
			Before Adjust	After Adjust	
Range	RANGE	ppb	500	500	0 - 500 standard
Internal Temperature	INTERNAL	°C	38.0	38.5	8.0 °C to 47.0 °C
Chamber Temp	CHAMBER	°C	45.9	45.9	43.0 °C to 47.0 °C
Pressure	PRESSURE	mmHg	702.6	701.9	400.0 to 1,000
Sample Flow	SAMP FLOW	LPM	0.656	0.655	0.350 to 1.000
Lamp Intensity	INTENSITY	Hz	19792	19883	20,000 to 50,000
Lamp Voltage	LAMP VOLTAGE	V	915	917	750 to 1,200
SO <sub>2</sub> Concentration	SO <sub>2</sub> CONCENTRATION	ppb	0.3	0.7	0 to 10,000
Motherboard Status	MOTHERBOARD STATUS	-	OK	OK	OK
Interface Status	INTERFACE STATUS	-	OK	OK	OK

Calibrate By :

(MR.PANUPON PODANG)  
May 16, 2023

Checked By :

(MS.SUTATIP IM-NOI)  
May 16, 2023



## Calibration Data of SO<sub>2</sub> Analyzer

### Analyzer Performance Test

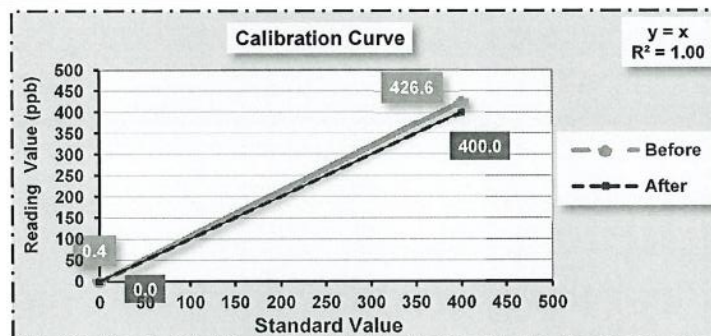
Equipment	Gas Analyzer ( SO <sub>2</sub> )	Customer Name	โพธิ์เกียรติ์ คอนซัลแตนต์
Manufacture	Horiba	Location	Envi Research
Model	APSA-370	Quotation	2023-00767
Serial No.	A5VTX5AF	Calibration Date	May 22, 2023
Analyzer Unit	ppb	Time	1:51 PM

### Instruments for Calibration

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

### Single Point Calibration

Standard Gas	Standard Gas Value	Analyzer Value ( ppb )		Stability		% Abs Error
		Before	After	Before	After	
Zero	0	0.4	0.0	-	-	-
Span	400	426.6	400.0	-	-	6.7



### STATUS TEST AND VALIDATION OF SO<sub>2</sub> ANALYZER MODEL APSA-370

Parameter	Unit	Observed Value		Nominal Range
		Before Adjust	After Adjust	
Range	ppb	500	500	0 - 500 Standard
Signal (SO <sub>2</sub> )	mV	13.2	14.1	Voltage of the measured SO <sub>2</sub> value
LAMP	mV	308.5	309.6	200 mV - 1200 mV
CELL	°C	34.9	34.9	Ambient temperature + 5 °C - 15 °C
PUMP	Kpa	44.8	44.8	65 kPa or less
AMBIENT	kPa	101.5	101.5	Current atmospheric pressure
DC 24V	V	24.0	24.0	24 V ±0.5 V
DC 5V	V	5.0	5.0	5 V ±0.5 V

Calibrate By :

(MR.PANUPON PODANG)

May 22, 2023



Checked By :

(MS.SUTATIP IM-NOI)

May 22, 2023

## Calibration Data of SO<sub>2</sub> Analyzer

### Analyzer Performance Test

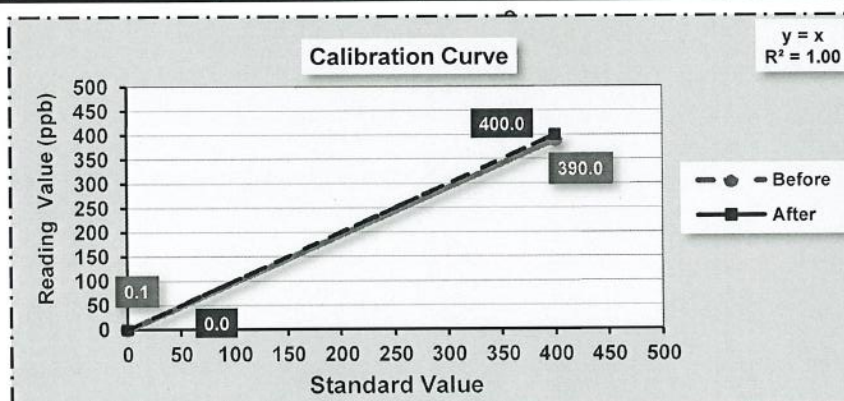
Equipment	Gas Analyzer ( SO <sub>2</sub> )	Customer Name	โพธิ์เกียรติ์ คอนซัลแตนต์
Manufacture	Thermo	Location	Envi Research
Model	43i-BNSAA	Quotation	2023-00767
Serial No.	CM14430004	Calibration Date	June 1, 2023
Analyzer Unit	ppb	Time	10:49 AM

### Instruments for Calibration

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

### Single Point Calibration

Standard Gas	Standard Gas Value	Analyzer Value ( ppb )		Stability		% Abs Error
		Before	After	Before	After	
Zero	0	0.1	0.0	-	-	-
Span	400	390.0	400.0	-	-	2.5



### STATUS TEST AND VALIDATION OF SO<sub>2</sub> ANALYZER MODEL 43i-BNSAA

Parameter	Display As	Unit	Observed Value		Nominal Range
			Before Adjust	After Adjust	
Range	RANGE	ppb	500	500	0 - 500 standard
Internal Temperature	INTERNAL	°C	35.7	35.6	8.0 °C to 45.0 °C
Chamber Temp	CHAMBER	°C	45.0	45.2	43.0 °C to 47.0 °C
Pressure	PRESSURE	mmHg	745.3	744.7	400.0 to 1,000
Sample Flow	SAMP FLOW	LPM	0.350	0.358	0.350 to 0.750
Lamp Intensity	LAMP INTENSITY	%	91	91	20 to 100
Lamp Voltage	LAMP VOLTAGE	V	1055	1060	500 to 1200
SO <sub>2</sub> Concentration	SO <sub>2</sub> CONCENTRATION	ppb	1.3	1.1	0 to 10,000
Motherboard Status	MOTHERBOARD STATUS	-	OK	OK	OK
Interface Status	INTERFACE STATUS	-	OK	OK	OK

Calibrate By :

(MR.PANUPON PODANG)

June 1, 2023

Checked By :

(MS.SUTATIP IM-NOI)

June 1, 2023



Accuracy Calibration Certificate

Environment Research & Technology Co., Ltd.  
25/114 Moo 6, Soi Chinakhet 1, Ngamwongwan Rd., Toongsongkhong  
Laksi  
10210  
Bangkok  
0332617856

NSC-JSL JIS 17025  
CALIBRATION 0062

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

Company:	Mettler Toledo	Instrument Type:	Weighting 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 (g)
1	220 g	0.0001 g

ภาคผนวก จ-1 หน้า 17/

Weighing Device

Calibration Guideline:  
METTLER 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.

TemperatureHumidity

As FoundAs Left

Calibrator:

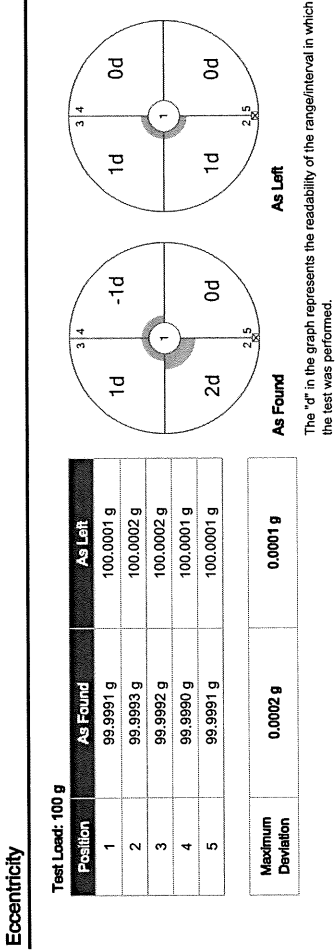
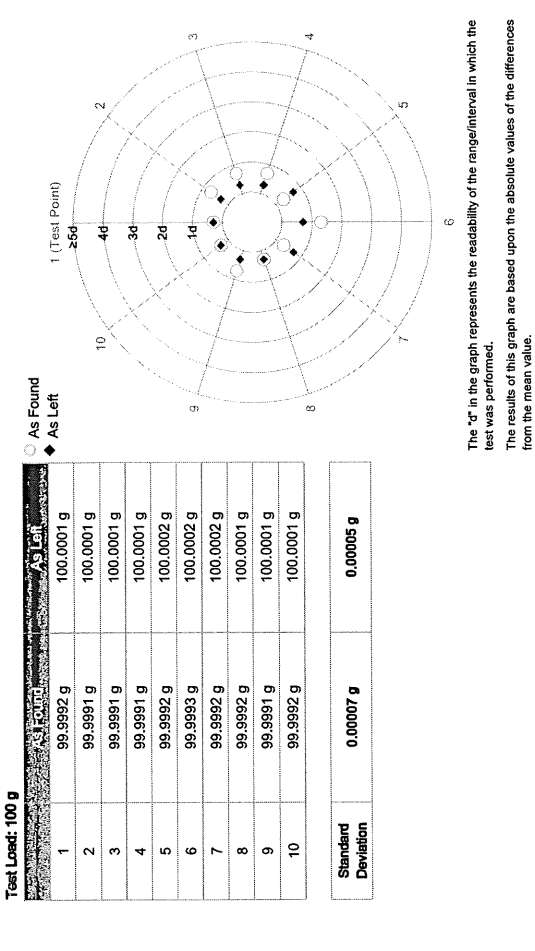
Issue Date:

Approved Signatory:

Technical Manager / Head of Calibration Center

Measurement Results

Repeatability



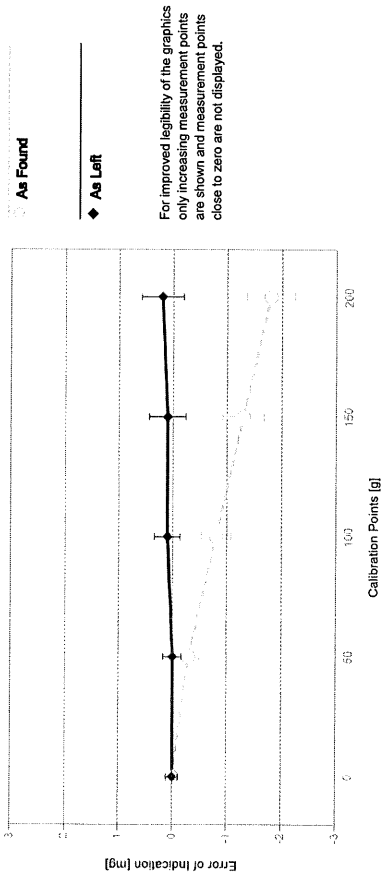


Error of Indication

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	0.0995 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

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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<sup>-6</sup> / K  
Temperature range on site for the evaluation of the measurement uncertainty in use: 3 K

Linearization of Uncertainty Equation

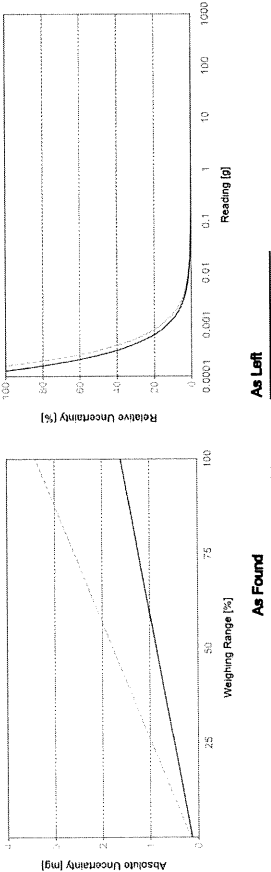
Range		As Found		As Left	
d	Max				
1	0.0001 g	220 g	$U_1 = 0.16 \text{ mg} + 0.0147 \text{ mg/g} \cdot R$	$U_1 = 0.13 \text{ mg} + 0.00671 \text{ mg/g} \cdot R$	

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%

ภาคผนวก จ-1 หน้า 19/62



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

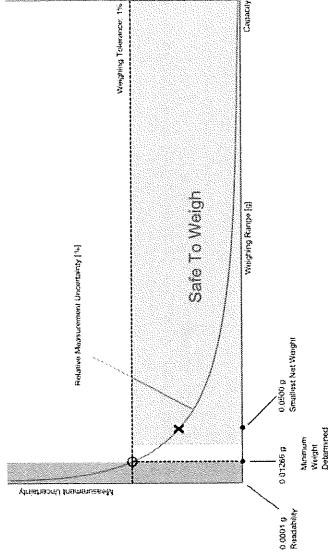
Process Requirements

Weighting 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	0.24189 g	0.40949 g	0.86155 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	As Found	As Left	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		N/A		N/A
0.2%	0.00005 g		✗		✗
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		✓	0.0001 g	✓
2%	1.0000 g		✓		✓
5%	2.5000 g		✓		✓

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

Error of Indication

As Found

Reference Value		Control limits for various weighing tolerances						
		Error	0.1%	0.2%	0.5%	1%	2%	5%
0.0000 g	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	0.0250 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	0.0500 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	0.0750 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	0.1000 g	0.2000 g	0.5000 g	1.0000 g	2.0000 g	5.0000 g
Result		✓	✓	✓	✓	✓	✓	✓

As Left

Reference Value		Control limits for various weighing tolerances						
		Error	0.1%	0.2%	0.5%	1%	2%	5%
0.0000 g	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	0.0250 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	0.0500 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	0.0750 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	0.1000 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



## The Result of Calibration

Issued by : Calibration &amp; Test Section : Meteorological Instruments Bureau

Date of Issue 12 April, 2023

Certification No. 159/23

Page : 1 of 3

Certification No. 159/23

Page : 2 of 3

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425		TESTED ANEMOMETER	
	Pressure Inches H2O	Vacuum Inches H2O	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 DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

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. 918602

Calibrated by :  Signed :

Mr. Watcharapol Subwat

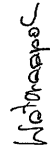
Mechanical Engineer

(Authorised Signatory)

Mr. Pised Pomsut

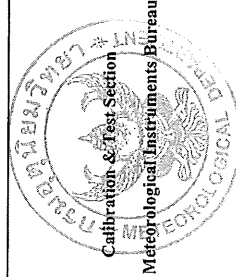
Mechanical Engineer

Calibrated by :



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 :

Wattasopon

Mr. Watcharapol Subwat  
Mechanical Engineer



# Sound Level Meter Calibration Report

**Support Equipment Type** : Sound Level Calibrator

**Manufacture** : BSWA Technology

**Model** : CA114

**Serial No.** : 470160

### Range of Calibrator

- **Sound Pressure Level** : 94.1 dB.

- Frequency : 1,000 Hz.

**Calibrated By** : Mr.Nitad Sirichad

**Calibration Date** : June 12, 2023

**Customer Name** : บริษัท ไฟร์เทียร์ คอนซัลแตนท์ จำกัด : โครงการนิคมอุตสาหกรรมบ่อทอง 33  
ของ บริษัท บ่อทอง อินดัสทรี เทคโนโลยี 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. 21-65/0732 MTC No. EEL. BP. 95/0865

## CALIBRATION CERTIFICATE

**Submitted by** : Environment Research & Technology Co., Ltd.  
**Address** : 25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road, Toongsonghong, Lakso, 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** : CA114  
**Serial No.** : 470160

### 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 Brüel&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** : 29 Aug. 2022

**Date of Calibration** : 6 Sep. 2022

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.

**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 : rumpa@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

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1/2



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0732 MTC No. EEL. BP. 95/0865

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
1/2 inch Brüel&Kjaer 4180	94.07	0.07	± 0.10	±0.75 dB

### 2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit
1/2 inch Brüel&Kjaer 4180	1002.2	2.2	± 1.5	±2.0%

### 3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit
1/2 inch Brüel&Kjaer 4180	1.50	± 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 :

(Mr. Weerachai Deechaiyae)

Approved by :

(Mr. Prawate Kluyapa)

Electrical and Electronic Standards Laboratory  
Industrial Metrology and Testing Service Centre

Date of Calibration : 6 Sep. 2022

Date of Issue : 7 Sep. 2022

Ref : 2011265082903844001

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.

**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 : rumpa@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

FMBL.MTC.002 Rev.4



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
53/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250  
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 22CH1754  
Page.: 1 of 2

## Certificate of Calibration

Equipment : pH Meter  
Manufacturer : Eutech  
Model : pHTestr 30  
Serial No. : 3066320  
ID No. : -

### Condition As-Received:

Received Date : 27 December 2022  
Calibration Date : 27 December 2022  
Reference : 2212-0734WN-10

### 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 Lemgagrakul

### Approved by :

( ) Malee Butkruea  
( ) Saithip Meangmai  
(V) Porpan Palpim

### Issue Date :

28 December 2022

The Uncertainties are for a confidence probability of approximately 95 %

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



Cert.No.: 22CH1754  
Page.: 2 of 2

### Condition of this calibration result

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	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.: 3066320	4.008	4.01	N/A	0.0071	2.00
	6.987	7.01	N/A	0.011	2.00
	10.008	10.01	N/A	0.0092	2.00

Remark - pH meter does not have voltage mode.

- Can not connect the BNC because the plug does not match with the socket.

- N/A = Not Available

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
5344 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 Hahib

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 %

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

A 0049319



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.

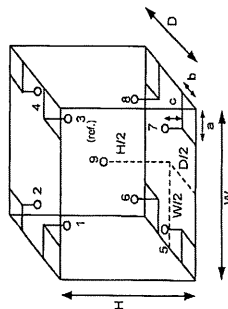
3. This certification is traceable to the International System of Unit.

Result of Calibration :- ( \* ) Without Adjustment

Function of UUC\* : Temperature Source

Fresh air setting : Close

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



Ref. Std. ID No.: @	
Position	Calibration Point
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

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<sup>3</sup>





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 k
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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Wdu.

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 Chinakiet 1, Ngamwongwan Rd., Toongsongkhong  
City: Laksei  
Zip / Postal: 10210  
State / Province: Bangkok  
Order Number: 0332617856

Contact: Ramita Taengthai

### Weighing Device

Manufacturer: Mettler Toledo  
Model: MS204S01  
Serial No.: B334691537  
Building: N/A  
Floor: 5  
Room: 504  
Instrument Type: Weighing Instrument  
Asset Number: ERTC-L-IN-088  
Terminal Model: N/A  
Terminal Serial No.: N/A  
Terminal Asset No.: N/A

ภาคผนวก จ-1 หน้า 29/6

### Procedure

Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)  
CPW002/20  
METTLER TOLEDO Work Instruction:  
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: Chawalt Wartsuoke  
Approved Signatory: Chawalt Wartsuoke  
Technical Manager / Head of Calibration Center

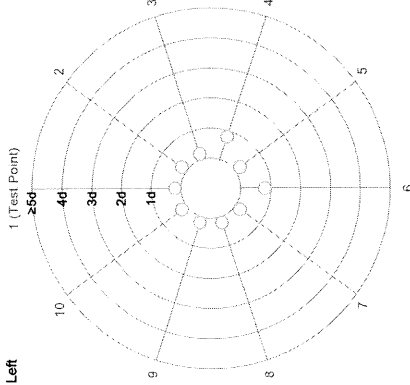
### Measurement Results

#### 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

○ As Found  
◆ As Left

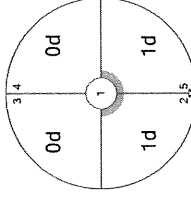


The "d" in the graph represents the readability of the range/interval in which the test was performed.  
The results of this graph are based upon the absolute values of the differences from the mean value.

### 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

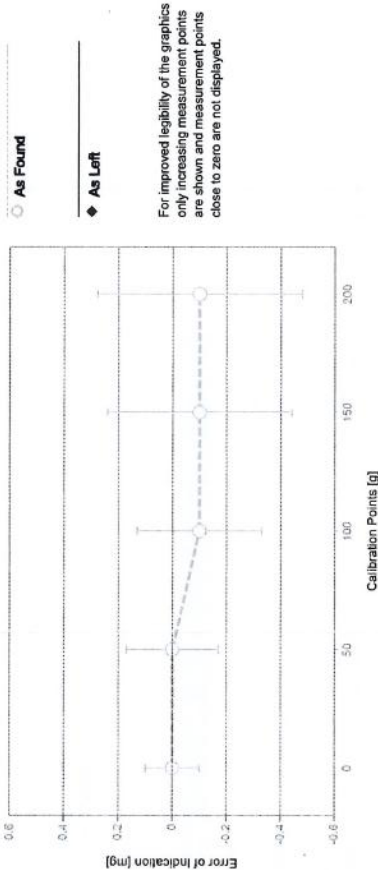


As Found

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
1	0.0000 g	0.0000 g	0.0000 g	0.10 mg
2	0.0500 g	0.0500 g	0.0000 g	0.12 mg
3	0.1000 g	0.1000 g	0.0000 g	0.12 mg
4	0.5000 g	0.5000 g	0.0000 g	0.12 mg
5	1.0000 g	1.0000 g	0.0000 g	0.12 mg
6	5.0000 g	5.0000 g	0.0000 g	0.13 mg
7	10.0000 g	10.0001 g	0.0001 g	0.13 mg
8	50.0000 g	50.0000 g	0.0000 g	0.17 mg
9	100.0000 g	99.9999 g	-0.0001 g	0.23 mg
10	150.0000 g	149.9999 g	-0.0001 g	0.34 mg
11	200.0000 g	199.9999 g	-0.0001 g	0.38 mg



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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:  $1.5 \cdot 10^{-6} / K$

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

Uncertization of Uncertainty Equation

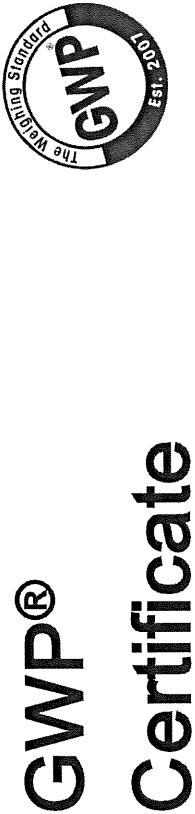
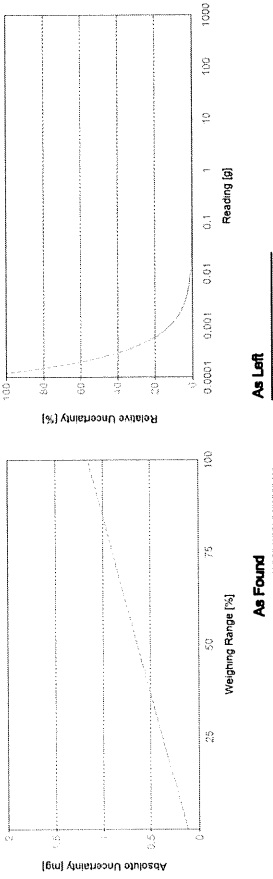
Range	As Found		As Left
	d	Max	
1	0.0001 g	220 g	N/A

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	N/A
0.2200 g	0.12 mg	N/A
2.2000 g	0.13 mg	N/A
22.0000 g	0.22 mg	N/A
220.0000 g	1.2 mg	N/A

ภาคผนวก จ-1 หน้า 31/62



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.

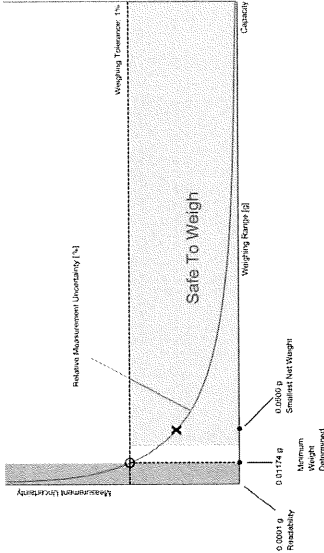
Process Requirements

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 Found	✓	As Found	✓
As Left	✓	As Left	✓	As Left	✓

✓ = Passed  
✗ = Failed  
Δ = Safety Factor not met

### Repeatability

Test Load: 100 g

Tolerance		Control Limit		As Found		As Left	
Tolerance	Result	Std. Deviation	Result	Std. Deviation	Result	Std. Deviation	Result
0.1%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.2%	0.00005 g	0.00005 g	✓	0.00004 g*	✓	0.00004 g*	✓
0.5%	0.00013 g	0.00013 g	✓		✓		✓
1%	0.00025 g	0.00025 g	✓		✓		✓
2%	0.00050 g	0.00050 g	✓		✓		✓
5%	0.00125 g	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	
Tolerance	Result	Std. Deviation	Result	Std. Deviation	Result	Std. Deviation	Result
0.1%	0.0500 g	0.0500 g	✓	0.0001 g	✓	0.0001 g	✓
0.2%	0.1000 g	0.1000 g	✓		✓		✓
0.5%	0.2500 g	0.2500 g	✓		✓		✓
1%	0.5000 g	0.5000 g	✓		✓		✓
2%	1.0000 g	1.0000 g	✓		✓		✓
5%	2.5000 g	2.5000 g	✓		✓		✓

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

Error of Indication

As Found

Reference Value		Error	Control limits for various weighing tolerances						
			0.1%	0.2%	0.5%	1%	2%	5%	
0.0000 g	0.0000 g	0.0000 g	N/A	N/A	N/A	N/A	N/A	N/A	
50.0000 g	0.0000 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	0.0000 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	0.0000 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	0.0000 g	0.1000 g	0.2000 g	0.5000 g	1.0000 g	2.0000 g	5.0000 g	
Result			✓	✓	✓	✓	✓	✓	

As Left

Reference Value		Error	Control limits for various weighing tolerances					
			0.1%	0.2%	0.5%	1%	2%	5%
0.0000 g		0.0000 g	N/A	N/A	N/A	N/A	N/A	N/A
50.0000 g		0.0000 g	0.0250 g	0.0500 g	0.1250 g	0.2500 g	0.5000 g	1.2500 g
100.0000 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  
5344 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 Hahib

**Approved by :**   
Approved Signatory

( ) Ponthippa Tameyakul  
( ) Malee Butkruea  
( ) Suwit Injai

**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 :** Hot Air Oven  
**Condition As-Received :** Used Item  
**Reference :** 2301-00020N-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.

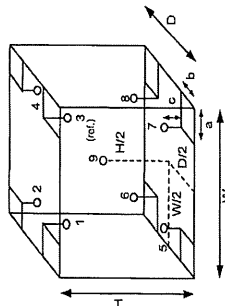
3. This certificate is traceable to the International System of Unit.

**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



Ref. Std. ID No.: @		
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

**Probe Installation Details :**

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

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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 k
104	104	104	0.16	2.4	2.6	0.86	2
180	180	180	0.34	6.1	8.8	1.8	2

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	103.368	103.014
180	176.454	179.253	182.386	180.810	181.999	178.253	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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Inctech Metrological Center Co.,Ltd.  
39/1 Soi 82, Sukhapiban 5 Rd., O ngoen,  
Saimai, Bangkok 10220, Thailand  
Tel. (662) 909-8820 (Auto 10 lines) www.imcinstrument.com



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Saimai, Bangkok 10220, Thailand  
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## 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 $\pm$ 10)  $^{\circ}$ C  
**Humidity** : (50 $\pm$ 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)

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Rev.02 / Mar 2020

FM-MT-01:

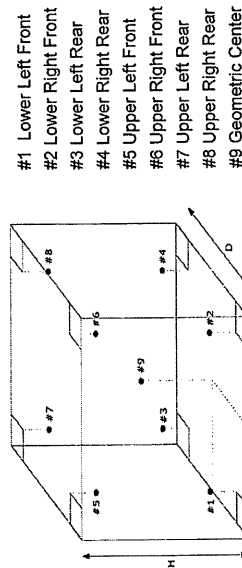
Certificate No. : MT22-6773

Page : 2 of 2

**Function** : Temperature measurement  
**Calibration point** : 20  $^{\circ}$ C  
**Result** : Without adjustment  
**Resolution** : 0.1  $^{\circ}$ C

Calibration point ( $^{\circ}$ C)	Temperature of UUC* at each position ( $^{\circ}$ C)									Uncertainty of measurement ( $\pm$ $^{\circ}$ 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 ( $^{\circ}$ C)	Indicating Temperature ( $^{\circ}$ C)	Measured stability ( $\pm$ $^{\circ}$ C)	Measured uniformity ( $^{\circ}$ C)	Overall variation ( $^{\circ}$ C)
20.0	20 to 20.2	0.51	0.87	1.5



Front view

**UUC\*** = Unit under calibration  
**Uniformity** = Maximum and Minimum difference of measured temperature at any probes and the measured temperature at the reference and same time.  
**Overall Variation** = Difference of temperature value between the maximum and minimum any time.  
**Stability** = One half of the maximum difference of measured temperatures at any one probe.

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Rev.02 / Mar 2020

FM-MT-01:





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



## Certificate of Calibration

Certificate No. : MT23-1348  
Page : 1 of 3

**Customer** : Environment research & Technology Co.,Ltd.  
**Address** : 25/114 Moo6 Soi Chinaketi1, Ngamwongwan Road, Toongsonghong, Laksi, Bangkok 10210

**Description** : Heating Block (TC-K)  
**Manufacturer** : Hanna  
**Model** : HI8398000-02  
**Serial No.** : G0059491  
**Identification No.** : ERTC-L-In-112  
**Calibration Place** : Customer Laboratory

**Order No.** : 0030/23  
**Received date** : Jan 02, 2023  
**Calibration date** : Jan 02, 2023  
**Environment Condition** :  
**Temperature** : (25 $\pm$ 10) °C  
**Humidity** : (50 $\pm$ 30) %RH

**Calibration Method** : Calibration were conducted using In-house calibration procedure CP-MT-009 According to comparison with LXI Data Acquisition Switch Unit.

ภาคผนวก 1 หน้า 37/62

### Reference Standard Instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
LXI Data Acquisition Switch Unit with RTD Sensor	34972A	MY49020096	MT22-6392	Dec 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 Sreebarnasarn  
Issue date : Jan 06, 2023

Approved by : (Mr.Panuwat Phuklan)

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approval of Intech Metrological Center Co.,Ltd

### Position



Top view

**Function** : Temperature measurement (Cont.)  
**Calibration point** : 150 °C  
**Immersion depth** : 50 mm.  
**Result** : Without adjustment

Position No.	UUC* setting (°C)	Standard reading (°C)	UUC* correction (°C)	Uncertainty of measurement ( $\pm$ °C)
1	150	153.601	3.601	0.12
2	150	153.612	3.612	0.12
3	150	153.921	3.921	0.12
4	150	150.662	0.662	0.12
5	150	153.559	3.559	0.12
6	150	153.631	3.631	0.12
7	150	154.258	4.258	0.12
8	150	154.463	4.463	0.12
9	150	154.486	4.486	0.12
10	150	154.461	4.461	0.12

Certificate No. : MT23-1348  
Page : 2 of 3

UUC\* = Unit under calibration



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Tel. (662) 909-8820 (Auto 10 lines) [www.imcinstrument.com](http://www.imcinstrument.com)



Function

: Temperature measurement

Calibration point

: 150 °C

Immersion depth

: 50 mm.

Result

: Without adjustment

Certificate No. : MT23-1348

Page : 3 of 3

Position No.	UUC* setting (°C)	Standard reading (°C)	UUC* correction (°C)	Uncertainty of measurement (+/- °C)
11	150	154.817	4.817	0.12
12	150	154.137	4.137	0.12
13	150	154.294	4.294	0.12
14	150	150.914	0.914	0.12
15	150	154.203	4.203	0.12
16	150	153.716	3.716	0.12
17	150	154.134	4.134	0.12
18	150	154.312	4.312	0.12
19	150	154.143	4.143	0.12
20	150	154.166	4.166	0.12
21	150	153.133	3.133	0.12
22	150	153.083	3.083	0.12
23	150	153.499	3.499	0.12
24	150	154.246	4.246	0.12
25	150	153.461	3.461	0.12

Mettler-Toledo (Thailand) Ltd.  
846/4 - 846/5 Lasalle Rd., Bangna Tai Sub-District  
Bangna District, Bangkok 10280  
+66 2723 0382  
MT-TH.ServiceSupport@mt.com



NSD-TIS-TIS 17025  
CALIBRATION 0662

# Accuracy Calibration Certificate

Customer

Company:

Environment Research & Technology Co., Ltd.

Address:

25/114 Moo 6, Soi Chinakhet 1, Ngamwongwan Rd., Toongsonghong

City:

Laksi

Zip / Postal:

10210

State / Province:

Bangkok

Order Number:

Contact:

Ramita Taengthai

Company:

Mettler Toledo

Instrument Type:

MS204 TS/00

Asset Number:

B547728937

Terminal Model:

N/A

Terminal Serial No.:

5

Terminal Asset No.:

504

Range

Max. Capacity

Repeatability (d)

1

220 g

0.0001 g

Weighing Device

Manufacturer:

Mettler Toledo

Model:

MS204 TS/00

Serial No.:

B547728937

Building:

N/A

Floor:

5

Room:

504

Weighting Instrument

ERTC-L-IN-114

Asset Number:

N/A

Terminal Model:

N/A

Terminal Serial No.:

N/A

Terminal Asset No.:

N/A

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Procedure

Calibration Guideline:

EURAMET cg-18 v. 4.0 (11/2015)  
CFW002/20

METTLER TOLEDO Work Instruction:

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

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

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

As Found

Temperature

Humidity

As Found

Start: 23.7 °C

End: 23.8 °C

Start: 45.6 %

End: 46.8 %

As Found Calibration Date:

17-Jan-2023

As Left Calibration Date:

N/A

Issue Date:

19-Jan-2023

Calibrator:

Chawalit

Approved Signatory:

Chawalit Martsuloke

Technical Manager / Head of Calibration Center

Software Version: 1.23.1.11  
Report Version: 2.16.30  
Form Number: F103C

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Software Version: 1.23.1.11  
Report Version: 2.16.30  
Form Number: F103C

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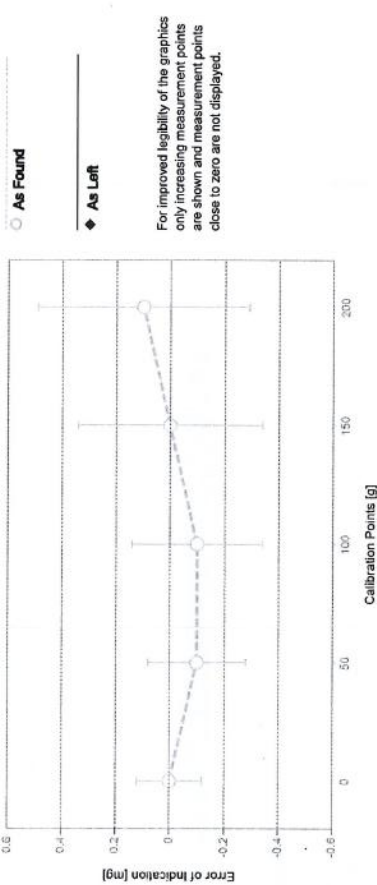
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Error of Indication

As Found	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.0000 g	0.12 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

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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.

<b>Weight Set 1: OIML E2</b>			
Weight Set No.:	WS57	Date of Issue:	06-Jan-2022
Certificate Number:	177037	Calibration Due Date:	03-Jul-2023
<b>Thermo Hygrometer</b>			
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 · 10<sup>-4</sup> / K  
Temperature range on site for the evaluation of the measurement uncertainty in use: 3 K

Linearization of Uncertainty Equation

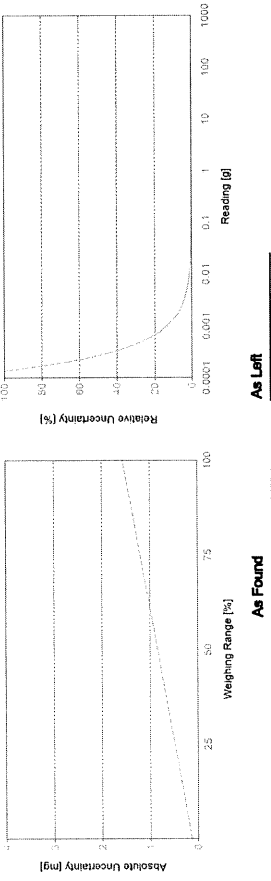
	Range		As Found	As Left
	d	Max		
1	0.0001 g	220 g	U <sub>1</sub> = 0.13 mg + 0.00647 mg/g · R	N/A

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

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

Net Indication	As Found		As Left	
0.0220 g	0.13 mg	0.59%	N/A	N/A
0.2200 g	0.13 mg	0.060%	N/A	N/A
2.2000 g	0.14 mg	0.0066%	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

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GWP®  
Certificate



As Found As Left

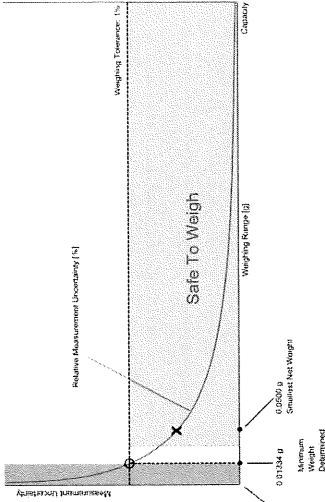
The weighing device meets the given process requirements. The weighing device meets the given process requirements.

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					
Safety Factor					
	1	2	3	5	10
Tolerance					
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					
Safety Factor					
	1	2	3	5	10
Tolerance					
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 Found	✓	As Found	✓
As Left	✓	As Left	✓	As Left	✓

- ✓ = Passed  
✗ = Failed  
Δ = Safety Factor not met

Repeatability

Test Load: 100 g

Tolerance		Control Limit		As Found		As Left		Result	
				Std. Deviation		Std. Deviation			
0.1%		N/A						N/A	
0.2%		0.00005 g						Δ	
0.5%		0.00013 g						✓	
1%		0.00026 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		Result	
				Deviation		Deviation			
0.1%		0.0500 g						✓	
0.2%		0.1000 g						✓	
0.5%		0.2500 g						✓	
1%		0.5000 g				0.0001 g		✓	
2%		1.0000 g						✓	
5%		2.5000 g						✓	

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



Error of Indication

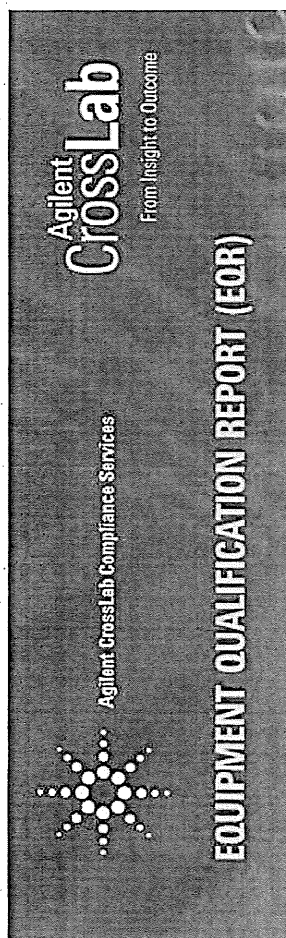
As Found

Reference Value		Control limits for various weighing tolerances							
		Error	0.1%	0.2%	0.5%	1%	2%	5%	
0.0000 g	0.0000 g	0.0000 g	N/A	N/A	N/A	N/A	N/A	N/A	N/A
50.0000 g	-0.0001 g	0.0250 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	0.0500 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	0.0750 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	0.1000 g	0.2000 g	0.5000 g	1.0000 g	2.0000 g	5.0000 g	
Result		✓	✓	✓	✓	✓	✓	✓	✓

As Left

Reference Value		Control limits for various weighing tolerances							
		Error	0.1%	0.2%	0.5%	1%	2%	5%	
0.0000 g	0.0000 g	0.0000 g	N/A	N/A	N/A	N/A	N/A	N/A	N/A
50.0000 g	-0.0001 g	0.0250 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	0.0500 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	0.0750 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	0.1000 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 &amp; Technology Co., Ltd

Org. Location: 25/114 Moo 6 Soi Chinaket, Ngamwongwan Rd., Bangkok 10210

Section	Page
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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	Status	Runs
Test		
Preparation : 5100 VDV	Pass	1
Instrument Tests : 5100 VDV	Pass	1
Autosampler Operation : Autosampler 1 - SPS4	Pass	1
Overall Qualification Status		

Pass

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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



This section describes the as found system configuration.

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.

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 2984

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

PLU-0001

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

## Configuration Details

Model/Serial No.:

G6011A

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

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## Image Details:

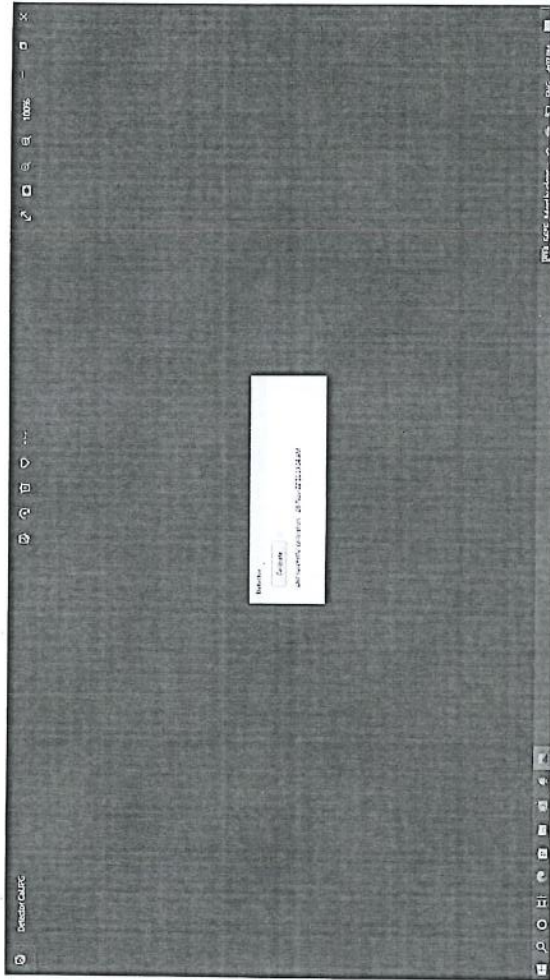
Was the detector calibration performed and completed successfully?

Date and Time:

November 28, 2022 4:07:22 PM

Host Name:

5CG0202NQ4



## Image Details:

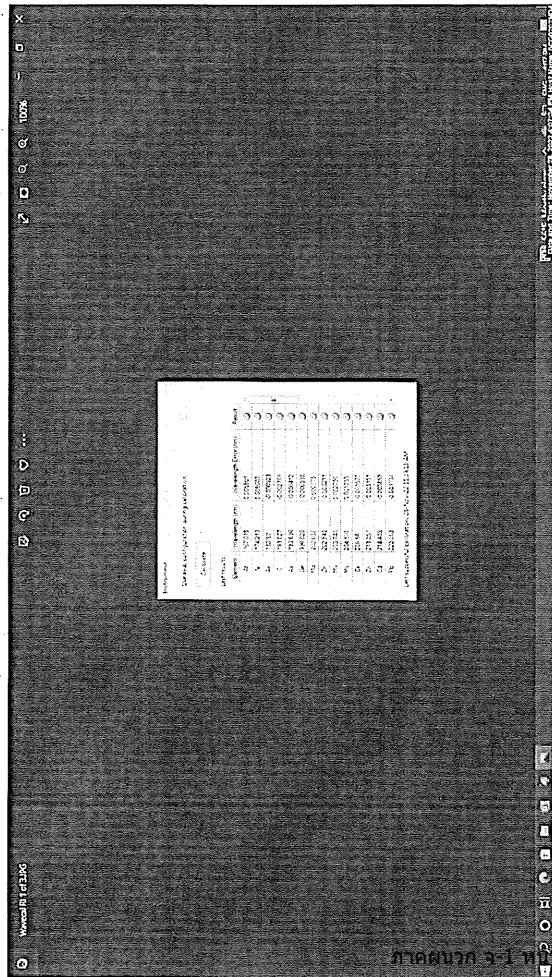
Was the instrument calibration performed and completed successfully?

Date and Time:

November 28, 2022 4:07:34 PM

Host Name:

SCG0202NQ4



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

Purpose:

This test verifies that the autosampler operates properly.

Configuration Details

Model/Serial No.: G8410A AU15220240

Results

Criteria

Observed Result	Expected Result	Status
Yes	Yes	Pass

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

Overall Test Status

Pass Runs: 1

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.



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
EQR	General	Instrument's Test Report	18
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EQR	Material	Certificate of Analysis Wavelength calibration solution	22

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Document Name:

Certificate of Qualification for ACE



## Agilent Technologies

### Agilent Compliance Engine Self Qualification

Date: April 17, 2022 11:11:13 PM  
Drive Serial #: 90592EBA  
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 address. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

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 address. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.



Document Name:

Certificate of System Qualification

Document Name:

Instrument's Test Report



## 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.

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			
Sensitivity Test			
Precision Test			
Resolution Test			
Element Wavelength	Specification	Width	
N (174.213 nm)	≤ 9.40	7.40	
As (188.980 nm)	≤ 8.20	6.48	
C (133.027 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 (229.424 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

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	SRB	8.0	41307.1	4600.0	
Ba (493.408 nm)	≥ 34.0	SRB	103.1	1275727.5	12253.3	
K (766.491 nm)	≥ 1.8	SRB	3.9	111109.8	22733.2	
Axial						
Element Wavelength	Specification	Method	Ratio	Standard	Blank	
As (188.980 nm)	≥ 208.0	SRBR	250.8	3657.4	192.0	
Se (196.026 nm)	≥ 159.0	SRBR	172.2	2502.2	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	665.7	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	176432.2	1297.2	
Cu (324.754 nm)	≥ 19.0	SRB	65.7	268073.8	4020.3	
Al (396.152 nm)	≥ 6.0	SRB	24.3	271032.8	10722.4	
Ba (493.408 nm)	≥ 60.0	SRB	275.4	8034569.3	29068.7	
K (766.491 nm)	≥ 24.0	SRB	81.9	3677804.4	44370.4	

Page 2 of 3

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



Document Name:

Software verification

Document Name:

Certificate of Analysis Wavelength calibration solution

Software Verification Report

Date: Monday, November 28, 2022 Time: 3:44:56 PM UTC Host Name: 5100VDV-AP  
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

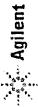
No missing files or invalid files found  
No system file difference found

File Registration Report Summary

Files Registration check not required for this product

Registry Report Summary

Registry entries check not required for this product



CERTIFICATE OF ANALYSIS

Agilent Product Name: Wavelength Calibration Solution for ICP-OES & MP-AES, 5 mg/L, 500mL  
Agilent Part No: 610030100  
Lot No: 001716321

Product Specifications

Analyte	Shipping Material	CAS #	Certified Conc.	Analyte	Shipping Material	CAS #	Certified Conc.
Al	AlNO <sub>3</sub>	7784-37-2	5.000 ± 0.025 mg/L	Mo	Mo	7439-98-5	5.001 ± 0.025 mg/L
As	As	7440-38-2	5.001 ± 0.025 mg/L	Ni	ONH <sub>2</sub> AAO <sub>2</sub>	13106-76-8	5.003 ± 0.025 mg/L
Ba	Ba(NO <sub>3</sub> ) <sub>2</sub>	10023-31-6	5.000 ± 0.025 mg/L	Pb	Pb	7440-32-0	5.001 ± 0.025 mg/L
Cd	Cd	7440-43-9	5.000 ± 0.025 mg/L	Se	Se	7782-49-2	5.000 ± 0.025 mg/L
Co	Co	7440-48-4	5.000 ± 0.025 mg/L	Sr	Si(NO <sub>3</sub> ) <sub>2</sub>	10042-76-3	5.000 ± 0.025 mg/L
Cr	Cr(NO <sub>3</sub> ) <sub>3</sub>	13548-38-4	5.000 ± 0.025 mg/L	Zn	Zn	7440-66-6	4.999 ± 0.025 mg/L
Cu	Cu	7440-50-8	5.000 ± 0.025 mg/L				
K	KNO <sub>3</sub>	7757-79-1	50.00 ± 0.25 mg/L				

Matrix: 5% HNO<sub>3</sub>


Intended Use: This solution is intended for use as a certified reference material for 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 9001:2015 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 (HNO<sub>3</sub>) and diluted with filtered (0.22µm), 18 M-ohm deionized water. The balance 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, 3114, 3115a, 3132, 3136, 3138, 3143a, 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.


## Document Name: Certificate of Analysis Wavelength calibration solution

## Document Name: Certificate of Analysis Wavelength calibration solution




**Period of Validity:** Agilent assures 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 this solution.

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

**Sample lot approval:**  
  
Chuck Swadlow, Certifying Officer

**Page 2 of 3**



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

**Homogeneity:** This solution was determined to be homogeneous by procedures consistent with the requirements of ISO 17024 and ISO Guide 35. Replicate samples of the finished solution were analyzed to confirm its homogeneity, in accordance with OSP 4.13. Homogeneity of homogeneity and stability. To ensure homogeneity, users should not take a smaller sub-sample than specified in the instructions for use, or using as well evaluate the method values and uncertainties.

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

**Quality Certification:** This CMA was prepared under a quality management system that is:

- Registered to ISO 9001 – Quality Management Systems – Requirements (TUV NORD Cert. Reg. No. 41 193 10960231)
- Accredited to ISO 17025 – General Requirements for the Competence of Reference Material Producers (AGLA Cert. No. 2044 020)
- ISO 17025 reference 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 (AGLA Cert. No. 2046 01)
- LAC-USA, 201 Ash Road, Northbrook, IL 60062

**Page 3 of 3**

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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

การเปิดเผยข้อมูล

Regulatory Disclaimer

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

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User Name: worawit.timakul  
Host Name: SC6221033  
System ID: MY15330001  
Print Date: November 28, 2022 4:16:06 PM

OO HW ICP 5100 Envl research 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	EptLoaded	Session	EQP details for primary technique [Eq] - File path: [ProtocolPacks\Eqs\Configurations\02.50\Eqs.02.50.eqp] EQP File Name: [Eqs.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

User Name: worawit.timakul  
 Hostname: SC03021024  
 System ID: MY15330001  
 Print Date: November 28, 2022 4:15:43 PM

# QQ HW ICP 6100 Envi resaarc 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: QQ HW ICP 5100 Envi resarc_20221128_Certificat e_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

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

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

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



Cert.No.: 22TW243  
Page.: 2 of 2

Cert.No.: 22TW243  
Page.: 1 of 2

## Certificate of Testing

Equipment : DO Meter  
Manufacturer : YSI  
Model : Pro 20  
Serial No. : 13C100551  
ID No. : No.2  
Received Date : 26 October 2022  
Test Date : 27 October 2022  
Reference : 2210-0840WN-2  
Submitted by : Environment Research & Technology Company Limited.  
25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road,  
Toongsonghong, Laksi, Bangkok 10210  
Laboratory Condition : Temperature (  $25 \pm 5$  ) °C  
Humidity (  $50 \pm 20$  ) %  
Test Procedure : In - house method : CP-CH9  
by Comparison Technique with Azide Modification Method  
Tested by : Walalak Sirithean

Approved by :   
Approved Signatory

(✓) Malee Bulkruea  
( ) Sathip Meangmai  
( ) Warakorn Lemgagatrakul

Issue Date : 1 November 2022

B 0300522

### 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.: 15K100212

Titration Method (Azide Modification Method)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
(mg/L)		
8.14	8.15	0.0071

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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a 1133338

# PinAAcle 900Z Preventive Maintenance Report

Company Name: ENVIRONMENT RESEARCH

Instrument Location: 25/114 M.6, THANON NGAMWONGWAN  
THUNG SONG HONG, LAKSI, BANGKOK, 10210

Instrument Serial No.: PZAS19031401

Date: 28-Jun-2022

## PinAAcle 900Z Preventive Maintenance (PM)

Company Name:	ENVIRONMENT RESEARCH			
Address (Instrument Location):	25/114 M.6, THANON NGAMWONGWAN, THUNG SONG HONG, LAKSI, BANGKOK			
Serial Number:	PZAS19031401	PM Number:	1/2	
Customer Name (if applicable):	K. RAIWIN	Telephone Number:	099-182-9241	
Customer Support Engineer Name:	K. DUANG	Service Order Number:	WO-01710018	
Date PM Performed: (DD-MMM-YYY)	28-Jun-2022	Next PM Due Date: (DD-MMM-YYY)	28-Dec-2022	
Standard Labor Hours to Complete PM :			5 hours	

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



### Scope

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

The customer should save their method before the PM begins.

### General Instructions:

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

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

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

Update the PM sticker and instrument logbook as required.

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## Component List

Component / Specific Model	Serial #	Configuration Notes

## Parts Lists

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

Additional Reagents and Standards Required for PM				
Part Number (if applicable)	Description	Quality	Batch/Lot #	Expired Date (MM/YY)
N9300244	GFAAS Mixed Standard	AR	56-021CRY1	30-Jun-2022

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

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

## Procedure Checklist

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

### 1. General:

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

### 2. PC Instrument Software:

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

### 3. Mechanical:

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

### 4. Electrical:

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

### 5. Optics:

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

### 6. Gasses:

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

### 7. After PM Performance tests [THGA]:

#### 7.1 Furnace Gas Flows

Description: Ensures the flow rates are within specification.

Parameter	Specification	Test Results	Pass/Fail
Internal Flow Rate	250 mL/min ± 25 mL/min	255	Passed
External Flow Rate	100 mL/min ± 10 mL/min	104	Passed

#### 7.2 Chromium Baseline Noise

Description: Signal to noise check.

Parameter	Specification	Results	Pass/Fail
Baseline Noise	≤ 0.005 Abs.	0.0007	Passed
Standard Deviation	≤ 0.005	0.0002	Passed

#### 7.3 Chromium Characteristic Mass and Precision

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

Parameter	Specification	Results	Pass/Fail
Cr m <sub>0</sub> Results	≤ 7.0 pg/0.0044 A-s	6.3	Passed
Precision	≤ 2.0 %	1.49	Passed



#### 7.4 Copper Characteristic Mass and Zeeman Ratio

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

Parameter	Specification	Results	Pass/Fail
Cu m <sub>g</sub> Result	≤ 16.5 pg/0.0044 A-s	14.2	Passed
Zeeman Ratio	0.52 ± 0.04	0.52	Passed

#### 8. Review:

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

#### Additional Comments

Additional Comments Regarding the PM

$$\text{Zeeman Ratio} = \frac{\text{Atomic Signal (Peak area)}}{\text{Atomic Signal (Peak area)} + \text{Background Signal (Peak area)}}$$

0.1529

0.1529+0.1361

0.52

#### Review

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

This PinAAcle 900Z Passes ☒ Fails ☐ the preventive maintenance.

Review of Preventive Maintenance:

Authorized PerkinElmer Representative:

Duang Hiransuk

Date:

28-Jun-2022  
(DD-MMM-YYYY)

Authorized Customer Representative:

อ. อ. อ. อ. อ.

Date:

28-Jun-2022  
(DD-MMM-YYYY)



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## เอกสารสอบเทียบเครื่องมือวิเคราะห์ บริษัท ศูนย์วิเคราะห์น้ำ จำกัด

## CERTIFICATE OF CALIBRATION

**Certificate No.:** C0-1908005/22

**Page** 1 **of total** 4 **pages**

**Customer** WATER ANALYSIS CENTER CO., LTD.  
30/5 Soi Viphavadee 60, Viphavadee Rangsit Road,  
Kwaeng Taladbangkhen, Khet Laksi, Bangkok 10210

<b>Equipment</b>	pH Meter		
<b>Manufacturer</b>	METTLER TOLEDO	<b>Model</b>	SevenCompact S220
<b>Serial No.</b>	B327527211	<b>ID No.</b>	WWL 0068
<b>Description</b>	Range : 0 - 14 pH, Resolution : 0.01 pH		

**Environmental Conditions**

Ambient Temperature:	(20 ± 2) °C
Relative Humidity:	(50 ± 10) %
Atmospheric Pressure:	-

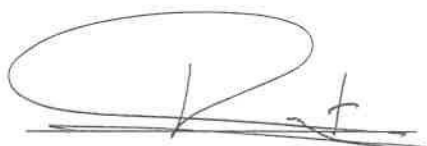
**Calibration Location** Jayhawks Laboratory (CL&GL)

**Received Date** 19 August 2022

**Calibration Date** 19 August 2022

**Date of Issue** 22 August 2022

**Checked by**



Act as Technical Manager

**Approved by**



Representative of Managing Director

( ) ( Krisyosl K. )	( ) ( Sakda Y. )
( ) ( Patiphan K. )	( / ) ( Onnapa P. )
( ) ( Pongsak H. )	( ) ( Nitiphong K. )
( ) ( Kanung C. )	( ) ( Nonthachai K. )
( ) ( Pramong P. )	( ) ( Noppol P. )

( Dr. Ekachai Puttitwong )

**Certificate No.:** C0-1908005/22

**Page 2 of total 4 pages**

**Reference Method:**

- The calibration method used was CP-178 based on an in-house method.
- This certificate can be traceable to the national standards, which is realized the shown measurement units according to the International System of Units (SI Units).

**Reference Standard:**

Type	pH Value	Lot No.	Due Date	Traceability
pH Standard Solution	4.01	081020	Jan. 22, 2023	NIMT
	7.01	020221	Jan. 18, 2023	
	10.00	091020	Feb. 7, 2023	

Type	Model	Serial No.	Certificate No.	Due Date	Traceability
Documenting Process Calibrator	753	3101007	10-0804001/22	Apr. 7, 2023	THC
Digital Thermometer with Sensor	1523 / 5622	1709138 / 4605984-005	10-1006004/22	Jun. 9, 2023	

**Remark:** This certificate is traceable to the International System of Unit (SI Unit) through:

- NIMT, National Institute of Metrology (Thailand).
- THC, Thai Heart Calibration Co., Ltd.

**Measurement Results:**

**1. Function Simulated pH Meter**

Standard Applied ( mV )	Nominal Value ( pH )	UUC Reading		Uncertainty ( ± mV )
		pH	mV	
177.48	4.00	4.01	177.4	0.060
0.00	7.00	7.00	0.0	0.060
-177.48	10.00	10.01	-177.4	0.060

UUC : Unit Under Calibration

Note : Adjust Curve to simulate pH (4,7,10)



**Certificate No.:** C0-1908005/22

**Page 3 of total 4 pages**

Measurement Results (Cont.):

**2. Calibration of pH Electrode (Serial No.: 3322791)**

pH Standard Solution ( pH )	Measured Value		Uncertainty ( ± pH )
	( pH )	( mV )	
4.01	4.01	185.9	0.013
7.01	7.01	9.3	0.013
10.00	10.01	-164.9	0.013

Note : Adjust Curve to Buffer Solution pH (4,7,10)

Temperature stability of micro bath :  $25 \pm 0.2^{\circ}\text{C}$

The above reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor  $k = 2.00$ , providing a level of confidence approximately 95%.

**Certificate No.:** C0-1908005/22

**Page** 4 **of total** 4 **pages**
**Reference Method:**

- The calibration method used was CP-096 based on an in-house method.
- The temperature scale used was an ITS-90.
- This certificate can be traceable to the national standards, which is realized the shown measurement units according to the International System of Units (SI Units).

**Reference Standard Instruments:**

Type	Model	Serial No.	Cert. No.	Due Date	Traceability
Thermometer Readout	1529-R	B7C853	I0-1011001/21	Nov. 10, 2022	THC
Platinum Resistance Thermometer	5626	4854	C0A30047	Oct. 22, 2023	FLUKE
Liquid Bath	XORTS-40A	XO111019	I0-0306002/21	Jun. 3, 2023	THC

**Remark:** This certificate is traceable to the International System of Unit (SI Unit) through:

- THC, Thai Heart Calibration Co., Ltd.
- FLUKE, Fluke Comporation, U.S.A.

**Measurement Results:**

( X ) Without Adjustment

Dimension of probe : Diameter 4 mm. Sensor Type : RTD (PT100)

Immersion Depth (mm.)	Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty ( $\pm$ °C)
120	22.00	22.0	0.00	0.060
120	25.00	25.0	0.00	0.060
120	28.00	28.0	0.00	0.060

UUC : Unit Under Calibration

The above reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor  $k = 2.00$ , providing a level of confidence approximately 95%.

- End of Certificate -

## CERTIFICATE OF CALIBRATION

**Certificate No.:** C0-2007006/22

**Page** 1 **of total** 2 **pages**

**Customer** WATER ANALYSIS CENTER CO., LTD.  
30/5 Soi Viphavadee 60, Viphavadee Rangsit Road,  
Kwaeng Taladbangkhen, Khet Lakxi, Bangkok 10210

<b>Equipment</b>	Conductivity Meter		
<b>Manufacturer</b>	EUTECH	<b>Model</b>	CON 2700
<b>Serial No.</b>	2657889	<b>ID No.</b>	WWL 0136
<b>Description</b>	-		

**Environmental Conditions**

Ambient Temperature:	(20 ± 2) °C
Relative Humidity:	(50 ± 10) %
Atmospheric Pressure:	-

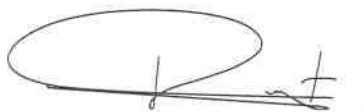
**Calibration Location** Jayhawks Laboratory (CL&GL)

**Received Date** 20 July 2022

**Calibration Date** 20 July 2022

**Date of Issue** 21 July 2022

**Checked by**



Act as Technical Manager

**Approved by**



Representative of Managing Director

( ) ( Krisyosl K. )	( ) ( Sakda Y. )
( ) ( Patiphan K. )	(✓) ( Onnapa P. )
( ) ( Pongsak H. )	( ) ( Nitiphong K. )
( ) ( Kanung C. )	( ) ( Nonthachai K. )
( ) ( Pramong P. )	( ) ( Noppol P. )

( Dr. Ekachai Puttitwong )

This calibration certificate shall not be reproduced other than in full except with the prior written approval of the Thai Heart Calibration Co., Ltd.

ภาคผนวก จ-2 หน้า 5/41

**Certificate No.:** C0-2007006/22

**Page 2 of total 2 pages**

**Reference Method:**

- The calibration method used was CP-177 based on an in-house method.
- This certificate can be traceable to the national standards, which is realized the shown measurement units according to the International System of Units (SI Units).

**Reference Standard :**

Material	Batch Value	Lot Number	Due Date	Traceability
Conductivity Standard Solution	151.1 $\mu\text{S/cm}$	S211008031	Jan. 18, 2023	SCP Science
	1.421 mS/cm	S220112015	May 16, 2023	

**Remark:** This certificate is traceable to the International System of Unit (SI Unit) through:

- SCP Science.

**Measurement Results:**

Conductivity Standard Solution	Measured Value	Correction	Uncertainty ( $\pm$ )
151.1 $\mu\text{S/cm}$	150.9 $\mu\text{S/cm}$	0.2 $\mu\text{S/cm}$	1.5 $\mu\text{S/cm}$
1.421 mS/cm	1.423 mS/cm	-0.002 mS/cm	0.0052 mS/cm

**Note :** Adjustment points: 151.1 $\mu\text{S/cm}$  1.421mS/cm

The above reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor  $k = 2.00$ , providing a level of confidence approximately 95%.

- End of Certificate -





Automation

# AUTOMATION SERVICE CO.,LTD.

## CALIBRATION LABORATORY

SV 201003/2023

Cert. No. WAC-065

Page 1 of 2

### CERTIFICATE OF CALIBRATION

Instrument : DO Meter  
Model : DO-31P  
Serial No. : 780065  
Manufacturer : TOA-DKK  
Measuring Range : 0.00 ~ 20.00 mg/l

Machine : -  
Location : -

Customer : Water Analysis Center Co.,Ltd.  
1/94 Moo.5 T.Kanham, A.U-Thai  
Ayutthaya 13210 Thailand

Date Of Received : 05 / 01 / 2023

Date Of Calibration : 05 / 01 / 2023

Ambient Condition : Temperature 25 °C  
Humidity 50 % RH

Calibrated By :

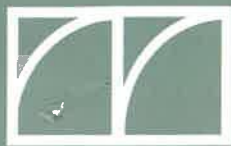
P. Yooyen  
( Ms. Phanee Yooyen )  
Technician

Approved By :

Prajit (for)  
( Mr. Nipon Phungsomsak )  
Technical Manager

Date Of Issue : 09 / 01 / 2023

This Certificate may not be reproduced other than in full, except with the prior written approval of the head of the industrial instruments calibration center.



Automation

# AUTOMATION SERVICE CO.,LTD.

## CALIBRATION LABORATORY

Instrument : DO Meter  
Model : DO-31P  
Serial No. : 780065

Cert. No. WAC-065  
Page 2 of 2

### Calibrate Procedure

- ☐ This instrument was calibrated by comparison with standard solution (PH/ORP)
- ☐ This instrument was calibrated by comparison with scattering plate value (Turbidity)
- ☐ This instrument was calibrated by comparison with conductivity (Conductivity)
- ☒ This instrument was calibrated by comparison with Sodium sulfite anhydrous (DO)

### Condition of this result of calibration

#### 1). Reference Standard Solution

<u>Standard</u>	<u>Lot No</u>	<u>Batch.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Sodium Sulfite Power	1.06657.0500	K54224057	-	30 Sep 2023

#### 2). Traceability This certification is traceable to

- ☒ Merck KGaA 64271 Darmstadt
- ☐ DKK Corporation

### Result Of Calibration

Standard Solution (mg/l) at 24.1°C		Before Adjust		After Adjust	
		Indicator	Error	Indicator	Error
Zero	0.00	0.05	+ 0.05	0.00	-
Span	8.25	7.13	- 1.12	8.25	-

DO Electrode No. OE270AA(5) S/N 111F0029

Calibrated By

*P. Yooyen*

( Ms. Phanee Yooyen )  
Technician

*Certificate of Calibration*

**TEMPERATURE  
CONTROLLER ENCLOSURES**



NSC-TISI-TIS 17025  
CALIBRATION 0183

**Certificate No.: MC 2207678**

Page 1 of 3



Customer : Water Analysis Center Co., Ltd.  
1/94 Moo 5, T.Kantham, A.U-Thai, Ayutthaya 13210.

Reference Job No. : 22-1601 Received Date : 12 July 2022

Description : Refrigerator

Manufacturer : SANDENINTERCOOL Model : SEC-1500SBD

Serial No. : SEC1500201A-0708-00304 ID. No. : WWL0038

Marking : Additionally for the purpose of identification by this laboratory a label marked  
with this certificate number ( MC 2207678 ) has been attached to the case.

Method : In-House calibration procedure MWI-T-033 this method is reference to  
TLAS G-20 "Temperature Controlled Enclosures".

Location of Calibration : Water Analysis Center Co., Ltd. ; Laboratory.

Environmental Conditions : Ambient Temperature : ( 25.8 to 27.5 ) °C  
Relative Humidity : ( 48.8 to 52.2 ) %

Date of Calibration : 12 July 2022 Date of Issue : 19 July 2022

Checked by : Thanagorn  
Thanagorn Limchaicharoen  
(Calibration Supervisor)

Approved by : Aittipong  
Aittipong Kanjanawasit  
( Technical Manager )

**The uncertainties are for a confidence probability of approximately 95%**

This certificate is issued in accordance with the conditions of accreditation granted by the National Standardization Council of Thailand-Office of the National Standardization Council that has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of Master Calibration Co.,Ltd.

Certificate No.: MC 2207678

Page 2 of 3

### The Reference Standard :

Description	Certificate No.	Serial No.	Due date
Data Acquisition/Switch Unit	MC 2114432	MY44096104	20 December 2022
With Thermocouple Type " T " ID. No.2/1 to 2/9			

This certificate is traceable to the international system of units maintained at:

- Master Calibration Co., Ltd.

### 1. Calibration Procedure:

This Instrument was calibration according to TLAS G-20 by comparison with calibrated thermocouple type T under no load condition. The Thermocouples were placed on nine points and located one thermocouple in each of the eight corners of the chamber and was away from the each wall of 5 cm to 10 cm. And placed the ninth thermocouple within 2.5 cm of the geometric center of the chamber.

*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. The reference sensor should preferably be located at the geometric center of the chamber.

*Temperature Stability* - one-half of the greatest maximum difference of measured temperatures at any one sensor.

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

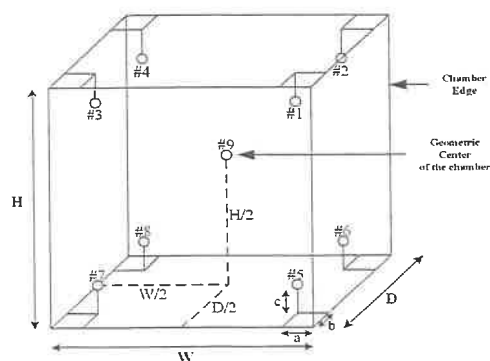


Figure 1 : Sensor Installation Location

Overall Ambient Temperature around the Chamber variation : 3.4 °C

Overall Line Voltage variation : 0.1 V

Chamber Size (W\*H\*D) : 171 cm x 157 cm x 60 cm

Checked by : *Thanagorn*



Certificate No.: MC 2207678

Page 3 of 3

## 2. Result of calibration :

### Temperature Measurement Accuracy Test

Indicating Temperature (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (±°C)
	#1	#2	#3	#4	#5	#6	#7	#8	Ref. #9	
2.5	3.5	3.6	3.7	3.5	3.6	3.4	3.4	3.3	3.4	1.1

### Chamber Characterization Result

Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
2.0	2.5	1.5	0.6	3.1

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 %.

**This report will certify of the calibrated equipment only.**

**End of Certificate**

Checked by :



ภาคผนวก จ-2 หน้า 11/41

# Certificate of Calibration

## TEMPERATURE CONTROLLER ENCLOSURES



NSC-TISI-TIS 17025  
CALIBRATION 0183

Certificate No.: MC 2303684

Page 1 of 3



Customer : Water Analysis Center Co., Ltd.  
1/94 Moo 5, T.Kantham, A.U-Thai, Ayutthaya 13210.

Reference Job No. : 23-0729 Received Date : 23 March 2023

Description : Oven

Manufacturer : Memmert Model : UF260

Serial No. : B620.0814 ID. No. : WWL0212

Marking : Additionally for the purpose of identification by this laboratory a label marked with this certificate number ( MC 2303684 ) has been attached to the case.

Method : In-House calibration procedure MWI-T-033 this method is reference to TLAS G-20 "Temperature Controlled Enclosures".

Location of Calibration : Water Analysis Center Co., Ltd. ; Laboratory.

Environmental Conditions : Ambient Temperature : ( 27.1 to 29.3 ) °C  
Relative Humidity : ( 38.0 to 72.2 ) %

Date of Calibration : 23 March 2023 Date of Issue : 24 March 2023

Checked by : Thanagorn  
Thanagorn Limchaicharoen  
(Calibration Supervisor)

Approved by : Aittipong  
Aittipong Kanjanawasit  
( Technical Manager )

The uncertainties are for a confidence probability of approximately 95%

This certificate is issued in accordance with the conditions of accreditation granted by the National Standardization Council of Thailand-Office of the National Standardization Council that has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full extent with the

Certificate No.: MC 2303684

Page 2 of 3

**The Reference Standard :**

Description	Certificate No.	Serial No.	Due date
Data Acquisition/Switch Unit With Thermocouple Type " T " ID. No.17/1 to 17/9	MC 2303173	MY41010916	9 March 2024

**This certificate is traceable to the international system of units maintained at:**

- Master Calibration Co., Ltd.

**1. Calibration Procedure:**

This Instrument was calibration according to TLAS G-20 by comparison with calibrated thermocouple type T under no load condition. The Thermocouples were placed on nine points and located one thermocouple in each of the eigh corners of the chamber and was away from the each wall of 5 cm to 10 cm. And placed the ninth thermocouple within 2.5 cm of the geometric center of the chamber.

*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. The reference sensor should preferably be located at the geometric center of the chamber.

*Temperature Stability* - one-half of the greatest maximum difference of measured temperatures at any one sensor.

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

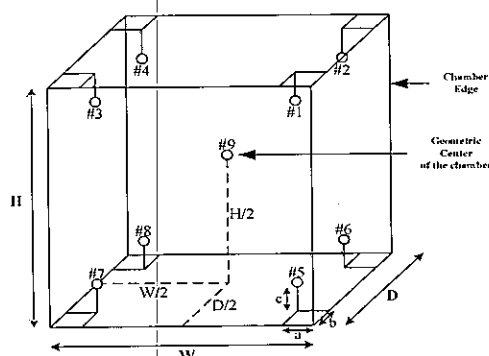


Figure 1 : Sensor Installation Location

Overall Ambient Temperature around the Chamber variation : 0.7 °C

Overall Line Voltage variation : 0.3 V

Chamber Size (W\*H\*D) : 65 cm x 80 cm x 50 cm

Certificate No.: MC 2303684

Page 3 of 3

## 2. Result of calibration :

### Temperature Measurement Accuracy Test

Indicating Temperature (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (±°C)
	#1	#2	#3	#4	#5	#6	#7	#8	Ref. #9	
104	103.7	103.9	103.6	103.8	103.7	104.2	104.1	104.2	104.3	0.58
180	179.4	179.8	179.4	179.7	179.4	179.9	179.8	180.2	180.0	1.3

### Chamber Characterization Result

Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
104	104	0.32	0.84	1.2
180	180	0.4	0.9	1.3

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 %.

**This report will certify of the calibrated equipment only.**

**End of Certificate**





# Certificate of Calibration

<b>Equipment:</b>	Balance	<b>Certificate No.:</b> C01223710
<b>Model:</b>	BL 210S	<b>Issued Date:</b> 07 December 2022
<b>Serial No. (or ID.):</b>	15808131 (WWL 0022)	<b>Job No.:</b> KSPR2215461
<b>Manufacturer:</b>	Sartorius	<b>Page:</b> 1 of 2
<b>Condition:</b>	In condition	

**Customer:** Water Analysis Center Co., Ltd.  
1/94 Moo 5, Rojana Industrial Park, Rojana Road,  
Tambol Kanham, Amphur U-Thai, Ayutthaya 13210 Thailand

**Environment Condition:** Temperature 25 °C ± 0.9 °C  
Humidity 48 %RH ± 4.9 %RH

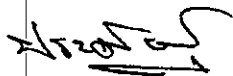
**Calibration Place:** Water Analysis Center Co., Ltd. (ห้องเครื่องชั่ง)  
1/94 Moo 5, Rojana Industrial Park, Rojana Road,  
Tambol Kanham, Amphur U-Thai, Ayutthaya 13210 Thailand

**Calibration By:** Mr. Pradit Siriboot

**Calibration Date:** 07 December 2022

**The Method used:** In-house method, CAL-WI-47, based on UKAS Lab 14

**Traceability:** This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Co., Ltd. Certificate No. C02221864



(Mr. Pradit Siriboot)

Person in charge



(Mr. Rungrod Jenkitrakulchai)

Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to International or national standard or other recognized national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor ( $k=2$ ) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

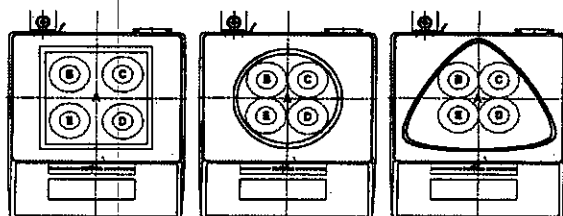
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

ภาคผนวก จ-2 หน้า 15/41

### Calibration Results:

#### Without Adjustment

Eccentric Error: Weight to be 1/3 or 1/2 of Maximum capacity, taken from the center of the pan as a zero reference.



Nominal Test Value 100 (g)

Reference Points (g)				
A	B	C	D	E
-	0.0001	0.0001	-0.0002	-0.0001

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.0001 (g)

Nominal test value (g)	Standard Deviation
20	0.00007
200	0.00007

Error of Indication from nominal or conventional mass value., Readability 0.0001 (g)

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
1	1.00001	1.0000	0.0000	0.00012	2.08
2	2.00001	2.0000	0.0000	0.00012	2.08
5	5.00003	5.0000	0.0000	0.00012	2.07
10	10.00002	10.0000	0.0000	0.00013	2.07
20	20.00001	20.0000	0.0000	0.00013	2.06
50	50.00003	50.0000	0.0000	0.00014	2.04
70	70.00004	70.0001	0.0001	0.00017	2.02
100	100.00002	100.0001	0.0001	0.00018	2.01
120	120.00003	120.0001	0.0001	0.00022	2.01
150	150.00005	150.0003	0.0003	0.00024	2.00
200	200.00006	200.0004	0.0003	0.00030	2.00

The End of Certificate



บริษัท ไทยยูนิค จำกัด

THAI UNIQUE CO., LTD.

80-82 ถนนประชาธิปไตย แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200

80-82 Prachathipatai Rd., Bangkhunphrom, Pranakorn, Bangkok 10200

Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thawatt@thaiunique.com, Website : www.thaiunique.com

## PREVENTATIVE MAINTENANCE (PM) CHECK LIST

### FOR ATOMIC ABSORPTION SPECTROMETER

Model & Serial Number: 240FS AA 8 M918230004

Customer : Water Analysis Center Co., Ltd.

Date: 27 Apr 2023

#### Safety

- ☒ Flame, Inspect/replace o-ring nebulizer, spray chamber and burner
- ☒ Flame, Clean nebulizer, spray chamber and burner
- ☒ Flame, Check liquid trap interlock, burner interlock, pressure relief bung interlock and shield interlock
- ☐ Furnace, Clean work head , electrode and shroud N/A
- ☐ Furnace, Clean PSD and PSD tray N/A
- ☐ Furnace, Check water pressure N/A
- ☒ Check drain tube
- ☒ Check exhaust system
- ☒ Check gas pressure sensor interlock
- ☒ Check and all gas hoses for SpectraAA
- ☒ Clean computer control

#### Optics

- ☒ Inspect/Replace that external optics surfaces
- ☒ Check Wavelength Accuracy the copper line at 323.0-326.0 nm = 324.6 nm
- ☒ Check that PMT % Gain the copper at 324.8 nm, 4 mA, 0.5 nm slit width, Gain = 39% (should be  $\leq 64\%$  or  $\leq 380V$ )
- ☒ Flame, Check D2 lamp is work



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80-82 Prachathipatai Rd., Bangkhunphrom, Pranakorn, Bangkok 10200

Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thawatt@thaiunique.com, Website : www.thaiunique.com

Electronics

- ☒ Check power supply voltage
- ☒ Check cables and connectors
- ☒ Check/Clean all boards in the instrument
- ☐ Furnace, Check camera and align\*\* N/A

\*\*Option for Graphite Zeeman only

Mechanisms

- ☒ Flame, Check the burner adjuster
- ☐ Furnace, Check PSD accessories N/A

Analytical performance

- ☒ Clear the sample compartment
- ☒ Flame, Check uptake rate form 7.2-10.6 mL per minute = 9.8 mL/min
- ☒ Test Photometric noise, STDV = 0.0000 Abs (should be  $\leq 0.00050$  Abs)
- ☒ Flame, Test high solids nebulizer setting use

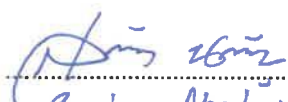
-Air/acet Cu 5 ppm = 0.85 Abs, and Precision  
(%RSD)= 0.5 % (should be  $> 0.55$  Abs and  $< 0.5\%$  RSD)


or

-N20/Acet Cu 5 ppm = \_\_\_\_\_ Abs, and Precision  
(%RSD)= \_\_\_\_\_ % (should be  $> 0.3$  Abs and  $< 0.5\%$  RSD)

- ☐ Furnace, Characteristic mass and sensitivity Cu 25 ppb = \_\_\_\_\_ Abs, and N/A  
Precision (%RSD)= \_\_\_\_\_ % (should be  $\geq 0.15$  Abs and  $\leq 4.0\%$  RSD)

SIGN :

Engineer :   
(Suriya Nacharoon)

Customer :   
(คุณ ลาวคณิศจ์ สวัสดิ์)





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THAI UNIQUE CO., LTD.

80-82 ถนนประชาธิปไตย แขวงบางขุนพรหม เขตพระนคร กรุงเทพฯ 10200

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PREVENTATIVE MAINTENANCE (PM) CHECK LIST

FOR ATOMIC ABSORPTION SPECTROMETER

Model & Serial Number: 240Z AA & M918230004

Customer : Water Analysis Center Co., Ltd.

Date: 26 Apr 2023

Safety

- ☐ Flame, Inspect/replace o-ring nebulizer, spray chamber and burner N/A
- ☐ Flame, Clean nebulizer, spray chamber and burner N/A
- ☐ Flame, Check liquid trap interlock, burner interlock, pressure relief bung N/A  
interlock and shield interlock
- ☒ Furnace, Clean work head , electrode and shroud
- ☒ Furnace, Clean PSD and PSD tray
- ☒ Furnace, Check water pressure
- ☒ Check drain tube
- ☒ Check exhaust system
- ☒ Check gas pressure sensor interlock
- ☒ Check and all gas hoses for SpectrAA
- ☒ Clean computer control

Optics

- ☒ Inspect/Replace that external optics surfaces
- ☒ Check Wavelength Accuracy the copper line at 323.0-326.0 nm = 324.7 nm
- ☒ Check that PMT % Gain the copper at 324.8 nm, 4 mA, 0.5 nm slit width, Gain = 49% (should be  $\leq 64\%$  or  $\leq 380V$ )
- ☐ Flame, Check D2 lamp is work N/A



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THAI UNIQUE CO., LTD.

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Tel. 0-2629-0191-6, 0-2280-1787, Fax. 0-2280-1788, E-mail : thawatt@thaiunique.com, Website : www.thaiunique.com

Electronics

- ☒ Check power supply voltage
- ☒ Check cables and connectors
- ☒ Check/Clean all boards in the instrument
- ☒ Furnace, Check camera and align\*\*

\*\*Option for Graphite Zeeman only

Mechanisms

- ☐ Flame, Check the burner adjuster N/A
- ☒ Furnace, Check PSD accessories

Analytical performance

- ☒ Clear the sample compartment
- ☐ Flame, Check uptake rate form 7.2-10.6 mL per minute = \_\_\_\_\_ mL/min N/A
- ☒ Test Photometric noise, STDV = 0.0002 Abs (should be  $\leq 0.00050$  Abs)
- ☐ Flame, Test high solids nebulizer setting use N/A
  - Air/acet Cu 5 ppm = \_\_\_\_\_ Abs, and Precision
  - (%RSD)= \_\_\_\_\_ % (should be  $> 0.55$  Abs and  $< 0.5\%$  RSD)
  - or
  - N20/Acet Cu 5 ppm = \_\_\_\_\_ Abs, and Precision
  - (%RSD)= \_\_\_\_\_ % (should be  $> 0.3$  Abs and  $< 0.5\%$  RSD)
- ☒ Furnace, Characteristic mass and sensitivity Cu 25 ppb = 0.49 Abs, and Precision (%RSD)= 1.7 % (should be  $\geq 0.15$  Abs and  $\leq 4.0\%$  RSD)

SIGN :

Engineer : Sanjya Nachareon  
(Sanjya Nachareon)

Customer : บริษัท 51 สอ.อ.อ.  
(นางสาวกมลทิพย์ สอ.อ.อ.)

## BSC Certification Test Report

Page 1 of 6

**Certificate No. :** M01075/22

**Customer Name :** LABORATORY WATER ANALYSIS CENTER COMPANY LIMITED

**Customer Address :** 1/94 Moo 5 T.Kanharm, A.U-Thai,  
Phra Nakhon Si Ayutthaya 13210

**Equipment :** Biological Safety Cabinet      **Class**    II      **Type** A2

**Manufacturer :** Microtech

**Model :** V6-T

**Serial No. :** 0972

**ID No. :** WWL0084

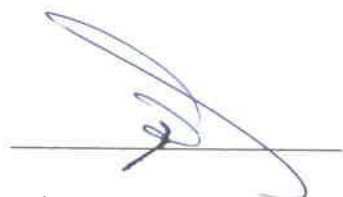
**Were in accordance with**    ☒ EN 12469    ☐ NSF 49    ☐ Manufacturer's specification

**Test Date :** 23/09/2022

**Due Date :** 23/09/2023      *or after HEPA filters are replaced or unit is moved*

**Test by :** Mr. Piyapong Pusua

**Approved by :**



(Mr.Kridsada Thinhuatoci)  
Authorized Signatory

**Issued Date :** 26/09/2022

This calibration certificate documents the traceability to national standards, which realize the unit 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 the Megafil Company Limited.  
ภาคผนวก จ-2 หน้า 21/41

**Certificate No. :** M01075/22

**Procedure Used :**

- : European Standard EN12469 : 2000 has the status of British Standard, Biotechnology Performance criteria for microbiological safety cabinets.
- : NSF International Standard / American National Standard NSF / ANSI 49-2008 Biosafety Cabinet : Design, Construction, Performance and Field Certification.
- : Australian Standard : AS 1807.23-2000 Determination of intensity of radiation from germicidal ultraviolet lamps.
- : Manufacturer's specification.

### 1. Downflow velocity test.

#### Measurement Information

No. of Rows	No. of Readings	Grid Spacing Front-Back	Grid Spacing Side-Side	Probe height Above sash
2	8	1/4,3/4	1/8,3/8	100mm

#### Measurement Data.

0.36	0.42	0.43	0.41
0.40	0.34	0.34	0.33

Average velocity 0.38 m/s ( 75 FPM.) Velocity range 0.25-0.50 m/s ( 49-98 FPM.)

Uniformity( EN: +/-20%avg.) 0.30 - 0.46 m/s ( 60 - 90 FPM.)

Supply filter dimension 24 x 72 (inch x inch) Supply filter area 10.69 SQ.FT

Downflow volume (Q) 802 CFM.

Result Summary ☒ Pass ☐ Fail

Equipment used : Thermo Anemometer Model 425 S/N : 02623979 Calibration date : 14/07/2022

Certificate No. : M01075/22

**2. Inflow velocity test.**

Select method. : ☐ DIM ☒ Exhaust velocity. ☐ MFG's Specifications

0.53	0.47	0.48	0.50	0.51
0.57	0.46	0.52	0.53	0.50
0.54	0.57	0.55	0.52	0.53
0.53	0.51	0.57	0.54	0.51
0.51	0.48	0.53	0.55	0.56

Average Inflow velocity 0.44 m/s (86 FPM.) Velocity range ≥0.40 m/s ( ≥79 FPM.)

Inflow dimension 8 x 72 (inch x inch) Inflow area 4.00 SQ.FT

Inflow volume(Q) 344 CFM

Result Summary ☒ Pass ☐ Fail

Adjustments Required ☐ Fan Speed ☐ Damper

Equipment used : Thermo Anemometer Model 425 S/N : 02623979 Calibration date : 14/07/2022

**3. HEPA filter leak test.**

**Measurement Data**

HEPA Filter	PAO Upstream Conc.(calculated)	Specification	Measured leak penetration
Supply HEPA Filter	<u>18</u> µg/l.	<0.003%	<u>&lt;0.003%</u>
Exhaust HEPA Filter	<u>18</u> µg/l.	<0.003%	<u>&lt;0.003%</u>



**Certificate No. :** M01075/22

**Leak location**

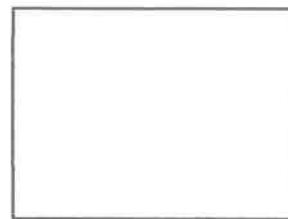
Supply HEPA Filter

Back



Exhaust HEPA Filter

Back



**Result Summary**

☒ **Pass**

☐ **Fail**

**Equipment used :** Aerosol Photometer **Model** 2I **S/N :** 26468 **Calibration date** 14/07/2022

**Equipment used :** Smoke Generator **Model** TDA-6D **S/N :** 26530

**4. Airflow smoke patterns test**

**Measurement Information**

1. Downflow Pattern test : Smoke shall be passed from one end of the cabinet to the other, along the centerline of the work surface, at a height of 4 inch (10 cm) above the top of the access opening
2. View screen retention test : Smoke shall be passed from one end of the cabinet to the other, 1.0 in (2.5 cm) behind the view screen, at a height 6.0 inch (15 cm) above the top of the access opening.
3. Work opening edge retention test : Smoke shall be passed along the entire perimeter of the work opening  
Particular attention should be paid to corners and vertical edges.
4. Sash/window seal test : Smoke shall be passed up the inside of the window 2 in (5 cm) from the sides and along the top of the work area.

**Certificate No. :** M01075/22

**Result Summary**

<b>Downflow Pattern test</b>	<input checked="" type="checkbox"/> <b>Accept</b>	<input type="checkbox"/> <b>Non-Conforming</b>
<b>View screen retention test</b>	<input checked="" type="checkbox"/> <b>Accept</b>	<input type="checkbox"/> <b>Non-Conforming</b>
<b>Work opening edge retention test</b>	<input checked="" type="checkbox"/> <b>Accept</b>	<input type="checkbox"/> <b>Non-Conforming</b>
<b>Sash/window seal test</b>	<input checked="" type="checkbox"/> <b>Accept</b>	<input type="checkbox"/> <b>Non-Conforming</b>

**5. Site installation**

<b>Sash Alarm.</b>	<input type="checkbox"/> <b>Pass</b>	<input type="checkbox"/> <b>Fail</b>	<input checked="" type="checkbox"/> <b>N/A</b>
<b>Interlock System.</b>	<input type="checkbox"/> <b>Pass</b>	<input type="checkbox"/> <b>Fail</b>	<input checked="" type="checkbox"/> <b>N/A</b>
<b>Exhaust System Performance</b>	<input type="checkbox"/> <b>Pass</b>	<input type="checkbox"/> <b>Fail</b>	<input checked="" type="checkbox"/> <b>N/A</b>

**Remark / Recommendation**

ระบบ Site installation ไม่มีการตรวจสอบ เนื่องจากตู้ไม่มีฟังก์ชันนี้

**6. Illumination Test (Lighting) : Option**

Lighting should be adequate for safe working within the cabinet. Illumination measured at the work surface.

Lux

620	965	938	561
867	1446	1492	768

**Remark :**

**Certificate No. :** M01075/22

**7. Ultraviolet Lamp Test (UV) : Option**

Ultraviolet radiation where UV Lamp are fitted, the intensity of radiation at a wavelength of 254 nm.

Shall be not less than 400 mW/m<sup>2</sup> when measures at work floor surface.

mW/m<sup>2</sup>

720	1510	1540	760
470	980	990	450

**Remark :**

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Ref No. : 0303/17008

## CERTIFICATE OF TESTING LABORATORY ACCREDITATION

This is to certify that

*Laboratory of Water Analysis Center Co., Ltd.  
1/94 Moo 5, Tambon Kanharm, Amphoe U-Thai,  
Changwat Phra Nakhon Si Ayutthaya 13210*

has successfully undergone assessment according to ISO/IEC 17025 : 2017  
and under the Bureau of Laboratory Accreditation, Department of Science Service  
for the requirements, regulations and criteria for the competence of testing laboratories

LABORATORY ACCREDITATION  
Accreditation Number TESTING - 0029  
BLA-DSS

The scope of accreditation is as annexed hereto

Issue date : 7<sup>th</sup> November 2022

Expired date : 6<sup>th</sup> November 2026

Signature : 

(Mrs. Pochaman Tagheen)

Director of Bureau of Laboratory Accreditation

## Scope of Testing Laboratory Accreditation

Laboratory Name : Laboratory of Water Analysis Center Co., Ltd.

Address : 1/94 Moo 5, Tambon Kanharm, Amphoe U-Thai,  
Changwat Phra Nakhon Si Ayutthaya 13210

Accreditation Number : Testing - 0029

Laboratory Status : ☒ Permanent ☐ Site ☐ Temporary ☐ Mobile

Item Number	Test Material / Product	Test Item / Range of Testing	Test Method / Technique Used
1	Bottled drinking water	- Chloride 6 mg/L to 1 000 mg/L  - Total hardness (Calculated as CaCO <sub>3</sub> ) 5 mg/L to 2 000 mg/L  - Total solids dried at 103 °C to 105 °C 25 mg/L to 4 000 mg/L	Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 4500-Cl <sup>-</sup> B  Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 2340 C  Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 2540 B

Initial Issue Date 23<sup>rd</sup> September 2008

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Bureau of Laboratory Accreditation, Department of Science Service, Ministry of Higher Education, Science, Research and Innovation



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Item Number	Test Material / Product	Test Item / Range of Testing	Test Method / Technique Used
1 (cont.)	Bottled drinking water	- Manganese 0.05 mg/L to 5 mg/L  - Iron 0.10 mg/L to 5 mg/L  - Cadmium 1 µg/L to 5 µg/L  - Lead 10 µg/L to 50 µg/L  - pH 6.0 to 8.0	Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 3111 B, 3030 E      Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 3113 B, 3030 E      In - house method : TM 001 based on Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 4500-H <sup>+</sup> B

Initial Issue Date 23<sup>rd</sup> September 2008

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Item Number	Test Material / Product	Test Item / Range of Testing	Test Method / Technique Used
2	Water	<p>- pH 6.0 to 10.0</p> <p>- Total suspended solids dried at 103 °C to 105 °C 10 mg/L to 1 000 mg/L</p> <p>- Total dissolved solids dried at 180 °C 25 mg/L to 4 000 mg/L</p>	<p>In - house method : TM 001 based on Standard Methods for the Examination of Water and Wastewater, APHA, AWWA &amp; WEF, 23<sup>rd</sup> ed., 2017, part 4500-H<sup>+</sup> B</p> <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA &amp; WEF, 23<sup>rd</sup> ed., 2017, part 2540 D</p> <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA &amp; WEF, 23<sup>rd</sup> ed., 2017, part 2540 C</p>

Initial Issue Date 23<sup>rd</sup> September 2008

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Item Number	Test Material / Product	Test Item / Range of Testing	Test Method / Technique Used
2 (cont.)	Water	- Cadmium 0.02 mg/L to 0.9 mg/L  - Copper 0.05 mg/L to 5 mg/L  - Zinc 0.05 mg/L to 5 mg/L  - Chromium 0.05 mg/L to 5 mg/L  - Nickel 0.10 mg/L to 4 mg/L  - Manganese 0.05 mg/L to 5 mg/L  - Lead 0.10 mg/L to 2 mg/L  - Iron 0.10 mg/L to 5 mg/L	Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 3111 B, 3030 E

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Item Number	Test Material / Product	Test Item / Range of Testing	Test Method / Technique Used
2 (cont.)	Water	- Water soluble silica (Calculated as $\text{SiO}_2$ ) 1.1 mg/L to 26 mg/L  - Chloride 6 mg/L to 1 000 mg/L  - Total hardness (Calculated as $\text{CaCO}_3$ ) 5 mg/L to 2 000 mg/L	Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 4500- $\text{SiO}_2$ C  Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 4500- $\text{Cl}^-$ B  Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 2340 C

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Item Number	Test Material / Product	Test Item / Range of Testing	Test Method / Technique Used
2 (cont.)	Water	- BOD 2 mg/L to 500 mg/L	In - house method : TM 041 based on Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 5210 B
		- BOD 2 mg/L to 500 mg/L	In - house method : TM 013 based on Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 5210 B, part 4500-O C
		- COD 40 mg/L to 200 mg/L	Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 5220 C

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Item Number	Test Material / Product	Test Item / Range of Testing	Test Method / Technique Used
2 (cont.)	Water	- Total Kjeldahl Nitrogen 5 mg/L to 200 mg/L  - Oil and grease 2 mg/L to 100 mg/L  - Total solids dried at 103 °C to 105 °C 25 mg/L to 4 000 mg/L	Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 4500-NH <sub>3</sub> C, part 4500-N <sub>org</sub> B  Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 5520 D  Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 2540 B

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Item Number	Test Material / Product	Test Item / Range of Testing	Test Method / Technique Used
2 (cont.)	Water	- Selenium 5 µg/L to 50 µg/L  - Arsenic 5 µg/L to 50 µg/L  - Barium 0.5 mg/L to 5 mg/L  - Cadmium 1 µg/L to 5 µg/L - Lead 10 µg/L to 50 µg/L	Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 3114 C  Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 3111 D, 3030 E  Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 3113 B, 3030 E

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Item Number	Test Material / Product	Test Item / Range of Testing	Test Method / Technique Used
3	Wastewater	<p>- pH 4.0 to 10.0</p> <p>- Total suspended solids dried at 103 °C to 105 °C 10 mg/L to 1 000 mg/L</p> <p>- Total dissolved solids dried at 180 °C 50 mg/L to 4 000 mg/L</p>	<p>In - house method : TM 001 based on Standard Methods for the Examination of Water and Wastewater, APHA, AWWA &amp; WEF, 23<sup>rd</sup> ed., 2017, part 4500 - H<sup>+</sup> B</p> <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA &amp; WEF, 23<sup>rd</sup> ed., 2017, part 2540 D</p> <p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA &amp; WEF, 23<sup>rd</sup> ed., 2017, part 2540 C</p>

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Item Number	Test Material / Product	Test Item / Range of Testing	Test Method / Technique Used
3 (cont.)	Wastewater	- Cadmium 0.02 mg/L to 0.9 mg/L - Copper 0.05 mg/L to 5 mg/L - Zinc 0.05 mg/L to 5 mg/L - Chromium 0.05 mg/L to 5 mg/L - Nickel 0.10 mg/L to 4 mg/L - Manganese 0.05 mg/L to 5 mg/L - Lead 0.10 mg/L to 2 mg/L - Iron 0.10 mg/L to 5 mg/L	Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 3111 B, 3030 E

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Item Number	Test Material / Product	Test Item / Range of Testing	Test Method / Technique Used
3 (cont.)	Wastewater	<p>- Total hardness (Calculated as <math>\text{CaCO}_3</math>) 5 mg/L to 2 000 mg/L</p> <p>- BOD 4 mg/L to 7 000 mg/L</p> <p>- BOD 4 mg/L to 7 000 mg/L</p>	<p>Standard Methods for the Examination of Water and Wastewater, APHA, AWWA &amp; WEF, 23<sup>rd</sup> ed., 2017, part 2340 C</p> <p>In - house method : TM 041 based on Standard Methods for the Examination of Water and Wastewater, APHA, AWWA &amp; WEF, 23<sup>rd</sup> ed., 2017, part 5210 B</p> <p>In - house method : TM 013 based on Standard Methods for the Examination of Water and Wastewater, APHA, AWWA &amp; WEF, 23<sup>rd</sup> ed., 2017, part 5210 B, part 4500-O C</p>

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Item Number	Test Material / Product	Test Item / Range of Testing	Test Method / Technique Used
3 (cont.)	Wastewater	- COD 40 mg/L to 3 000 mg/L  - Total Kjeldahl Nitrogen 5 mg/L to 200 mg/L  - Oil and grease 2 mg/L to 1 000 mg/L	Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 5220 C  Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 4500-NH <sub>3</sub> C, 4500-N <sub>org</sub> B  Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 5520 D

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Laboratory Status : ☒ Permanent ☐ Site ☐ Temporary ☐ Mobile

Item Number	Test Material / Product	Test Item / Range of Testing	Test Method / Technique Used
3 (cont.)	Wastewater	- Total solids dried at 103 °C to 105 °C 25 mg/L to 4 000 mg/L  - Selenium 5 µg/L to 50 µg/L  - Arsenic 5 µg/L to 50 µg/L  - Barium 0.5 mg/L to 5 mg/L	Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 2540 B  Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 3114 C  Standard Methods for the Examination of Water and Wastewater, APHA, AWWA & WEF, 23 <sup>rd</sup> ed., 2017, part 3111 D, 3030 E

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Item Number	Test Material / Product	Test Item / Range of Testing	Test Method / Technique Used
4	Environmental noise	- Sound level Equivalent sound level $L_{eq,T}$ 30 dB (A) to 120 dB (A) Maximum sound level $L_{max}$ 30 dB (A) to 120 dB (A)	In - house method : TM 201 based on ISO 1996-2 : 2017

Issue Date : 7<sup>th</sup> November 2022

Signature :



(Mrs. Pochaman Tagheen)

Director of Bureau of Laboratory Accreditation

Initial Issue Date 23<sup>rd</sup> September 2008

Issue Number 13

Bureau of Laboratory Accreditation, Department of Science Service, Ministry of Higher Education, Science, Research and Innovation