

## ภาคผนวก จ

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เอกสารสอบเทียบเครื่องมือฯ

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เอกสารสอบเทียบเครื่องมือฯ  
บริษัท เอ็นไวรอนमेंท์ รีเสิร์ช แอนด์ เทคโนโลยี จำกัด

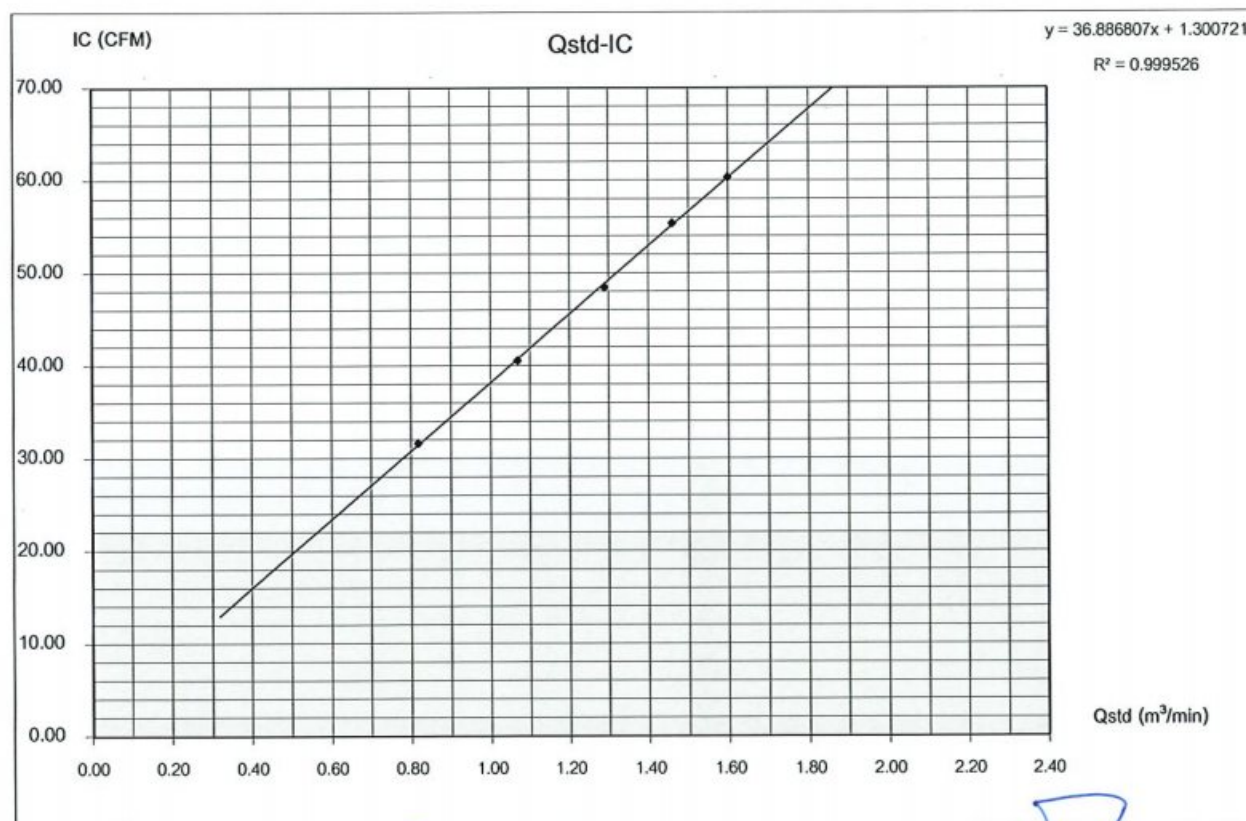
# TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2023-00730			Date	November 1, 2023
Sampler Location	โรงเรียนนาครดงวิทยาคม			Start Time	9:08 AM
Sampler Number	TSP No.A10	Transfer Standard Type	Orifice	Stop Time	9:18 AM
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr. Aukkarawit Boonsong
Motor Serial Number	2012-04	Calibrator Serial Number	3362		
Recorder Serial Number	1504				

Plate No.	(Delta H)			( A )	( X )	( I )	( Y )	Temperature	Barometric Pressure	Start Meter	Stop Meter	
	Pressure Drop Across Orifice (inH <sub>2</sub> O)			$[\Delta H_{2O}(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	Qstd = (1/m)[(A-b)] ( m <sup>3</sup> /min )	Sample Flow Rate Indicator ( ft <sup>3</sup> /min )	IC = $1/[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$ (°K = °C+273)	( mmHg )				
	Positive	Negative	ΔH <sub>2</sub> O									
5	1.4	1.4	2.8	1.65508	0.81741	32.0	31.65	303.0	756.0			
7	2.4	2.4	4.8	2.16701	1.06807	41.0	40.55	303.0	756.0			
10	3.5	3.5	7.0	2.61692	1.28836	49.0	48.47	303.0	756.0			
13	4.5	4.5	9.0	2.96730	1.45992	56.0	- 55.39	303.0	756.0			
18	5.4	5.4	10.8	3.25052	1.59859	61.0	60.34	303.0	756.0			
Linear Regression Y ON X : Y= mX + b							Average	303.0	756.0			
1	Slope ( m )			2.04234	Linear Equation			r <sup>2</sup>	0.999526	Pstd(mmHg)	760.	
2	Intercept ( b )			-0.01435	Set Point Flow Rate ( X ) (m <sup>3</sup> /min)		1.133	r	0.999763	T <sub>MTP</sub>	298.	
3	Correlation Coefficient ( r )			0.99993	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)		0.978322043		
Result									C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.989101634	

COMMENT

Andersen Instruments, Inc.



Checked By

( Mr. Prayun Detkla )  
Technician

Approved By

( Mr. Panupon Podang )  
Environmental Scientist

# PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2023-00730	Date	November 1, 2023
Sampler Location	โรงเรียนนาครีวิทยาคม	Start Time	9:18 AM
Sampler Number	PM-10 No.23	Transfer Standard Type	Orifice
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A
Motor Serial Number	2135	Calibrator Serial Number	3362
Recorder Serial Number	2391	Calibrated By	Mr. Aukkarawit Boonsong

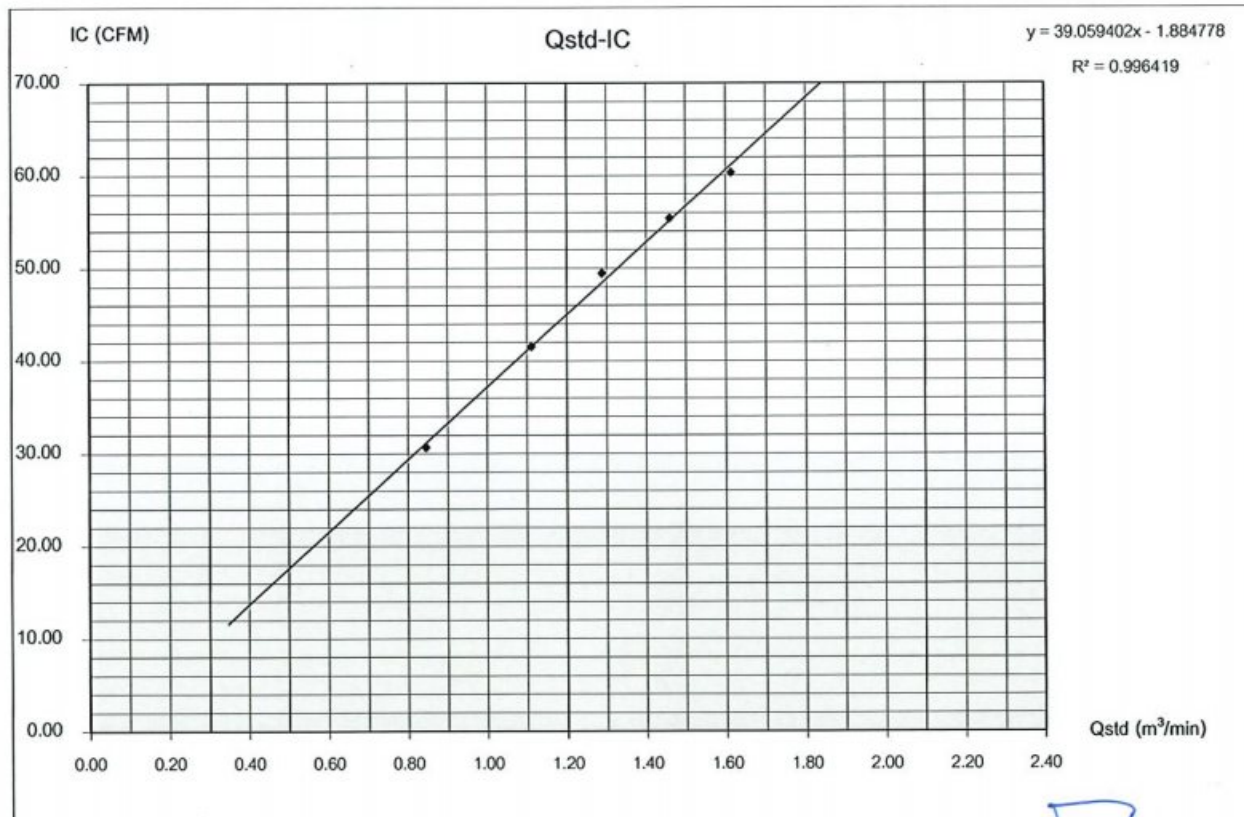
Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric	Start	Stop
	Positive	Negative	$\Delta H_2O$	$[\Delta H_2O(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ ( $m^3/min$ )	Sample Flow Rate Indication ( $ft^3/min$ )	$IC = [(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	( $^{\circ}K = ^{\circ}C + 273$ )	Pressure (mmHg)	Meter	Meter
5	1.5	1.5	3.0	1.71317	0.84586	31.0	30.66	303.0	756.0		
7	2.6	2.6	5.2	2.25550	1.11140	42.0	41.54	303.0	756.0		
10	3.5	3.5	7.0	2.61692	1.28836	50.0	49.46	303.0	756.0		
13	4.5	4.5	9.0	2.96730	1.45992	56.0	55.39	303.0	756.0		
18	5.5	5.5	11.0	3.28048	1.61326	61.0	60.34	303.0	756.0		

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

1	Slope (m)	2.04234	Linear Equation			$r^2$	0.996419	Pstd(mmHg)	760.0
2	Intercept (b)	-0.01435	Set Point Flow Rate (X) ( $m^3/min$ )		1.133	r	0.9982079	T <sub>std</sub>	298.0
3	Correlation Coefficient (r)	0.99993	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.978322043	
Result						$C = (Pa/Pstd)*(Tstd/Ta)^{0.5}$		0.989101634	

COMMENT

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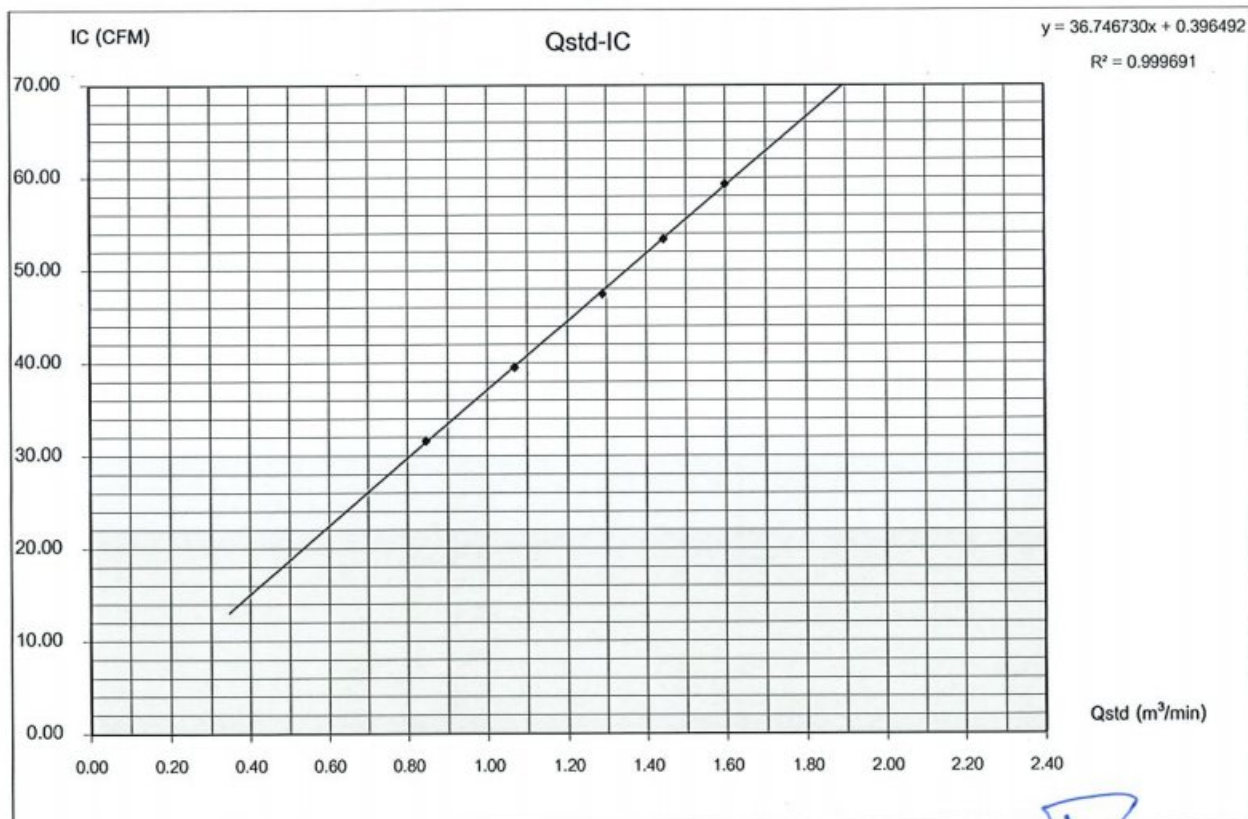
## TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2023-00730	Date	November 1, 2023
Sampler Location	บ้านเจ็ดเสมียน หมู่ 14	Start Time	10:18 AM
Sampler Number	TSP No.A3	Transfer Standard Type	Onifice
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A
Motor Serial Number	704	Calibrator Serial Number	3362
Recorder Serial Number	4651	Calibrated By	Mr. Aukkarawit Boonsong

Plate No.	(Delta H)			( A )	( X )	( I )	( Y )	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH <sub>2</sub> O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$	ample Flow Rate Indica	$IC = [(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	(°K = °C+273)	( mmHg )		
	Positive	Negative	ΔH <sub>2</sub> O		( m <sup>3</sup> /min )	( ft <sup>3</sup> /min )					
5	1.5	1.5	3.0	1.71317	0.84586	32.0	31.65	303.0	756.0		
7	2.4	2.4	4.8	2.16701	1.06807	40.0	39.56	303.0	756.0		
10	3.5	3.5	7.0	2.61692	1.28836	48.0	47.48	303.0	756.0		
13	4.4	4.4	8.8	2.93415	1.44369	54.0	53.41	303.0	756.0		
18	5.4	5.4	10.8	3.25052	1.59859	60.0	59.35	303.0	756.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	756.0		
1	Slope ( m )			2.04234	Linear Equation			r <sup>2</sup>	0.999691	Pstd(mmHg)	760.
2	Intercept ( b )			-0.01435	Set Point Flow Rate ( X ) (m <sup>3</sup> /min)		1.133	r	0.9998455	T <sub>NTP</sub>	298.
3	Correlation Coefficient ( r )			0.99993	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)			0.978322043
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5			0.989101634

### COMMENT

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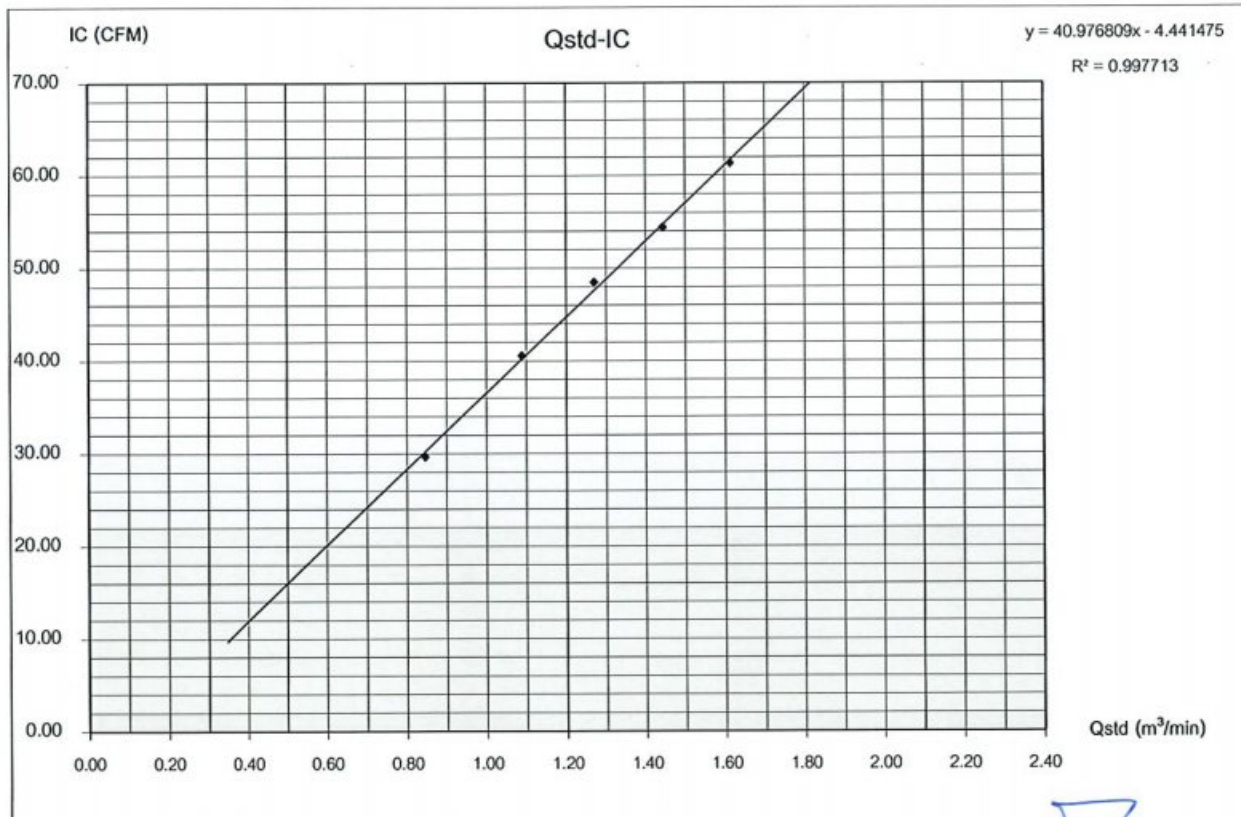
# PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2023-00730	Date	November 1, 2023
Sampler Location	บ้านเขื่อนจันทพรพนา 14	Start Time	10:08 AM
Sampler Number	PM-10 No.28	Transfer Standard Type	Orifice
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A
Motor Serial Number	2206	Calibrator Serial Number	3362
Recorder Serial Number	2613	Calibrated By	Mr. Aukkarawit Boonsong

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 Indicator	$IC = I[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	(°K = °C+273)	( mmHg )		
	Positive	Negative	ΔH <sub>2</sub> O		( m <sup>3</sup> /min )	( ft <sup>3</sup> /min )					
5	1.5	1.5	3.0	1.71317	0.84586	30.0	29.67	303.0	756.0		
7	2.5	2.5	5.0	2.21170	1.08995	41.0	40.55	303.0	756.0		
10	3.4	3.4	6.8	2.57926	1.26992	49.0	48.47	303.0	756.0		
13	4.4	4.4	8.8	2.93415	1.44369	55.0	54.40	303.0	756.0		
18	5.5	5.5	11.0	3.28048	1.61326	62.0	61.32	303.0	756.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	756.0		
1	Slope ( m )			2.04234	Linear Equation			r <sup>2</sup>	0.997713	Pstd(mmHg)	760
2	Intercept ( b )			-0.01435	Set Point Flow Rate ( X ) (m <sup>3</sup> /min)		1.133	r	0.998858	T <sub>NTP</sub>	298
3	Correlation Coefficient ( r )			0.99993	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)			0.978322043
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5			0.989101634

## COMMENT

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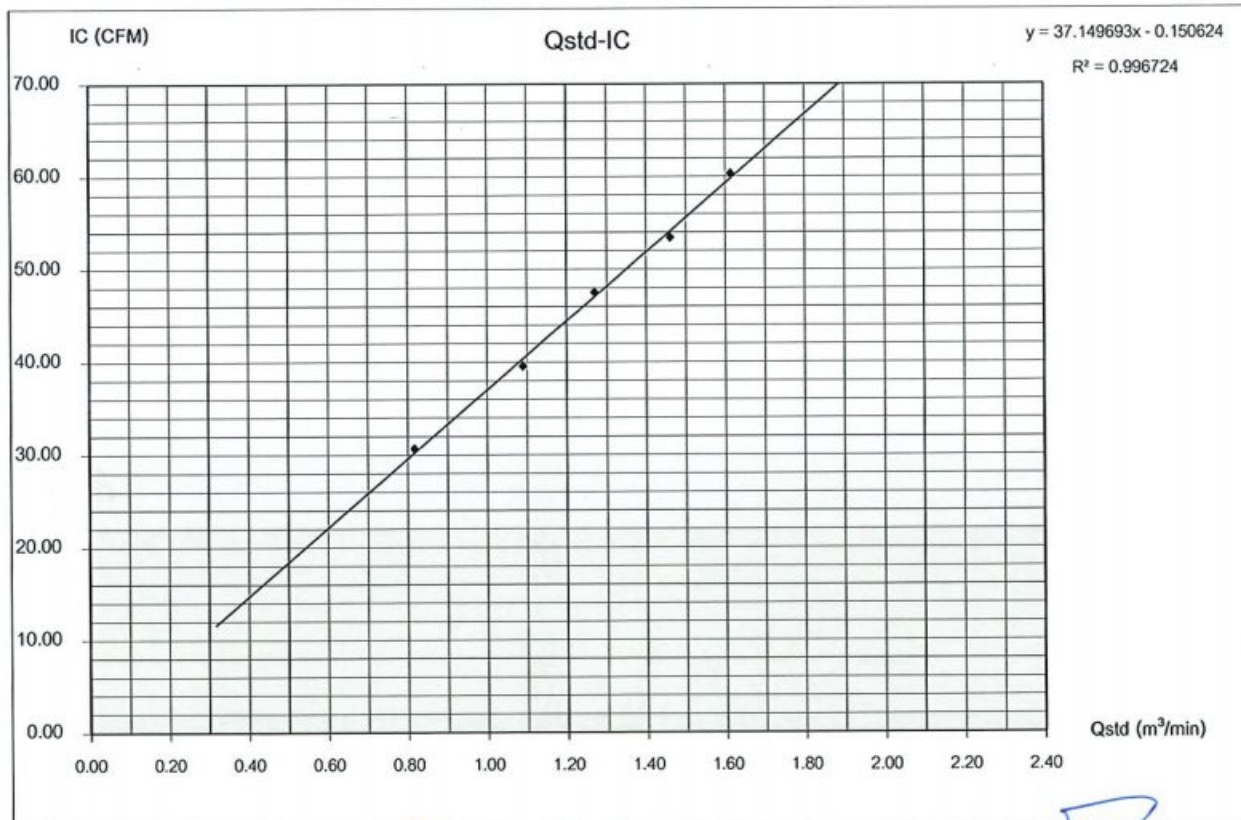
## PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2023-00730	Date	November 1, 2023
Sampler Location	มูลนิธิธรรมกัญญ์	Start Time	11:13 AM
Sampler Number	PM-10 No.25	Transfer Standard Type	Orifice
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A
Motor Serial Number	2150	Calibrator Serial Number	3362
Recorder Serial Number	2409	Calibrated By	Mr. Aukkarawit Boonsong

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	$IC = \{[(Pa/P_{std})(T_{std}/Ta)]^{1/2}\}^{1/2}$				
	Positive	Negative	$\Delta H_2O$		( m <sup>3</sup> /min )	( ft <sup>3</sup> /min )		(°K = °C+273)	( mmHg )		
5	1.4	1.4	2.8	1.65508	0.81741	31.0	30.66	303.0	756.0		
7	2.5	2.5	5.0	2.21170	1.08995	40.0	39.56	303.0	756.0		
10	3.4	3.4	6.8	2.57926	1.26992	48.0	47.48	303.0	756.0		
13	4.5	4.5	9.0	2.96730	1.45992	54.0	53.41	303.0	756.0		
18	5.5	5.5	11.0	3.28048	1.61326	61.0	60.34	303.0	756.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	756.0		
1	Slope ( m )			2.04234	Linear Equation			r <sup>2</sup>	0.996724	Pstd(mmHg)	760.0
2	Intercept ( b )			-0.01435	Set Point Flow Rate ( X ) (m <sup>3</sup> /min)		1.133	r	0.9983607	T <sub>NTP</sub>	298.15
3	Correlation Coefficient ( r )			0.99993	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)			0.978322043
Result								C=(Pa/Pstd)*(Tstd/Ta)^0.5			0.989101634

### COMMENT

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# TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

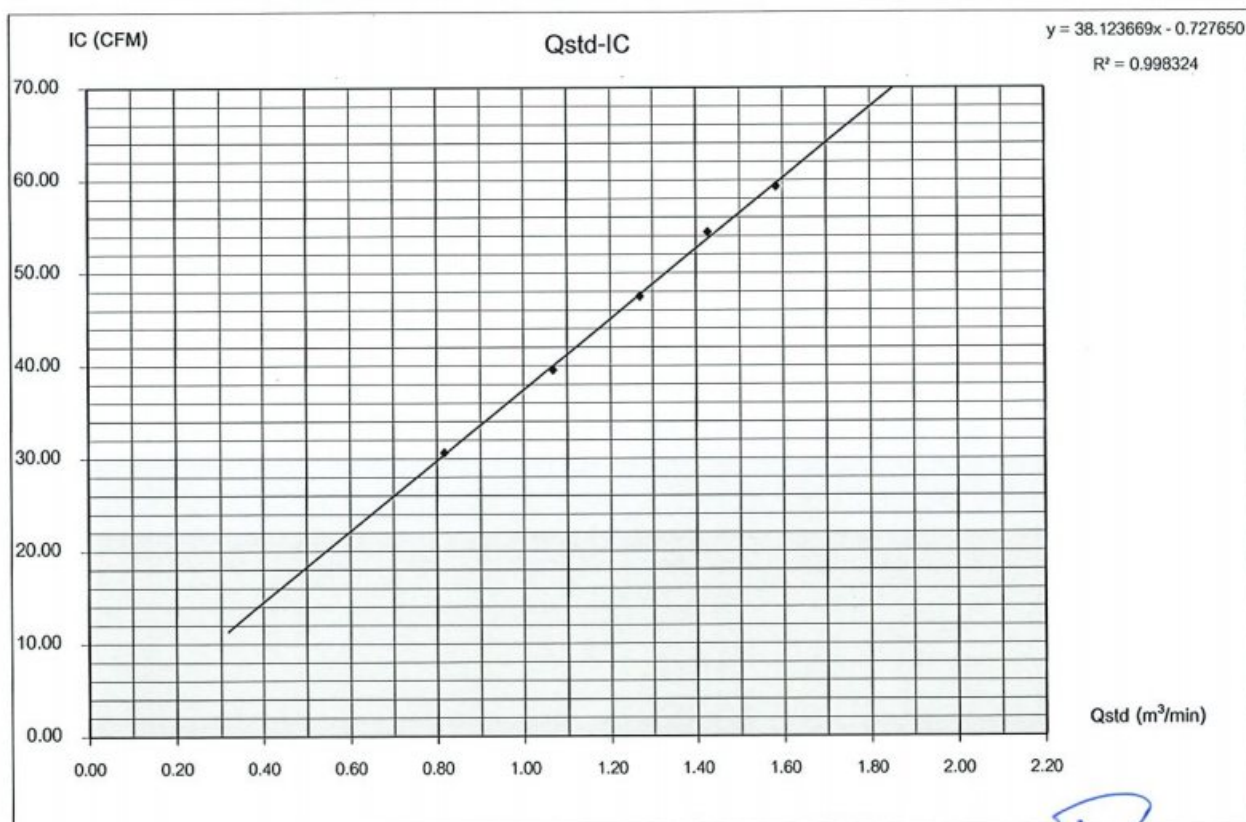
Quotation	2023-00730	Date	November 1, 2023
Sampler Location	มูลนิธิธรรมิกศึกษา	Start Time	11:03 AM
Sampler Number	TSP No.A19	Transfer Standard Type	Orifice
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A
Motor Serial Number	2014-04	Calibrator Serial Number	3362
Recorder Serial Number	7372	Calibrated By	Mr. Aukkarawit Boonsong

Plate No.	(Delta H)	(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH <sub>2</sub> O)	$[\Delta H_2O(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$	ample Flow Rate Indication	$IC = [(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	(°K = °C+273)	(mmHg)		
	Positive Negative ΔH <sub>2</sub> O		(m <sup>3</sup> /min)	(ft <sup>3</sup> /min)					
5	1.4 1.4 2.8	1.65508	0.81741	31.0	30.66	303.0	756.0		
7	2.4 2.4 4.8	2.16701	1.06807	40.0	39.56	303.0	756.0		
10	3.4 3.4 6.8	2.57926	1.26992	48.0	47.48	303.0	756.0		
13	4.3 4.3 8.6	2.90062	1.42727	55.0	54.40	303.0	756.0		
18	5.3 5.3 10.6	3.22028	1.58379	60.0	59.35	303.0	756.0		
Linear Regression Y ON X : Y= mX + b						Average	303.0	756.0	

1	Slope ( m )	2.04234	Linear Equation			r <sup>2</sup>	0.998324	Pstd(mmHg)	760.0
2	Intercept ( b )	-0.01435	Set Point Flow Rate ( X ) (m <sup>3</sup> /min)		1.133	r	0.9991616	T <sub>NTP</sub>	298.0
3	Correlation Coefficient ( r )	0.99993	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)		0.978322043	
Result						C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.989101634	

## COMMENT

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Environmental Scientist



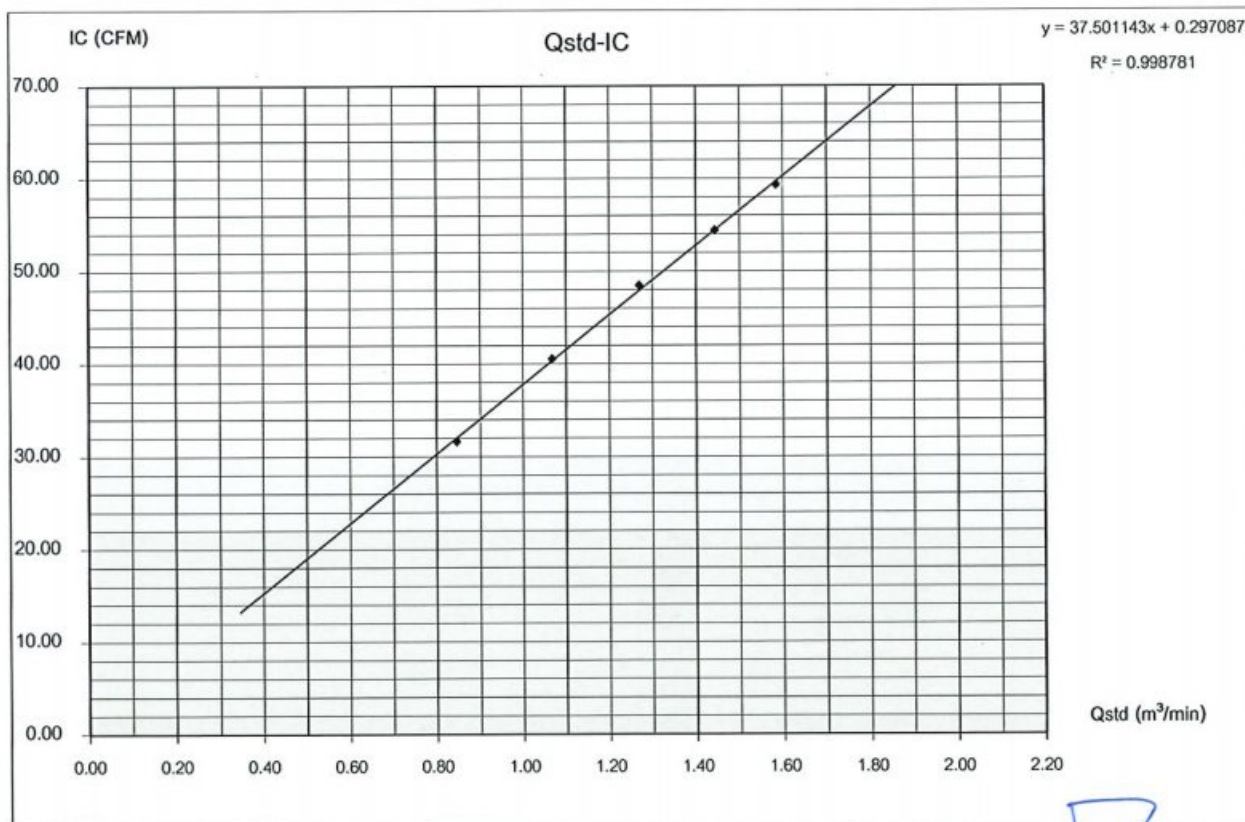
## TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2023-00730	Date	November 1, 2023
Sampler Location	ศูนย์บริการสาธารณสุข (ทต.บางพลี)	Start Time	15:26:00 AM
Sampler Number	TSP No.A18	Transfer Standard Type	Orifice
Instrument Model	HIVOL-BBCBE	Calibrator Model	TE-5025A
Motor Serial Number	2014-03	Calibrator Serial Number	3362
Recorder Serial Number	7373	Calibrated By	Mr. Aukkarawit Boonsong

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 Indicator	$IC = I[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	('K = °C+273)	( mmHg )			
	Positive	Negative	ΔH <sub>2</sub> O		( m <sup>3</sup> /min )	( ft <sup>3</sup> /min )						
5	1.5	1.5	3.0	1.71317	0.84586	32.0	31.65	303.0	756.0			
7	2.4	2.4	4.8	2.16701	1.06807	41.0	40.55	303.0	756.0			
10	3.4	3.4	6.8	2.57926	1.26992	49.0	48.47	303.0	756.0			
13	4.4	4.4	8.8	2.93415	1.44369	55.0	54.40	303.0	756.0			
18	5.3	5.3	10.6	3.22028	1.58379	60.0	59.35	303.0	756.0			
Linear Regression Y ON X : Y= mX + b							Average	303.0	756.0			
1	Slope ( m )			2.04234	Linear Equation			r <sup>2</sup>	0.998781	Pstd(mmHg)	760.0	
2	Intercept ( b )			-0.01435	Set Point Flow Rate ( X ) ( m <sup>3</sup> /min )		1.133	r	0.9993903	T <sub>NTP</sub>	298.15	
3	Correlation Coefficient ( r )			0.99993	Final Set Flow Rate = ( I )		0	(Pa/Pstd)*(Tstd/Ta)			0.978322043	
Result									C=(Pa/Pstd)*(Tstd/Ta)^0.5			0.989101634

### COMMENT

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Environmental Scientist

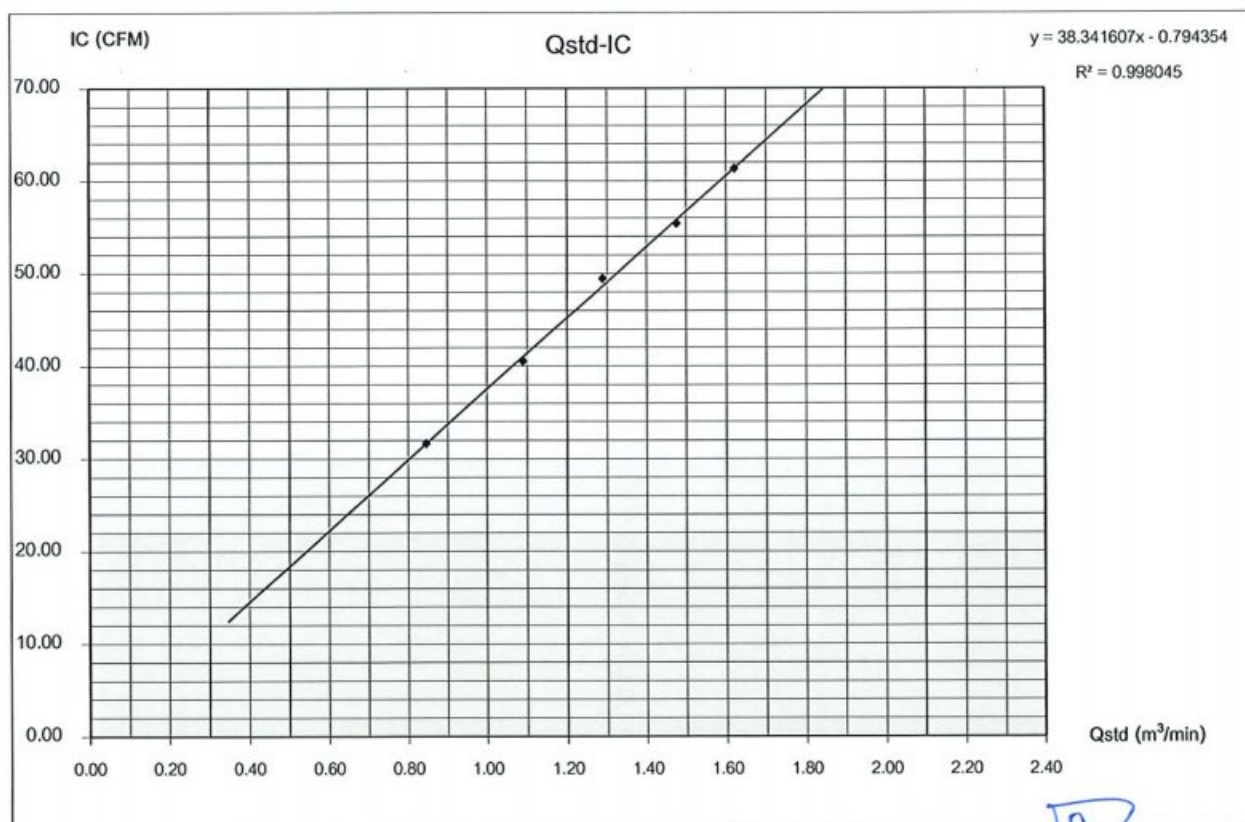
# PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Quotation	2023-00730	Date	November 1, 2023
Sampler Location	ศูนย์บริการสาธารณสุข (พล.บางปู)	Start Time	15:36:00 AM
Sampler Number	PM-10 No.12	Transfer Standard Type	Orifice
Instrument Model	HIVOL-BMBBE	Calibrator Model	TE-5025A
Motor Serial Number	B2012-10	Calibrator Serial Number	3362
Recorder Serial Number	4650	Calibrated By	Mr. Aukkarawit Boonsong

Plate No.	(Delta H)			( A )	( X )	( I )	( Y )	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH <sub>2</sub> O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ ( m <sup>3</sup> /min )	Sample Flow Rate Indicator ( ft <sup>3</sup> /min )	$IC = I[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	(°K = °C+273)	( mmHg )		
	Positive	Negative	ΔH <sub>2</sub> O								
5	1.5	1.5	3.0	1.71317	0.84586	32.0	31.65	303.0	756.0		
7	2.5	2.5	5.0	2.21170	1.08995	41.0	40.55	303.0	756.0		
10	3.5	3.5	7.0	2.61692	1.28836	50.0	49.46	303.0	756.0		
13	4.6	4.6	9.2	3.00009	1.47598	56.0	55.39	303.0	756.0		
18	5.5	5.6	11.1	3.29536	1.62055	62.0	61.32	303.0	756.0		
Linear Regression Y ON X : Y= mX + b							Average	303.0	756.0		
1	Slope ( m )			2.04234	Linear Equation			r <sup>2</sup>	0.998045	Pstd(mmHg)	760.0
2	Intercept ( b )			-0.01435	Set Point Flow Rate ( X ) ( m <sup>3</sup> /min )			1.133	r	0.999022	T <sub>MTP</sub>
3	Correlation Coefficient ( r )			0.99993	Final Set Flow Rate = ( I )			0	(Pa/Pstd)*(Tstd/Ta)		0.978322043
Result									C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.989101634

## COMMENT

Andersen Instruments, Inc.



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Technician

Approved By

( Mr. Panupon Podang )  
Environmental Scientist



RECALIBRATION
DUE DATE:
January 17, 2024

# Certificate of Calibration

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

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

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

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

Standard Conditions	
Tstd:	298.15 °K
Pstd:	760 mm Hg
Key	
ΔH: calibrator manometer reading (in H2O)	
ΔP: rootsmeter manometer reading (mm Hg)	
Ta: actual absolute temperature (°K)	
Pa: actual barometric pressure (mm Hg)	
b: intercept	
m: slope	

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

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

METTLER TOLEDO



## Accuracy Calibration Certificate

### Customer

Company: Environment Research & Technology Co., Ltd.  
Address: 25/114 Moo 8, Soi Chinakiet 1, Ngamwongwan Rd., Toongsonghong  
City: Lakki Contact: Ramita Taengmai  
Zip / Postal: 10210  
State / Province: Bangkok  
Order Number: 1033217312

### Weighing Device

Manufacturer: Mettler Toledo Instrument Type: Weighing Instrument  
Model: AB204-S Asset Number: ERT-CL-IN-0048  
Serial No.: 1123103723 Terminal Model: N/A  
Building: N/A Terminal Serial No.:  
Floor: 4 Terminal Asset No.:  
Room: 456

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

### Procedure

Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)  
METTLER TOLEDO Work Instruction: CPW002/26

This calibration certificate contains measurements for As Found and As Left calibrations.  
The sensitivity/span of the weighing instrument was adjusted before As Found and As Left calibrations with a built-in weight.  
In accordance with EURAMET cg-18 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific calibration conditions.

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

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

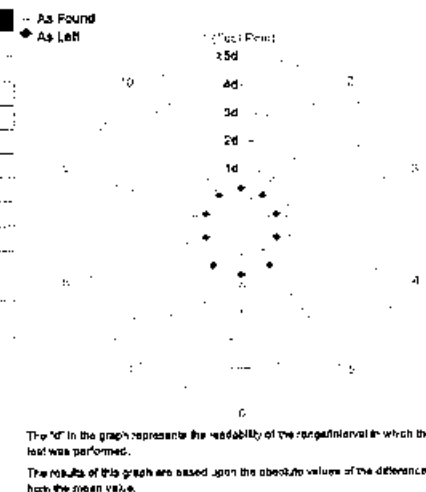
METTLER TOLEDO

## Measurement Results

### Repeatability

Test Load: 100 g

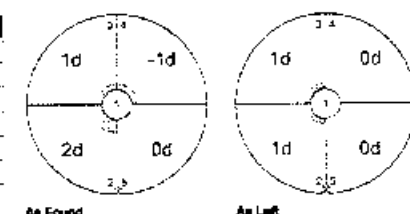
	As Found	As Left
1	99.9992 g	100.0001 g
2	99.9991 g	100.0001 g
3	99.9991 g	100.0001 g
4	99.9991 g	100.0001 g
5	99.9992 g	100.0002 g
6	99.9993 g	100.0002 g
7	99.9992 g	100.0002 g
8	99.9992 g	100.0001 g
9	99.9991 g	100.0001 g
10	99.9992 g	100.0001 g
Standard Deviation	0.00007 g	0.00005 g



### Eccentricity

Test Load: 100 g

Position	As Found	As Left
1	99.9991 g	100.0001 g
2	99.9993 g	100.0002 g
3	99.9992 g	100.0002 g
4	99.9990 g	100.0001 g
5	99.9991 g	100.0001 g
Maximum Deviation	0.0002 g	0.0001 g





### Error of Indication

#### As Found

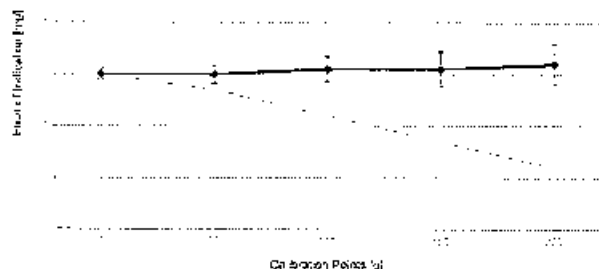
	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.0000 g	0.0000 g	0.0000 g	0.15 mg	2
2	0.0500 g	0.0500 g	0.0000 g	0.16 mg	2
3	0.1000 g	0.0999 g	-0.0001 g	0.16 mg	2
4	0.5000 g	0.4999 g	-0.0001 g	0.16 mg	2
5	1.0000 g	1.0000 g	0.0000 g	0.16 mg	2
6	5.0000 g	5.0001 g	0.0001 g	0.16 mg	2
7	10.0000 g	10.0001 g	0.0001 g	0.17 mg	2
8	50.0000 g	49.9997 g	-0.0003 g	0.20 mg	2
9	100.0000 g	99.9992 g	-0.0008 g	0.27 mg	2
10	150.0000 g	149.9987 g	-0.0013 g	0.36 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

#### As Found

#### As Left



For improved legibility of the graphics only increasing measurement points are shown and measurement points close to zero are not displayed.

The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor  $k$  - which can be larger than 2 according to EURAMET cg-16. 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: 577037 Calibration Due Date: 03-Jul-2023

#### Thermo Hygrometer

Equipment No.: IN265 Date of Issue: 26-Jul-2022  
Certificate Number: 22H1503 Calibration Due Date: 04-Jul-2023

### Remarks

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

#### End of Accredited Section

The information below and any attachments to this calibration certificate are not part of the accredited calibration.

### Measurement Uncertainty of the Weighing Instrument in Use

Stated is the expanded uncertainty with  $k=2$  in use. The formula shall be used for the estimation of the uncertainty under consideration of the errors of indication. The value R represents the net load indication in the unit of measure of the device.

Temperature coefficient for the evaluation of the measurement uncertainty in use:  $3.0 \cdot 10^{-6} / K$

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

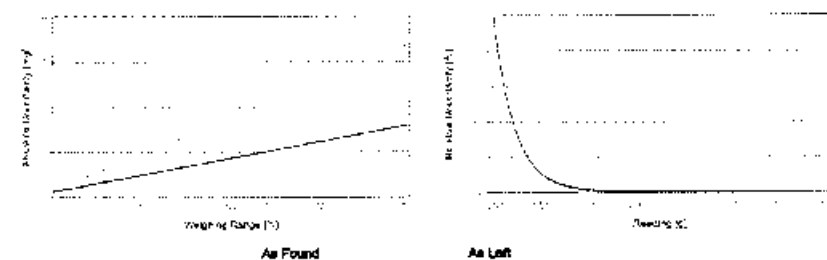
#### Linearization of Uncertainty Equation

1	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	0.16 mg	0.0087%	0.14 mg	0.0065%
22.0000 g	0.48 mg	0.0022%	0.28 mg	0.0013%
220.0000 g	3.4 mg	0.0015%	1.8 mg	0.00073%



# GWP® Certificate



As  
Found



As  
Left



The weighing device meets the given  
process requirements.

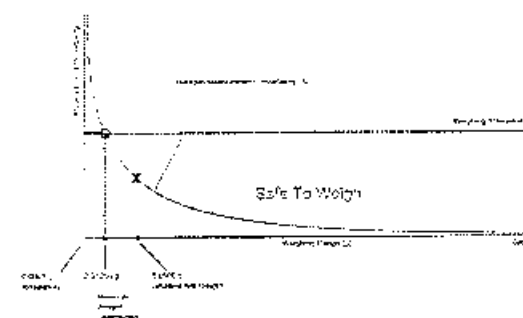
The weighing device meets the given  
process requirements.

Tests Performed: ☒ As Found ☒ As Left

### Process Requirements

Weighing Tolerance: 1% | Smallest Net Weight: 0.0500 g | Safety Factor: 2

#### Safe Weighing Range



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

## Minimum Weight

### As Found Minimum Weight Table

Minimum weights for different weighing tolerances and safety factors					
Tolerance	Safety Factor				
	1	2	3	5	10
0.1%	0.16012 g	0.32511 g	0.49616 g	0.85155 g	1.85026 g
0.2%	0.07947 g	0.16012 g	0.24199 g	0.40949 g	0.85155 g
0.5%	0.03165 g	0.06348 g	0.09550 g	0.16012 g	0.32511 g
1%	0.01580 g	0.03165 g	0.04754 g	0.07947 g	0.16012 g
2%	0.00789 g	0.01580 g	0.02372 g	0.03959 g	0.07947 g
5%	0.00316 g	0.00631 g	0.00947 g	0.01580 g	0.03165 g

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

### As Left Minimum Weight Table

Minimum weights for different weighing tolerances and safety factors					
Tolerance	Safety Factor				
	1	2	3	5	10
0.1%	0.12735 g	0.25542 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:

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

## Measurement Results

### Results Summary

	Repeatability	Eccentricity	Error of Indication
As Found	✓	✓	✓
As Left	✓	✓	✓
✓ = Passed			
✗ = Failed			
! = Safety Factor not met			

### Repeatability

Test Load: 100 g

Tolerance	Control Limit	As Found		As Left	
		Std. Deviation	Result	Std. Deviation	Result
0.1%	N/A		N/A		N/A
0.2%	0.00004 g		✓		✓
0.5%	0.00013 g		✓		✓
1%	0.00025 g	0.00007 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% 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	0.0002 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

		Control limits for various weighing tolerances					
Reference Value	Error	0.1%	0.2%	0.5%	1%	2%	5%
0.0000 g	0.0000 g	N/A	N/A	N/A	N/A	N/A	N/A
50.0000 g	-0.0003 g	0.0250 g	0.0500 g	0.1250 g	0.2500 g	0.5000 g	1.2500 g
100.0000 g	-0.0006 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0000 g	-0.0013 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
200.0000 g	-0.0018 g	0.1000 g	0.2000 g	0.5000 g	1.0000 g	2.0000 g	5.0000 g
Result		✓	✓	✓	✓	✓	✓

## As Left

		Control limits for various weighing tolerances					
Reference Value	Error	0.1%	0.2%	0.5%	1%	2%	5%
0.0000 g	0.0000 g	N/A	N/A	N/A	N/A	N/A	N/A
50.0000 g	0.0000 g	0.0250 g	0.0500 g	0.1250 g	0.2500 g	0.5000 g	1.2500 g
100.0000 g	0.0001 g	0.0500 g	0.1000 g	0.2500 g	0.5000 g	1.0000 g	2.5000 g
150.0000 g	0.0001 g	0.0750 g	0.1500 g	0.3750 g	0.7500 g	1.5000 g	3.7500 g
200.0000 g	0.0002 g	0.1000 g	0.2000 g	0.5000 g	1.0000 g	2.0000 g	5.0000 g
Result		✓	✓	✓	✓	✓	✓

The weighing tolerance is met if the error (of indication) for each test point is less than or equal to the corresponding control limit for that particular weighing tolerance. Results at or close to the zero point cannot be assessed.



## Calibration Data of NOx Analyzer

### Analyzer Performance Test

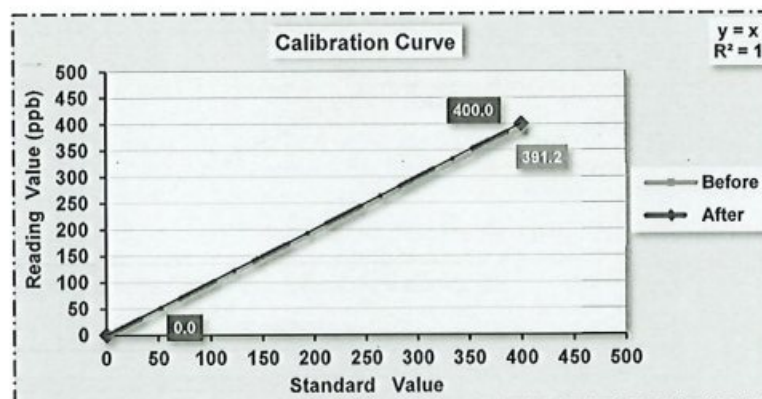
Equipment	Gas Analyzer ( NOx )	Customer Name	โพธิ์เพชร คอนซัลแตนต์
Manufacture	HORIBA	Location	Envi Research
Model	APNA-370	Quotation	2023-00730
Serial No.	J6GUBA4N	Calibration Date	October 31, 2023
Analyzer Unit	ppb	Time	2:26 PM

### 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	-0.1	0.0	0.3	0.0	-	-	-
Span	400	391.8	400.0	391.2	400.0	0.6	0.0	-	-	2.2



### 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	2.6	3.0	Voltage of the measured NO value
Signal NOx	mV	14.7	15.1	Voltage of the measured NOx value
Detector	°C	41.5	41.5	43 °C ± 5 °C
Ambient	kPa	101.5	101.5	Current atmospheric pressure
DC 24V	V	23.7	23.8	24V ±0.5
DC 5V	V	5.0	5.0	5V ±0.5
NO Slope	-	0.78170	0.81240	0.50000 - 2.0000
NOx Slope	-	0.76180	0.80650	0.50000 - 2.0000

Calibrate By :

(MR.PANUPON PODANG)  
October 31, 2023

Checked By :

(MS.SUTATIP IM-NOI)  
October 31, 2023

## Calibration Data of NOx Analyzer

### Analyzer Performance Test

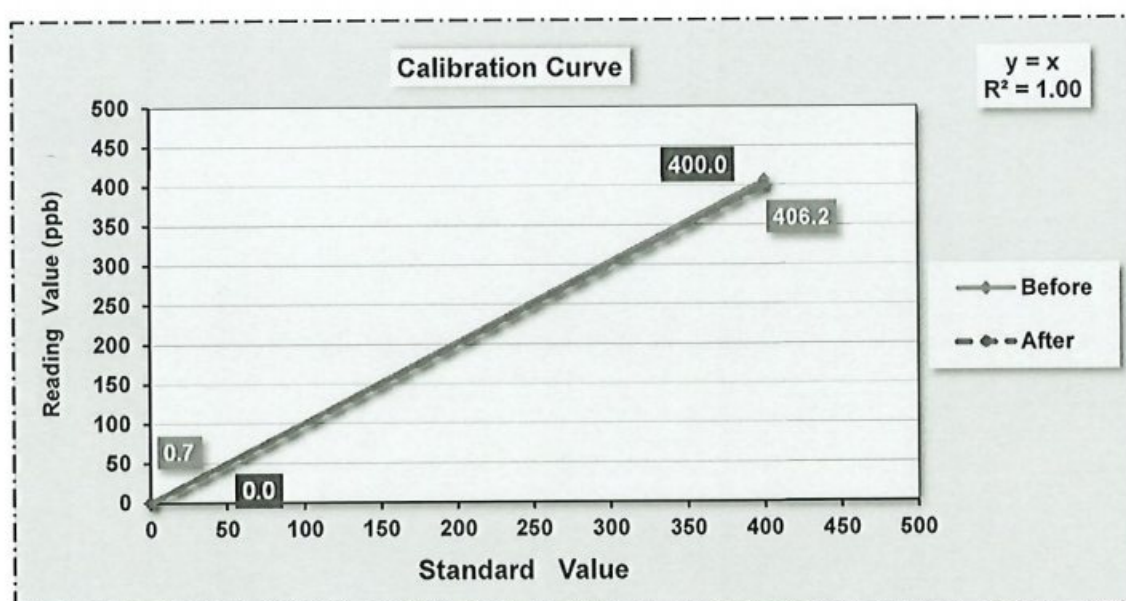
Equipment	Gas Analyzer ( NOx )	Customer Name	โพธิ์เทียม คอนซัลแตนต์
Manufacture	API	Location	Envi Research
Model	200A	Quotation	2023-00730
Serial No.	1464	Calibration Date	October 31, 2023
Analyzer Unit	ppb	Time	2:10 PM

### Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300	0165
Standard Gas Components	CO = 4,516 ppm		
Cylinder No : EB0123013	NO = 55.3 ppm		
Expire Date : Oct 22, 2027	SO <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	0.9	0.0	0.7	0.0	0.2	0.0	-	-	-
Span	400	406.7	405.0	406.2	400.0	0.5	5.0	-	-	1.6





## STATUS TEST AND VALIDATION OF NO<sub>x</sub> ANALYZER MODEL 200A

Parameter	Display As	Unit	Observed Value		Nominal Range
			Before Adjust	After Adjust	
Range	RANGE	ppb	500	500	0 - 500 standard
Stability	STABIL	ppb	0.50	0.20	< 2 with zero air
Sample Flow	SAMP FL	cc / min	521.00	518.00	500 +/- 50
Ozone Flow	OZONE FL	cc / min	79.00	79.00	80 +/- 10
PMT signal	PMT	mV	47.40	48.00	0 to 5,000
Auto - Zero	AZERO	mV	39.4	39.6	-20 to 150
High Voltage Power Supply	HVPS	V	777.00	777.00	450 to 900
Reaction Cell Temperature	RCELL TEMP	°C	50.00	49.90	50 +/- 1
Box Temperature	BOX TEMP	°C	31.50	31.60	Ambient temp.+3 / -7
PMT Temperature	PMT TEMP	°C	7.10	7.00	7 +/- 1
Converter Temperature	MOLY TEMP	°C	313.70	314.00	315 +/- 5
Reaction Cell Pressure	RCEL	In - Hg - A	8.40	8.50	2 to 10 ( Constant )
Sample Pressure	SAMP	In - Hg - A	30.30	30.10	Ambient - 1 ( Constant )
NO <sub>x</sub> Slope	NO <sub>x</sub> SLOPE	-	1.272	1.251	1.000 +/- 0.300
NO <sub>x</sub> Offset	NO <sub>x</sub> OFFSET	mV	-3.70	-3.70	0 +/- 20
NO Slope	NO SLOPE	-	1.277	1.256	1.000 +/- 0.300
NO Offset	NO OFFSET	mV	-3.60	-3.70	0 +/- 20

Calibrate By :

(MR.PANUPON PODANG)

October 31, 2023



Checked By :

(MS.SUTATIP IM-NOI)

October 31, 2023

## Calibration Data of NOx Analyzer

### Analyzer Performance Test

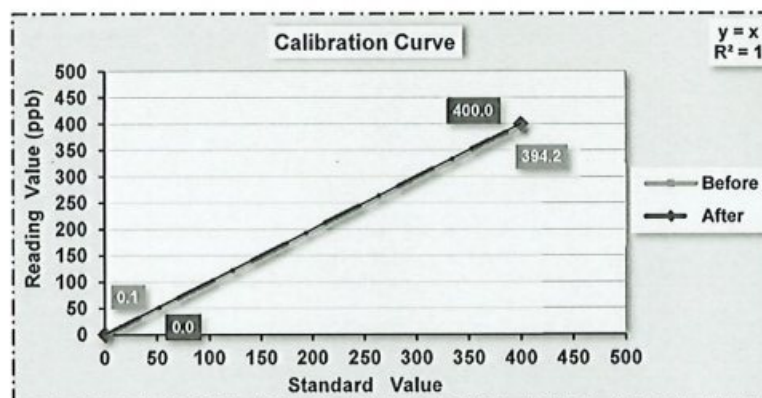
Equipment	Gas Analyzer ( NOx )	Customer Name	โพรเทียร์ คอนซัลแตนต์
Manufacture	HORIBA	Location	Envi Research
Model	APNA-370	Quotation	2023-00730
Serial No.	KPACV8NA	Calibration Date	October 31, 2023
Analyzer Unit	ppb	Time	2:48 PM

### 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	-0.5	0.0	0.1	0.0	-0.6	0.0	-	-	-
Span	400	396.3	400.0	394.2	400.0	2.1	0.0	-	-	1.5



### 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	1.9	2.0	Voltage of the measured NO value
Signal NOx	mV	14.7	14.8	Voltage of the measured NOx value
Detector	°C	42.1	42.0	43 °C ± 5 °C
Ambient	kPa	101.2	101.0	Current atmospheric pressure
DC 24V	V	23.8	23.8	24V ±0.5
DC 5V	V	5.0	5.0	5V ±0.5
NO Slope	-	0.91997	0.92145	0.50000 - 2.0000
NOx Slope	-	0.92375	0.92856	0.50000 - 2.0000

Calibrate By :

(MR.PANUPON PODANG)  
October 31, 2023



Checked By :

(MS.SUTATIP IM-NOI)  
October 31, 2023



## Calibration Data of NOx Analyzer

### Analyzer Performance Test

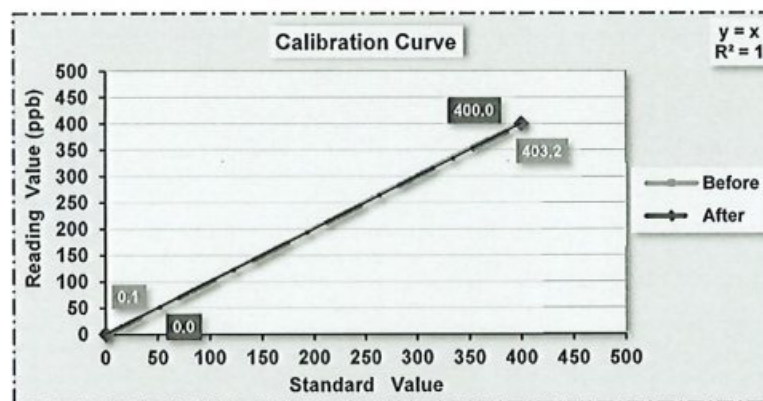
Equipment	Gas Analyzer ( NOx )	Customer Name	โพธิ์เทพย์ คอนซัลแตนต์
Manufacture	HORIBA	Location	Envi Research
Model	APNA-370	Quotation	2023-00730
Serial No.	U65W031M	Calibration Date	October 31, 2023
Analyzer Unit	ppb	Time	2:21 PM

### 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	-0.1	0.0	0.1	0.0	-0.2	0.0	-	-	-
Span	400	404.6	400.0	403.2	400.0	1.4	0.0	-	-	0.8

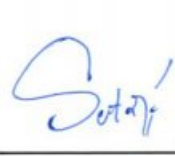


### STATUS TEST AND VALIDATION OF NOx ANALYZER MODEL APNA-370

Parameter	Unit	Observed Value		Nominal Range
		Before Adjust	After Adjust	
Range	ppb	500	500	0 - 500 Standard
Signal NO	mV	2.6	2.4	Voltage of the measured NO value
Signal NOx	mV	15.3	15.0	Voltage of the measured NOx value
Detector	°C	42.1	42.0	43 °C ± 5 °C
Ambient	kPa	101.6	101.3	Current atmospheric pressure
DC 24V	V	23.6	23.6	24V ±0.5
DC 5V	V	5.0	5.0	5V ±0.5
NO Slope	-	1.17060	1.15620	0.50000 - 2.0000
NOx Slope	-	1.11920	1.10260	0.50000 - 2.0000

Calibrate By :   
(MR.PANUPON PODANG)  
October 31, 2023



Checked By :   
(MS.SUTATIP IM-NOI)  
October 31, 2023

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

### Analyzer Performance Test

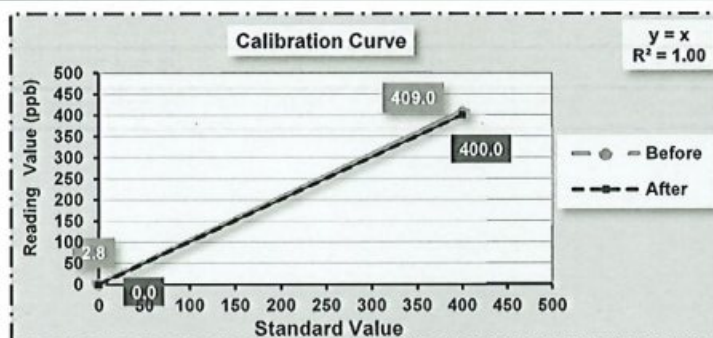
Equipment	Gas Analyzer ( SO <sub>2</sub> )	Customer Name	โพธิ์เพียร คอนซัลแตนต์
Manufacture	Horiba	Location	Envi Research
Model	APSA-370	Quotation	2023-00730
Serial No.	A5VTX5AF	Calibration Date	October 31, 2023
Analyzer Unit	ppb	Time	2:34 PM

### 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	2.8	0.0	-	-	-
Span	400	409.0	400.0	-	-	2.3



### 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	12.3	8.4	Voltage of the measured SO <sub>2</sub> value
LAMP	mV	250.0	251.2	200 mV - 1200 mV
CELL	°C	32.9	32.9	Ambient temperature + 5 °C - 15 °C
PUMP	Kpa	44.8	44.8	65 kPa or less
AMBIENT	kPa	101.8	101.9	Current atmospheric pressure
DC 24V	V	24.0	24.0	24 V ±0.5 V
DC 5V	V	4.9	4.9	5 V ±0.5 V

Calibrate By :

(MR.PANUPON PODANG)  
October 31, 2023

Checked By :

(MS.SUTATIP IM-NOI)  
October 31, 2023



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

### Analyzer Performance Test

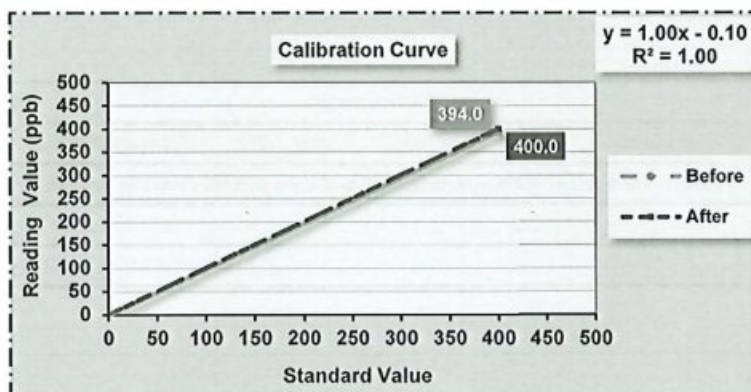
Equipment	Gas Analyzer ( SO <sub>2</sub> )	Customer Name	ฟอร์เทียร์ คอนซัลแตนต์
Manufacture	Thermo	Location	Envi Research
Model	43C	Quotation	2023-00730
Serial No.	73379-373	Calibration Date	October 26, 2023
Analyzer Unit	ppb	Time	11:48 AM

### 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	-0.2	-0.1	-	-	-
Span	400	394.0	400.0	-	-	1.5



### 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	33.5	33.5	8.0 °C to 47.0 °C
Chamber Temp	CHAMBER	°C	45.5	45.5	43.0 °C to 47.0 °C
Pressure	PRESSURE	mmHg	731.2	731.4	400.0 to 1,000
Sample Flow	SAMP FLOW	LPM	0.637	0.638	0.350 to 1.000
Lamp Intensity	INTENSITY	Hz	20171	20019	20,000 to 50,000
Lamp Voltage	LAMP VOLTAGE	V	919	920	750 to 1,200
SO <sub>2</sub> Concentration	SO <sub>2</sub> CONCENTRATION	ppb	0.5	0.9	0 to 10,000
Motherboard Status	MOTHERBOARD STATUS	-	OK	OK	OK
Interface Status	INTERFACE STATUS	-	OK	OK	OK

Calibrate By :

(MR.PANUPON PODANG)  
October 26, 2023

Checked By :

(MS.SUTATIP IM-NOI)  
October 26, 2023

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

### Analyzer Performance Test

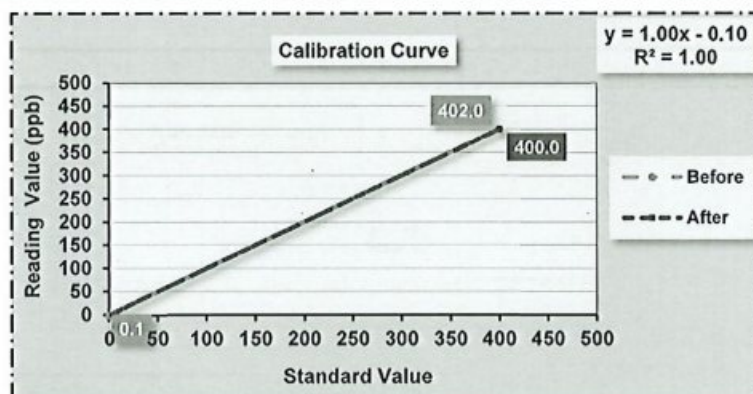
Equipment	Gas Analyzer ( SO <sub>2</sub> )	Customer Name	โพธิ์เพียร คอนซัลแตนต์
Manufacture	Thermo	Location	Envi Research
Model	43C	Quotation	2023-00730
Serial No.	73370-373	Calibration Date	October 26, 2023
Analyzer Unit	ppb	Time	11:48 AM

### 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	-0.1	-	-	-
Span	400	402.0	400.0	-	-	0.5



### 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	30.7	30.8	8.0 °C to 47.0 °C
Chamber Temp	CHAMBER	°C	44.3	44.4	43.0 °C to 47.0 °C
Pressure	PRESSURE	mmHg	716.4	716.5	400.0 to 1,000
Sample Flow	SAMP FLOW	LPM	0.389	0.390	0.350 to 1.000
Lamp Intensity	INTENSITY	Hz	27367	27114	20,000 to 50,000
Lamp Voltage	LAMP VOLTAGE	V	962	962	750 to 1,200
SO <sub>2</sub> Concentration	SO <sub>2</sub> CONCENTRATION	ppb	0.4	0.8	0 to 10,000
Motherboard Status	MOTHERBOARD STATUS	-	OK	OK	OK
Interface Status	INTERFACE STATUS	-	OK	OK	OK

Calibrate By :

(MR.PANUPON PODANG)  
October 26, 2023

Checked By :

(MS.SUTATIP IM-NOI)  
October 26, 2023



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

### Analyzer Performance Test

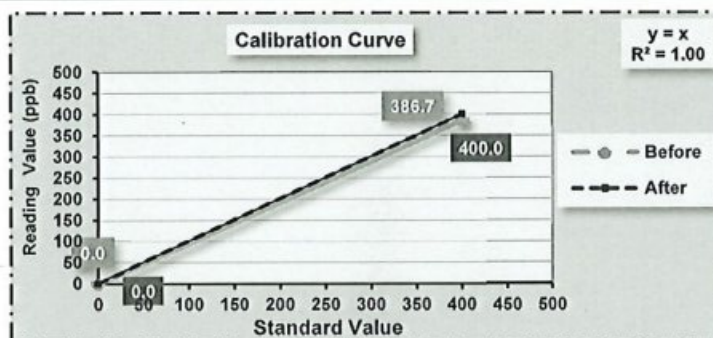
Equipment	Gas Analyzer ( SO <sub>2</sub> )	Customer Name	โพธิ์เพียร คอนซัลแตนต์
Manufacture	Horiba	Location	Envi Research
Model	APSA-370	Quotation	2023-00730
Serial No.	12E8X34P	Calibration Date	August 24, 2023
Analyzer Unit	ppb	Time	1:39 PM

### 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	0.0	0.0	-	-	-
Span	400	386.7	400.0	-	-	3.3



### 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	7.4	7.6	Voltage of the measured SO <sub>2</sub> value
LAMP	mV	351.0	351.1	200 mV - 1200 mV
CELL	°C	35.0	35.1	Ambient temperature + 5 °C - 15 °C
PUMP	Kpa	43.2	43.2	65 kPa or less
AMBIENT	kPa	100.5	100.5	Current atmospheric pressure
DC 24V	V	23.9	23.9	24 V ±0.5 V
DC 5V	V	5.0	5.0	5 V ±0.5 V

Calibrate By :

(MR.PANUPON PODANG)

August 24, 2023

Checked By :

(MS.SUTATIP IM-NOI)

August 24, 2023



# CERTIFICATE OF ANALYSIS

## Grade of Product: EPA Protocol

Part Number:	E04NI99E15A0292	Reference Number:	160-401604495-1
Cylinder Number:	EB0123013	Cylinder Volume:	144.4 Cubic Feet
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
PGVP Number:	A12019	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Oct 22, 2019

Expiration Date: Oct 22, 2027

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals

### ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	55.00 PPM	55.27 PPM	G1	+/- 0.8% NIST Traceable	10/14/2019, 10/22/2019
NITRIC OXIDE	55.00 PPM	55.27 PPM	G1	+/- 0.8% NIST Traceable	10/14/2019, 10/22/2019
SULFUR DIOXIDE	55.00 PPM	54.93 PPM	G1	+/- 0.9% NIST Traceable	10/14/2019, 10/22/2019
CARBON MONOXIDE	4500 PPM	4516 PPM	G1	+/- 0.6% NIST Traceable	10/14/2019
NITROGEN	Balance				

### CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	13010429	KAL004123	97.6 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Jul 23, 2025
NTRM	13010429	KAL004123	97.6 PPM NOx/NITROGEN	+/- 0.8%	Jul 23, 2025
NTRM	16010235	KAL004419	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021
NTRM	08012318	KAL004620	4857 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 07, 2024

### ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
MKS FTIR - CO - 000928781	FTIR	Sep 26, 2019
MKS FTIR - NO - 000928781	FTIR	Oct 18, 2019
MKS FTIR - NOx - 000928781	FTIR	Oct 18, 2019
MKS FTIR - SO2 - 000928781	FTIR	Oct 03, 2019

Triad Data Available Upon Request

NOTES: Gross Weight: 28.0 Kg, Net Weight: 4.6 Kg.



*Michael A. Smith*  
Approved for Release



# THAI METEOROLOGICAL DEPARTMENT

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

## Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 10 August, 2022

Certification No. 287/22

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : Davis Instruments Inc.

Type : Weather Wizard III Product No. 7425

Serial No. : WC80813A59 ID No. : No.12

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

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1005.6 hPa

### NATIONAL STANDARD WIND TUNNEL :

: Micromanometer Theodor Friedrichs FC014 Serial No. 9310119

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

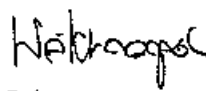
N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

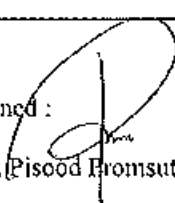
: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)

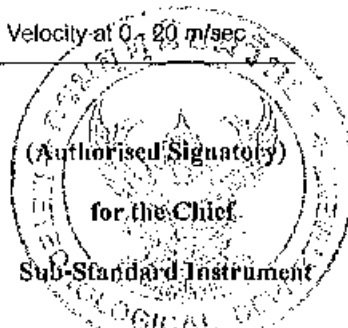
Serial Number 110730029 (sensor 120629586)

### JAPAN QUALITY ASSURANCE ORGANIZATION

: Standard Velocity at 0 - 20 m/sec

Calibrated by :   
Mr. Watcharapol Subwat  
Mechanical Engineer

Signed :   
Mr. Pissod Promsut





# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Certification No. 287/22

10 August, 2022

Page : 2 of 2

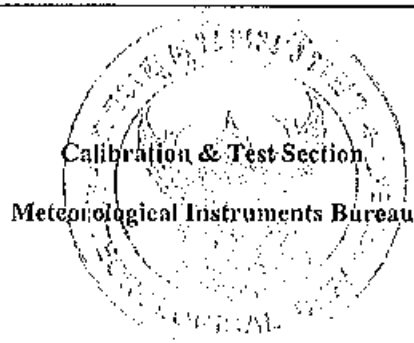
Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	inches H <sub>2</sub> O	inches H <sub>2</sub> O	m/sec	m/sec	m/sec
1.00	-	-	-	0.9	0.10
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.9	0.10
7.04	-	-	-	6.7	0.34
9.02	-	-	-	8.9	0.12
11.01	-	-	-	10.3	0.71
13.01	-	-	-	12.1	0.91
15.01	-	-	-	14.3	0.71
17.02	-	-	-	16.1	0.92
20.02	-	-	-	19.3	0.72

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

Calibrated by :

*Watcharapol*

Mr. Watcharapol Subwat  
Mechanical Engineer



# Sound Level Meter Calibration Report

<b>Support Equipment Type</b>	:	Sound Level Calibrator
<b>Manufacture</b>	:	BSWA Technology
<b>Model</b>	:	CA111
<b>Serial No.</b>	:	590331
<b>Range of Calibrator</b>		
- Support Equipment Type	:	94.0
- Frequency	:	1,000 Hz.
<b>Calibrated By</b>	:	Mr.Assada Chaiyawong
<b>Calibration Date</b>	:	November 1, 2023
<b>Customer Name</b>	:	บริษัท โฟรท์เทียร์ คอนซัลแตนต์ จำกัด : โครงการจัดตั้งนิคมอุตสาหกรรมแพรงษา ของบริษัท วีเอ็นเอส พร็อพเพอร์ตี้ จำกัด

[illegible]

Checked By

Synthesis m. (1m x 6)

Mr.Prayun Detkla

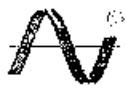
## Technician

Approved By

Ms.Sutatip Im-noi

## Environmental Scientist





# Calibration Chart

BSWA-IV-0021-03-0045A

**Sound Calibrator model** CA111  
**Serial Number** 590331  
**Appearance** OK  
**Power Supply** 1.5V LR6 (AA battery) x2  
**Sound Pressure Level** 94.04 / 114.05 dB  
**Frequency** 999.9 / 999.9 Hz  
**THD (@1000Hz)** 0.71 / 1.33 %

*Copying and using select parts, or tampering with this document without the permission of BSWA is forbidden!*

## BSWA Technology Ltd.

[www.bswa-tech.com](http://www.bswa-tech.com)

This equipment was calibrated at the following ambient conditions:

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

This equipment is qualified!

C. Z.  
**Calibrated**

2023-3-7  
**Date**

---

เอกสารสอบเทียบเครื่องมือฯ  
บริษัท เทสท์ เทค จำกัด



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



## Certificate of Calibration

Certificate No. : 23T793

Page : 1 of 2

Equipment : Digital Thermometer With Sensor

Manufacturer: Testo

Model : 926

Serial No.: 5809260110250914

ID No.: EQL-058

Condition As-Received: Used Item

Received Date: 07 April 2023

Calibration Date: 18 April 2023  
to 08 May 2023

Reference: 2304-0179DN

Ambient Temperature: ( 25 ± 3 ) °C

Relative Humidity: ( 50 ± 20 ) %

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.

Submitted by: TEST TECH CO.,LTD. (HEAD Office)

30, 32 Rama II Soi 63, Rama II Rd.,  
Samaedam, Bangkhunthian, Bangkok 10150

Procedure used: Calibration were conducted using in-house calibration procedure CP-T01 according to comparison with  
Industrial Platinum Resistance Thermometer (IPRT) into liquid bath temperature controller.  
The temperature scale used was based on ITS-90.

### Condition of this result of calibration

1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Black Stack Thermometer	1560	8C454	221616	23 May 2023
2) PRT Scanner Module	2562	A01303	221616	23 May 2023
3) Industrial Platinum Resistance Thermometer	5627	739433	221616	23 May 2023
4) Industrial Platinum Resistance Thermometer	5627	739434	221616	23 May 2023

2.The 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 maintained through:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Sithinon Poomai  
Issue Date : 12 May 2023

Approved Signatory :

[ ] Phalinee Prabpaipal  
[ ] Chatchawan Khunpiluek  
[x] Wanlop Larpkurn

B 0313441





Cert. No.: 23T793

Page.: 2 of 2

**Result of Calibration:-**

Without Adjustment

**Function:**

Temperature measurement

This equipment was connected with Thermocouple Type T

ID No. EQL-058

Immersion Depth ( mm.)	Standard Temperature ( °C )	UUC* Reading ( °C )	Error ( °C )	Uncertainty of Measurement ( ±°C )
150	3.0045	2.9	-0.1045	0.24
150	20.0060	19.9	-0.1060	0.24
150	35.0057	34.8	-0.2057	0.24
150	103.0046	102.6	-0.4046	0.37
150	104.0025	103.6	-0.4025	0.37
150	120.0046	119.7	-0.3046	0.42
150	140.0018	139.7	-0.3018	0.47
150	150.0083	149.7	-0.3083	0.49
150	170.0054	169.5	-0.5054	0.55
150	180.0026	178.9	-1.1026	0.58

**Result of Calibration:-**

Without Adjustment

**Function:**

Temperature measurement

This equipment was connected with Thermocouple Type T

ID No. EQL-058 Water Proof

Dimension of probe : Diameter 6 mm., Length 111 mm. Sheath material : Stainless Steel

Immersion Depth ( mm.)	Standard Temperature ( °C )	UUC* Reading ( °C )	Error ( °C )	Uncertainty of Measurement ( ±°C )
100	41.5080	41.3	-0.2080	0.24
100	45.0040	44.8	-0.2040	0.24
100	50.0045	49.8	-0.2045	0.24
100	83.0082	82.7	-0.3082	0.31
100	92.0024	91.7	-0.3024	0.33
100	95.0054	94.7	-0.3054	0.34
100	150.0076	149.4	-0.6076	0.49

UUC\* : Unit Under Calibration

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

-o0o-

a 1160657



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



## Certificate of Calibration

Certificate No. : 23T475

Page : 1 of 2

Equipment : Digital Thermometer With Sensor

Manufacturer: Testo

Model : 926

Serial No.: 33824123/004

ID No.: EQL-138

Condition As-Received: Used Item

Received Date: 09 March 2023

Calibration Date: 20 March 2023  
to 22 March 2023

Reference: 2303-0314DN

Ambient Temperature: ( 25  $\pm$  3 ) °C

Relative Humidity: ( 50  $\pm$  20 ) %

Submitted by: TEST TECH CO.,LTD. (HEAD Office)

30, 32 Rama II Soi 63, Rama II Rd.,

Samaedam, Bangkhunthian, Bangkok 10150

Procedure used: Calibration were conducted using in-house calibration procedure CP-T01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into liquid bath temperature controller.  
The temperature scale used was based on ITS-90.

### Condition of this result of calibration

1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Digital Thermometer	1529	A7A609	2211274	17 Oct 2023
2) Industrial Platinum Resistance Thermometer	5627-12	571970	2211274	17 Oct 2023
3) Industrial Platinum Resistance Thermometer	5627	824304	2211274	17 Oct 2023

2.The 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 maintained at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Sataporn Mulkamdee

Issue Date : 23 March 2023

Approved Signatory :

[ ] Phalinee Prabpalpal

[ ] Chatchawan Khunpiluek

[x] Wanlop Larpkurn

B 0310381



Cert. No.: 23T475

Page.: 2 of 2

**Result of Calibration:-**

Without Adjustment

**Function:**

Temperature measurement

This equipment was connected with Thermocouple Type T ID No. EQL-138

Immersion	Standard	UUC*		Uncertainty
Depth	Temperature	Reading	Error	of Measurement
( mm.)	( °C )	( °C )	( °C )	( ±°C )
150	2.9962	2.6	-0.3962	0.24
150	35.0051	34.8	-0.2051	0.24
150	36.0061	35.8	-0.2061	0.24
150	36.9974	36.8	-0.1974	0.24
150	41.5051	41.4	-0.1051	0.24
150	43.9973	43.9	-0.0973	0.24
150	55.0047	55.0	-0.0047	0.25
150	169.9960	170.4	0.4040	0.55

UUC\* : Unit Under Calibration

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

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235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160  
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584  
www.qcalibration.com




CERTIFICATE No : 22T8762  
REFERENCE No : 66179-2

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : LIQUID IN GLASS THERMOMETER  
MANUFACTURER : PRECISION  
MODEL : ---  
SERIAL No : 8925  
-- No : EQL-103  
RESOLUTION : 0.1 °C  
TYPE : TOTAL IMMERSION  
CONDITION AS RECEIVED : USED ITEM  
SUBMITTED BY : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKHUNTHIAN, BANGKOK 10150

ALIBRATED BY : CHARUKIT L.  
CALIBRATION DATE : 18-Aug-22  
APPROVED BY :   
PONGSAK J.  
ISSUED DATE : 18-Aug-22  
RECEIVED DATE : 11-Aug-22

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF  
QUALITY CALIBRATION CO., LTD.



**QUALITY CALIBRATION CO.,LTD.**

235 Petchkasem 63/2 Road, Laksong, Bangkai, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

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CERTIFICATE No : 22T8762

PAGE : 2 OF 2

**Calibration Report**

EQUIPMENT : LIQUID IN GLASS THERMOMETER  
MANUFACTURER : PRECISION  
MODEL : ---  
ID No : EQL-103  
RESOLUTION : 0.1 °C  
RECEIVED DATE : 11-Aug-22  
AMBIENT TEMPERATURE : 23 °C ± 3 °C

SERIAL NUMBER : 8925  
TYPE : TOTAL IMMERSION  
CALIBRATION DATE : 18-Aug-22  
RELATIVE HUMIDITY : 50 %RH ± 20 %RH

**CONDITION OF THIS RESULTS OF CALIBRATION**

1. THIS INSTRUMENT WAS CALIBRATED BASED ON ASTM E77:1992 BY COMPARISON WITH STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT) INTO LIQUID BATH TEMPERATURE CONTROLLER. THE TEMPERATURE SCALE USED WAS BASED ON S-90.

2. REFERENCE STANDARD INSTRUMENTS :-

<u>INSTRUMENT</u>	<u>MODEL</u>	<u>SERIAL No</u>	<u>CERTIFICATE No</u>	<u>DUE DATE</u>
1) STANDARD THERMOMETER	1529	A22167	21T12439	09-Dec-22
2) SPRT PROBE	5612	587312	21T12439	09-Dec-22
3) PRECISION BATH	7320	A21105	21T12433	16-Dec-22
4) PRECISION BATH	CTR-40	A68155	21T12434	10-Dec-22

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-  
- NATIONAL INSTITUTE OF METROLOGY (THAILAND).

**RESULT OF CALIBRATION : WITHOUT ADJUSTMENT**

STANDARD READING (°C)	UUC* READING (°C)	IMMERSION DEPTH (mm)	CORRECTION (°C)	EMERGENT STEM TEMPERATURE (°C)	UNCERTAINTY OF MEASUREMENT (±°C)
20.0214	20.0	140	0.0214	N/A	0.079
25.0309	25.0	160	0.0309	N/A	0.079
41.5541	41.5	225	0.0541	N/A	0.079
44.5416	44.5	235	0.0416	N/A	0.079
45.0409	45.0	240	0.0409	N/A	0.079
50.0520	50.0	260	0.0520	N/A	0.084

UUC\* : UNIT UNDER CALIBRATION

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR  $k=2$ , PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



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## Certificate of Calibration

Certificate No. : 22H2197

Page : 1 of 2

Equipment : Dial Thermo-Hygrometer  
Manufacturer: Barigo  
Model : -  
Serial No.: -  
ID No.: EQL-064

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except with the prior written approval of the head of  
Corporate Services 3: Equipment Calibration and Testing Services.

Condition As-Received: Used Item

Received Date: 17 October 2022

Calibration Date: 25 October 2022  
to 28 October 2022

Reference: 2210-0461DN

Submitted by: TEST TECH CO.,LTD. (HEAD Office)

Ambient Temperature: ( 25 ± 3 ) °C

Relative Humidity: ( 50 ± 20 ) %

30, 32 Rama II Soi 63, Rama II Rd.,

Samaedam, Bangkhunthian, Bangkok 10150

Procedure used: Calibration were conducted using in-house calibration procedure CP-H02 according to comparison with standard chilled mirror sensor for humidity measurement function and comparison with standard temperature probe for temperature measurement function into humidity / temperature chamber.

### Condition of this result of calibration

1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Chilled-Mirror Hygrometer	Dew Master	41292	19848	03 Nov 2022
2) Handheld Thermometer With Sensor	1523	3240076	221249	02 Mar 2023

2.The 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 maintained at:-

- National Institute of Standards and Technology (NIST) , The United States of America
- National Institute of Metrology Thailand (NIMT)

Calibrated by : Surasit Phansudnoi  
Issue Date : 01 November 2022

Approved Signatory :

☒ Chakrit Waewanjua

☐ Pornthippa Tameyakul

☐ Viporn Tantiyawutti



Cert. No.: 22H2197

Page.: 2 of 2

**Result of Calibration:-**

Without Adjustment

Function:

Humidity measurement.

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
25.0	30.1	29.0	-1.1	1.5
25.0	40.1	39.0	-1.1	1.5
25.0	50.1	50.0	-0.1	1.7
25.0	60.0	61.0	1.0	1.7
25.0	75.2	76.5	1.3	1.7

**Result of Calibration:-**

Without Adjustment

Function:

Temperature measurement.

Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
15.013	15.0	-0.013	0.72
20.023	20.0	-0.023	0.72
25.019	25.0	-0.019	0.72
30.009	30.0	-0.009	0.72

**UUC\* : Unit Under Calibration**

The reported uncertainty of measurement was base on standard uncertainty multiplied by coverage factor  $k = 2.00$ , providing confidence level approximately 95%.

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CERTIFICATE No : 22T8761  
REFERENCE No : 66179-1

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : LIQUID IN GLASS THERMOMETER  
MANUFACTURER : PRECISION  
MODEL : G13004  
SERIAL No : N/A  
No : EQL-111  
RESOLUTION : 1 °C  
TYPE : TOTAL IMMERSION  
CONDITION AS RECEIVED : USED ITEM  
SUBMITTED BY : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKHUNTHIAN, BANGKOK 10150

LIBRATED BY : CHAICHARN CH.  
CALIBRATION DATE : 18-Aug-22  
APPROVED BY : PONGSAK J.  
ISSUED DATE : 18-Aug-22  
RECEIVED DATE : 11-Aug-22



**QUALITY CALIBRATION CO.,LTD.**

235 Petchkasem 63/2 Road, Laksong, Bangkai, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

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CERTIFICATE No : 22T8761

PAGE : 2 OF 2

**Calibration Report**

EQUIPMENT : LIQUID IN GLASS THERMOMETER  
MANUFACTURER : PRECISION  
MODEL : G13004  
ID No : EQL-111 SERIAL NUMBER : N/A  
RESOLUTION : 1 °C TYPE : TOTAL IMMERSION  
RECEIVED DATE : 11-Aug-22 CALIBRATION DATE : 18-Aug-22  
AMBIENT TEMPERATURE : 23 °C ± 3 °C RELATIVE HUMIDITY : 50 %RH ± 20 %RH

**CONDITION OF THIS RESULTS OF CALIBRATION**

1. THIS INSTRUMENT WAS CALIBRATED BASED ON ASTM E77:1992 BY COMPARISON WITH STANDARD PLATINUM RESISTANCE THERMOMETER (SPRT) INTO LIQUID BATH TEMPERATURE CONTROLLER. THE TEMPERATURE SCALE USED WAS BASED ON ITS -90.

2. REFERENCE STANDARD INSTRUMENTS :-

<u>INSTRUMENT</u>	<u>MODEL</u>	<u>SERIAL No</u>	<u>CERTIFICATE No</u>	<u>DUE DATE</u>
1) STANDARD THERMOMETER	1529	A22167	21T12439	09-Dec-22
2) SPRT PROBE	5612	587312	21T12439	09-Dec-22
3) PRECISION BATH	7320	A21105	21T12433	16-Dec-22

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND).

**RESULT OF CALIBRATION : WITHOUT ADJUSTMENT**

STANDARD READING (°C)	UUC* READING (°C)	IMMERSION DEPTH (mm)	CORRECTION (°C)	EMERGENT STEM TEMPERATURE (°C)	UNCERTAINTY OF MEASUREMENT (±°C)
115.0063	115.0	110	0.0063	N/A	0.15
121.0191	121.0	120	0.0191	N/A	0.15

U : UNIT UNDER CALIBRATION

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR  $k=2$ , PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



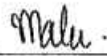
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Cert.No.: 23CH92

Page.: 1 of 3

## Certificate of Calibration

Equipment :	Conductivity Meter
Manufacturer :	TOA
Model :	CM-41X
Serial No. :	842572
ID No. :	EQL-211
Condition As-Received:	Used Item
Received Date :	19 January 2023
Calibration Date :	20 January 2023
Reference :	2301-0614DN-1
Submitted by :	TEST TECH CO.,LTD. (HEAD Office) 30, 32 Rama II Soi 63, Rama II Rd., Samaedam, Bangkhunthian, Bangkok 10150
Ambient Temperature :	(25 ± 2.5) °C
Relative Humidity :	(50 ± 15) %
Calibration Procedure:	In -house method : - CP-CH6 by direct measurement with certified reference material (CRM) - CP-CH8 by comparison with standard thermometer
Calibrated by :	Warakorn Lerngagtrakul
Approved by :	 Approved Signatory
( / ) Malee Butkruea	
( ) Saithip Meangmai	
( ) Warakorn Lerngagtrakul	
Issue Date :	24 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.

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Cert.No.: 23CH92

Page.: 2 of 3

**Condition of this result of calibration**

## 1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Certificate No.	Due date
1) Thermometer	1963878	130RC095	2211140	12 Sep 2023
2) Ref. Std. Thermometer	4982054	110RC044	2211306	27 Oct 2023

This certification is traceable to the International System of Unit maintained at:-

- Traceable to National Institute of Metrology (Thailand), NIMT

## 2. Certified Reference Materials :-

- Conductivity calibration solution, CPA chem Ltd., The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Conductivity Solution	Manufacturer	Lot No.	Exp. date
147.0 $\mu\text{S/cm}$	CPA Chem	823327	20 June 2023
1.413 $\text{mS/cm}$	CPA Chem	823328	20 June 2023
12.880 $\text{mS/cm}$	CPA Chem	823329	20 June 2023

- Control Conductivity calibration solution temperature by Water bath  $(25 \pm 0.1)^\circ\text{C}$

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

**Calibration results**

Function : Conductivity Measurement

(\*) After Adjustment at 147.0, 1413.0, 12880  $\mu\text{S/cm}$ 

Conductivity Electrode Serial No.: 806F0005

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement ( $\pm$ )	Coverage factor k
147.0 $\mu\text{S/cm}$	150.3 $\mu\text{S/cm}$	147.0 $\mu\text{S/cm}$	0.99 $\mu\text{S/cm}$	2.00
1.413 $\text{mS/cm}$	1.428 $\text{mS/cm}$	1.413 $\text{mS/cm}$	0.0092 $\text{mS/cm}$	2.00
12.880 $\text{mS/cm}$	12.71 $\text{mS/cm}$	12.88 $\text{mS/cm}$	0.086 $\text{mS/cm}$	2.00

**Remark**

- UUC\* = Unit Under Calibration

- 147.0  $\mu\text{S/cm}$  Adjustment Cell constant =  $98.5\text{m}^{-1}$ - 1.413  $\text{mS/cm}$  Adjustment Cell constant =  $99.5\text{m}^{-1}$ - 12.880  $\text{mS/cm}$  Adjustment Cell constant =  $101.8\text{m}^{-1}$ 

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a 1144880



Cert.No.: 23CH92

Page.: 3 of 3

**Calibration Results**

**Function : Temperature Measurement**

**( \* ) Without adjustment**

This equipment was connected with Temperature Probe;

- Model : CT-58101B

- Serial No. : 806F0005

Dimension of probe;

- Length : 114 mm.

- Diameter : 12 mm.

- Immersion Depth : 100 mm.

Calibration Point ( °C )	Standard Temperature ( °C )	UUC* Reading ( °C )	Error ( °C )	Uncertainty of Measurement ( ± °C )	Coverage factor <i>k</i>
25.0	25.003	25.0	-0.003	0.13	2.00

**Remark : - UUC\* = Unit Under Calibration**

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

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*Malu.*

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## Certificate of Calibration

Certificate No. : 23M259

Page : 1 of 2

Equipment : Standard Weight  
Manufacturer: LS  
Model : -  
Serial No.: -  
ID No.: EQL-121  
Condition As-Received: Used Item  
Received Date: 02 February 2023  
Calibration Date: 07 February 2023

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except with the prior written approval of the head of  
Corporate Services 3: Equipment Calibration and Testing Services.

Reference: 2302-0080DN  
Ambient Temperature: ( 23 ± 2 ) °C  
Relative Humidity: ( 50 ± 15 ) %  
Atmospheric Pressure: 1008.9 mbar

Submitted by: TEST TECH CO.,LTD. (HEAD Office)

30, 32 Rama II Soi 63, Rama II Rd.,  
Samaedam, Bangkhunthian, Bangkok 10150

**Procedure used:** Calibration were conducted using in-house calibration procedure CP-M01 according to comparison method against standard weights on the basis of weighings at an average air density of 1.2 kg/m<sup>3</sup> and a temperature of 23.4 °C material density of weight is 8000 kg/m<sup>3</sup>.

### Condition of this result of calibration

1. Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Standard weight Set (E2)	YCS31-712-00	50202965	MM-0109-22	11 Jul 2024

2. This certificate is not certified for any commercial transaction.


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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Chaowalit Rittirak  
Issue Date : 08 February 2023

Approved Signatory :

  
[ ] Phalinee Prabpaipal  
[x] Sura Suwannasri  
[ ] Chaowalit Rittirak



Cert No.: 23M259

Page: 2 of 2

Result of calibration

Without adjustment

Nominal Value	Conventional mass	Uncertainty of Measurement ( $\pm$ )	Maximum Permissible error ( $\pm$ )
50 g	50.00015 g	0.10 mg	0.30 mg

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 %.

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## Certificate of Calibration

Certificate No. : 23M260  
Page : 1 of 2

Equipment : Standard Weight

Manufacturer: -

Model : -

Serial No.: -

ID No.: EQL-258

Condition As-Received: Used Item

Received Date: 02 February 2023

Calibration Date: 07 February 2023

Reference: 2302-0080DN

Submitted by: TEST TECH CO.,LTD. (HEAD Office)

Ambient Temperature: ( 23 ± 2 ) °C

Relative Humidity: ( 50 ± 15 ) %

Atmospheric Pressure: 1012 mbar

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except with the prior written approval of the head of  
Corporate Services 3: Equipment Calibration and Testing Services.

30, 32 Rama II Soi 63, Rama II Rd.,  
Samaedam, Bangkhunthian, Bangkok 10150

Procedure used: Calibration were conducted using In-house calibration procedure CP-M01 according to comparison method against standard weights on the basis of weighings at an average air density of 1.2 kg/m<sup>3</sup> and a temperature of 23.6 °C material density of weight is 8000 kg/m<sup>3</sup>.

### Condition of this result of calibration

1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Standard weight Set (E2)	YCS31-712-00	50202965	MM-0109-22	11 Jul 2024

2.This certificate is not certified for any commercial transaction.


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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Chaowalit Rittirak  
Issue Date : 08 February 2023

Approved Signatory :

  
[ ] Phalinee Prabpaipal  
[x] Sura Suwannasri  
[ ] Chaowalit Rittirak

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Cert No.: 23M260

Page: 2 of 2

Result of calibration

Without adjustment

Nominal Value	Conventional mass	Uncertainty of Measurement ( $\pm$ )	Maximum Permissible error ( $\pm$ )
2 kg	2.0000034 kg	3.0 mg	10 mg

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 %.

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a 1146232





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## Certificate of Calibration

Certificate No. : 22M1563

Page : 1 of 2

Equipment : Standard Weight

Manufacturer: -

Model : -

Serial No.: M 0030/11

ID No.: EQL-139

Condition As-Received: Used Item

Received Date: 11 August 2022

Calibration Date: 24 August 2022

Reference: 2208-0438DN

Submitted by: TEST TECH CO.,LTD. (HEAD Office)

Ambient Temperature: ( 23 ± 2 ) °C

Relative Humidity: ( 50 ± 15 ) %

Atmospheric Pressure: 1008 mbar

30, 32 Rama II Soi 63, Rama II Rd.,  
Samaedam, Bangkhunthian, Bangkok 10150

Procedure used: Calibration were conducted using in-house calibration procedure CP-M01 according to comparison method against standard weights on the basis of weighings at an average air density of 1.2 kg/m<sup>3</sup> and a temperature of 23.0 °C material density of weight is 8000 kg/m<sup>3</sup>.

### Condition of this result of calibration

#### 1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Standard weight Set (E2)	YCS31-712-00	50202965	MM-0109-22	11 Jul 2024


2.This certificate is not certified for any commercial transaction.

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

4.This Certification is traceable to the International System of Unit maintained at:-  
-National Institute of Metrology Thailand (NIMT)

Calibrated by : Chaowalit Rittirak  
Issue Date : 25 August 2022

Approved Signatory :

  
☐ Phalinee Prabpaipal  
☒ Sura Suwannasri  
☐ Chaowalit Rittirak

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Cert No.: 22M1563

Page: 2 of 2

**Result of calibration**

Without adjustment

Nominal Value	Conventional mass	Uncertainty of Measurement ( $\pm$ )	Maximum Permissible error ( $\pm$ )
2 g	2.000020 g	0.040 mg	0.12 mg

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 %.

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## Certificate of Calibration

Certificate No. : 22M1562

Page : 1 of 2

Equipment : Standard Weight

Manufacturer: Mettler Toledo

Model : -

Serial No.: 11119459

ID No.: EQL-149

Condition As-Received: Used Item

Received Date: 11 August 2022

Calibration Date: 24 August 2022

Reference: 2208-0438DN

Submitted by: TEST TECH CO.,LTD. (HEAD Office)

Ambient Temperature: ( 23 ± 2 ) °C

Relative Humidity: ( 50 ± 15 ) %

Atmospheric Pressure: 1008 mbar

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Corporate Services 3: Equipment Calibration and Testing Services.

30, 32 Rama II Soi 63, Rama II Rd.,  
Samaedam, Bangkhunthian, Bangkok 10150

Procedure used: Calibration were conducted using in-house calibration procedure CP-M01 according to comparison method against standard weights on the basis of weighings at an average air density of 1.2 kg/m<sup>3</sup> and a temperature of 23.0 °C material density of weight is 8000 kg/m<sup>3</sup>.

### Condition of this result of calibration

1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Standard weight Set (E2)	YCS31-712-00	50202965	MM-0109-22	11 Jul 2024

2.This certificate is not certified for any commercial transaction.

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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Chaowalit Rittirak

Issue Date : 25 August 2022

Approved Signatory :

☐ Phalinee Prabpaipal

☒ Sura Suwannasri

☐ Chaowalit Rittirak

B 0295803



Cert No.: 22M1562

Page: 2 of 2

**Result of calibration**

Without adjustment

Nominal Value	Conventional mass	Uncertainty of Measurement ( $\pm$ )	Maximum Permissible error ( $\pm$ )
20 g	20.000011 g	0.080 mg	0.25 mg

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

-o0o-

a 1122452



## Certificate of Calibration

Equipment:	TURBIDIMETER	Certificate No.:	C08230153
Model:	2100N	Issued Date:	15 September 2023
Serial No. (or ID.):	970400003415 (EQL-024)	Job No.:	WO-00005226
Manufacturer:	HACH	Page:	1 of 2
Condition:	In Condition		

Customer: TEST TECH CO., LTD.  
30,32 Rama II Soi 63, Rama II Rd.,  
Samaedam, Bangkhuntien Bangkok 10150 Thailand

Environment Condition: Temperature 23 °C ± 2 °C  
Humidity 50 %RH ± 15 %RH

Calibration Place: Environment Laboratory, DKSH Technology Limited.  
2533 Sukhumvit Road, Bangchak,  
Phrakhanong, Bangkok 10260 Thailand

Calibration By: Miss.Orawan Khlaiphloi  
Calibration Date: 14 September 2023  
The Method used: In house method, CAL-WI-23, base on Hach Manufacturer Method 8195  
Traceability: This certificate is traceable to Primary standard Fromazin and StablCal accepted by  
United States Environmental Protection Agency (EPA) through Hach Company  
Certificate No. A1075 , A1074 , A1091 , A1074 , A1074



(Miss Orawan Khlaiphloi)

Person in charge



(Mr. Nitinun Srihawan)

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.

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด  
DKSH Technology Limited  
2533 ถนนสุขุมวิท แขวงบางนา เขตคลองเตย กรุงเทพมหานคร 10260  
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260  
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

### Calibration Results:

#### Before Adjustment

Std Turbidity (NTU)	UUC Reading	Correction	Deviation	Uncertainty
0.050	0.088	-0.038	0.0	0.070
20.40	19.1	1.30	0.0	1.0
205.0	195	10.0	0.5	10
1028.0	952	76.0	0.9	50
4068.0	3942	126.0	0.9	200

#### After Adjustment

Std Turbidity (NTU)	UUC Reading	Correction	Deviation	Uncertainty
0.050	0.084	-0.034	0.0	0.070
20.40	20.4	0.00	0.0	1.0
205.0	205	0.0	0.5	10
1028.0	1026	2.0	0.5	50
4068.0	4063	5.0	0.5	200

The End of Certificate



CERTIFICATE No : 23E0843  
REFERENCE No : 67999-1

PAGE : 1 OF 2

## Certificate of Calibration

**EQUIPMENT** : pH METER  
**MANUFACTURER** : DKK-TOA  
**MODEL** : HM-25R  
**SERIAL No** : 760205  
**ID No** : EQL-183  
**CONDITION AS RECEIVED** : USED ITEM  
**SUBMITTED BY** : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKHUNTHIAN, BANGKOK 10150

**CALIBRATED BY** : PRASERT P.

**CALIBRATION DATE** : 27-Jan-23

**APPROVED BY** :   
PONGSAK J.

**ISSUED DATE** : 03-Jan-23

**RECEIVED DATE** : 27-Jan-23



CERTIFICATE No : 23E0843

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : pH METER  
MANUFACTURER : DKK-TOA  
ID No : EQL-183  
RECEIVED DATE : 27-Jan-23  
AMBIENT TEMPERATURE : 23°C ± 1°C

MODEL : HM-25R  
SERIAL NUMBER : 760205  
CALIBRATION DATE : 27-Jan-23  
RELATIVE HUMIDITY : 51 %RH ± 10 % RH

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY DIRECT MEASUREMENT METHOD BASED ON WI-TQ-062. THE DISPLAY UNIT WAS TESTED BY GENERATING STANDARD VOLTAGE TO THE UNIT AND READ THE VALUE COMPARED WITH CALCULATED VALUE. THE DISPLAY AND ELECTRODE WAS CALIBRATED BY USING STANDARD pH BUFFER SOLUTION.
2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No/ LOT No	CERTIFICATE No	DUE DATE
1) pH STANDARD SOLUTION	00651-06	CC719181	4880-12119147	05-Apr-23
2) pH STANDARD SOLUTION	00651-08	CC718727	4881-12110709	31-Mar-23
3) pH STANDARD SOLUTION	00651-10	CC717045	4882-12065386	17-Mar-23
4) PROCESS CALIBRATOR	CA150	91S6079	22E1145	31-Mar-23
5) BATH	260014	1247.48074	22T9870	13-Sep-23
6) THERMOMETER WITH PROBE	421504	55000379	22T9904	13-Sep-23

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO SI UNIT MAINTAINED AT :-
  - NATIONAL INSTITUTE OF STANDARD AND TECHNOLOGY, USA.
  - NATIONAL INSTITUTE OF METROLOGY (THAILAND)

### RESULT OF CALIBRATION : WITHOUT ADJUSTMENT

#### 1. DISPLAY UNIT WITH pH ELECTRODE S/N: 202F0138MK

STANDARD pH BUFFER SOLUTION (pH)	UUC READING (pH)	CORRECTION (pH)	ACTUAL READING (mV)	UNCERTAINTY OF MEASUREMENT (± pH)	COVERAGE FACTOR k
4.007	4.01	-0.003	178	0.013	2.0
7.004	7.00	0.004	0.0	0.013	2.0
10.014	10.01	0.004	-177	0.014	2.0

#### 2. DISPLAY UNIT MEASUREMENT TEMPERATURE WITH PROBE

STANDARD READING (°C)	UUC* READING (°C)	IMMERSION DEPTH (mm)	CORRECTION (°C)	UNCERTAINTY OF MEASUREMENT (±°C)
25.002	25.0	80	0.002	0.21

#### 3. PERCENT SLOPE 98%

UUC : UNIT UNDER CALIBRATION

THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



**QUALITY CALIBRATION CO.,LTD.**

235 Petchkasem 63/2 Road, Laksong, Bangkac, Bangkok 10160  
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584



CERTIFICATE No : 21E11277  
REFERENCE No : 63049-1

PAGE : 1 OF 2

**Certificate of Calibration**

**EQUIPMENT** : pH METER  
**MANUFACTURER** : TOA DKK  
**MODEL** : HM-41X  
**SERIAL No** : 784787  
**ID No** : EQL-199  
**CONDITION AS RECEIVED** : USED ITEM  
**SUBMITTED BY** : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKHUNTHIAN, BANGKOK 10150

**CALIBRATED BY** : PRASERT P.  
**CALIBRATION DATE** : 15-Oct-21

**APPROVED BY** :   
PONGSAK J.

**ISSUED DATE** : 15-Oct-21

**RECEIVED DATE** : 15-Oct-21

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF  
QUALITY CALIBRATION CO., LTD..



# QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

CERTIFICATE No : 21E11277

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : pH METER  
MANUFACTURER : TOA DKK  
ID No : EQL-199  
RECEIVED DATE : 15-Oct-21  
AMBIENT TEMPERATURE : 25° C ± 1° C  
MODEL : HM-41X  
SERIAL NUMBER : 784787  
CALIBRATION DATE : 15-Oct-21  
RELATIVE HUMIDITY : 51 %RH ± 10 % RH

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY DIRECT MEASUREMENT METHOD BASED ON WI-TQ-062. THE DISPLAY UNIT WAS TESTED BY GENERATING STANDARD VOLTAGE TO THE UNIT AND READ THE VALUE COMPARED WITH CALCULATED VALUE. THE DISPLAY AND ELECTROD WAS CALIBRATED BY USING STANDARD pH BUFFER SOLUTION.
2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No/ LOT No	CERTIFICATE No	DUE DATE
1) pH STANDARD SOLUTION	00651-06	CC719181	4880-12119147	05-Apr-23
2) pH STANDARD SOLUTION	00651-08	CC718727	4881-12110709	31-Mar-23
3) pH STANDARD SOLUTION	00651-10	CC717045	4882-12065386	17-Mar-23
4) PROCESS CALIBRATOR	744	7514008	21E1392	29-Apr-22
5) BATH	260014	1247 48074	21T9121	10-Sep-22
6) THERMOMETER WITH PROBE	421504	55000379	21T9129	14-Sep-22
7) STANDARD THERMOMETER	2560	A14546	PSL-T0049/64	23-Nov-22

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
5. THIS CERTIFICATE IS TRACEABLE TO SI UNIT MAINTAINED AT :-
  - NATIONAL INSTITUTE OF STANDARD AND TECHNOLOGY, USA.
  - NATIONAL INSTITUTE OF METROLOGY (THAILAND)

### RESULT OF CALIBRATION : ADJUSTMENT

#### 1. DISPLAY UNIT WITH pH ELECTRODE S/N: 903F0008MK

STANDARD pH BUFFER SOLUTION (pH)	UUC READING (pH)	CORRECTION (pH)	ACTUAL READING (mV)	UNCERTAINTY OF MEASUREMENT (± pH)	COVERAGE FACTOR k
4.007	4.01	-0.003	177	0.013	2.00
7.003	7.00	0.003	0	0.013	2.00
10.014	10.01	0.004	-177	0.014	2.00

#### 2. DISPLAY UNIT MEASUREMENT TEMPERATURE WITH PROBE

STANDARD READING (°C)	UUC* READING (°C)	IMMERSION DEPTH (mm)	CORRECTION (°C)	UNCERTAINTY OF MEASUREMENT (±°C)
25.008	25.0	80	0.008	0.21

UUC : UNIT UNDER CALIBRATION

THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT





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



## Certificate of Calibration

Certificate No. : 22H2197

Page : 1 of 2

Equipment : Dial Thermo-Hygrometer

Manufacturer: Barigo

Model : -

Serial No.: -

ID No.: EQL-064

Condition As-Received: Used Item

Received Date: 17 October 2022

Calibration Date: 25 October 2022  
to 28 October 2022

Reference: 2210-0461DN

Ambient Temperature: ( 25  $\pm$  3 ) °C

Relative Humidity: ( 50  $\pm$  20 ) %

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.

Submitted by: TEST TECH CO.,LTD. (HEAD Office)

30, 32 Rama II Soi 63, Rama II Rd.,  
Samaedam, Bangkhunthian, Bangkok 10150

Procedure used: Calibration were conducted using in-house calibration procedure CP-H02 according to comparison with standard chilled mirror sensor for humidity measurement function and comparison with standard temperature probe for temperature measurement function into humidity / temperature chamber.

### Condition of this result of calibration

#### 1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Chilled-Mirror Hygrometer	Dew Master	41292	19848	03 Nov 2022
2) Handheld Thermometer With Sensor	1523	3240076	221249	02 Mar 2023


2.The 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 maintained at:-

- National Institute of Standards and Technology (NIST) , The United States of America
- National Institute of Metrology Thailand (NIMT)

Calibrated by : Surasil Phansudnoi  
Issue Date : 01 November 2022

Approved Signatory :

  
[✓] Chakrit Waewanjua  
[ ] Pornthippa Tameyakul  
[ ] Viporn Tantiyawutti



Cert. No.: 22H2197

Page.: 2 of 2

**Result of Calibration:-**

Without Adjustment

Function:

Humidity measurement.

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
25.0	30.1	29.0	-1.1	1.5
25.0	40.1	39.0	-1.1	1.5
25.0	50.1	50.0	-0.1	1.7
25.0	60.0	61.0	1.0	1.7
25.0	75.2	76.5	1.3	1.7

**Result of Calibration:-**

Without Adjustment

Function:

Temperature measurement.

Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
15.013	15.0	-0.013	0.72
20.023	20.0	-0.023	0.72
25.019	25.0	-0.019	0.72
30.009	30.0	-0.009	0.72

UUC\* : Unit Under Calibration

The reported uncertainty of measurement was base on standard uncertainty multiplied by coverage factor  $k = 2.00$ , providing confidence level approximately 95%.

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**QUALITY CALIBRATION CO.,LTD.**  
235 Petchkasem 63/2 Road, Laksong, Bangkac, Bangkok 10160  
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584  
www.qcalibration.com



CERTIFICATE No : 23T8798  
REFERENCE No : 70515-6

PAGE : 1 OF 2

## Certificate of Calibration

**EQUIPMENT** : HOT AIR OVEN  
**MANUFACTURER** : MEMMERT  
**MODEL** : UFE 500  
**SERIAL No** : G508.0791  
**ID No** : EQL-128  
**CONDITION AS RECEIVED** : USED ITEM  
**SUBMITTED BY** : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKHUNTHIAN, BANGKOK 10150

**CALIBRATED BY** : CHAICHARN CH.

**CALIBRATION DATE** : 11-Sep-23

**APPROVED BY** :   
PONGSAK J.

**ISSUED DATE** : 15-Sep-23

**RECEIVED DATE** : 11-Sep-23

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF  
QUALITY CALIBRATION CO., LTD.

F-G010 REV : 03



CERTIFICATE No : 23T8798

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : HOT AIR OVEN  
MANUFACTURER : MEMMERT  
MODEL : UFE 500  
ID No : EQL-128  
RECEIVED DATE : 11-Sep-23  
AMBIENT TEMPERATURE : 24 °C ± 1 °C  
S/N : G508.0791  
CALIBRATION DATE : 11-Sep-23  
RELATIVE HUMIDITY : 51 %RH ± 10 %RH

### CONDITION OF THIS RESULTS OF CALIBRATION

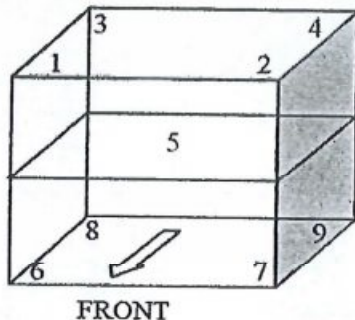
1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED RTD Pt100 UNDER NO LOAD CONDITION. THE TEMPERATURE PROBES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOMETER PROBE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOMETER PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH RTD	HYDRA 2635A	7301307	23T6636	10-Jul-24

3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.  
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.  
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-  
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



#### GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 1
Overall Line Voltage (V) variation : 10
Instrument Condition : Normal
Chamber Size (W*L*H): 56*40*48 cm

#### CHAMBER PERFORMANCE

Calibrate Piont (°C)	Average All Position Temp. (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
104.0	104.49	0.28	0.66	0.93
180.0	180.25	0.32	0.62	1.11

#### TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (± °C)
		#1	#2	#3	#4	Ref. 5	#6	#7	#8	#9	
104.0	104.0	104.46	104.13	104.45	104.28	104.57	104.67	104.60	104.58	104.67	0.38
180.0	180.0	180.27	179.85	180.41	179.93	180.19	180.54	180.41	180.51	180.13	1.1

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2: LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k =2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



CERTIFICATE No : 23T8799  
REFERENCE No : 70515-7

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : HOT AIR OVEN  
MANUFACTURER : MEMMERT  
MODEL : UFE 500  
SERIAL No : G512.2005  
ID No : EQL-161  
CONDITION AS RECEIVED : USED ITEM  
SUBMITTED BY : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKHUNTHIAN, BANGKOK 10150

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 11-Sep-23

APPROVED BY :   
PONGSAK J.

ISSUED DATE : 15-Sep-23

RECEIVED DATE : 11-Sep-23





CERTIFICATE No : 23T8799

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : HOT AIR OVEN  
MANUFACTURER : MEMMERT  
MODEL : UFE 500  
ID No : EQL-161  
RECEIVED DATE : 11-Sep-23  
AMBIENT TEMPERATURE : 24 °C ± 1 °C  
S/N : G512.2005  
CALIBRATION DATE : 11-Sep-23  
RELATIVE HUMIDITY : 51 %RH ± 10 %RH

### CONDITION OF THIS RESULTS OF CALIBRATION

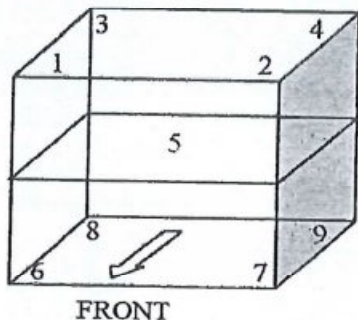
1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED RTD Pt100 UNDER NO LOAD CONDITION. THE TEMPERATURE PROBES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOMETER PROBE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOMETER PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH RTD	HYDRA 2635A	7301307	23T6636	10-Jul-24

3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.  
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.  
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-  
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



#### GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 1
Overall Line Voltage (V) variation : 10
Instrument Condition : Normal
Chamber Size (W*L*H): 56*40*48 cm

#### CHAMBER PERFORMANCE

Calibrate Piont (°C)	Average All Position Temp. (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
104.0	103.96	0.14	0.58	0.73
180.0	179.55	0.22	0.93	1.47

#### TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (± °C)
		#1	#2	#3	#4	Ref. 5	#6	#7	#8	#9	
104.0	104.0	104.16	104.13	104.20	103.98	103.76	103.76	104.06	103.71	103.93	0.38
180.0	180.0	179.73	179.89	180.04	179.54	179.30	178.98	179.75	178.97	179.77	1.1

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2: LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR  $k=2$ , PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT





CERTIFICATE No : 23T8797  
REFERENCE No : 70515-5

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : HOT AIR OVEN  
MANUFACTURER : MEMMERT  
MODEL : UF 110  
SERIAL No : B414.0764  
ID No : EQL-169  
CONDITION AS RECEIVED : USED ITEM  
SUBMITTED BY : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKHUNTHIAN, BANGKOK 10150

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 11-Sep-23

APPROVED BY :   
PONGSAK J.

ISSUED DATE : 15-Sep-23

RECEIVED DATE : 11-Sep-23



CERTIFICATE No : 23T8797

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : HOT AIR OVEN  
MANUFACTURER : MEMMERT  
MODEL : UF 110  
ID No : EQL-169  
RECEIVED DATE : 11-Sep-23  
AMBIENT TEMPERATURE : 24 °C ± 1 °C  
S/N : B414.0764  
CALIBRATION DATE : 11-Sep-23  
RELATIVE HUMIDITY : 51 %RH ± 10 %RH

### CONDITION OF THIS RESULTS OF CALIBRATION

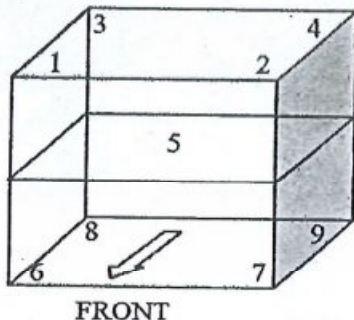
1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED RTD Pt100 UNDER NO LOAD CONDITION. THE TEMPERATURE PROBES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOMETER PROBE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOMETER PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

### 2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH RTD	HYDRA 2635A	7301307	23T6636	10-Jul-24

3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.  
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.  
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-  
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



#### GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 1
Overall Line Voltage (V) variation : 3
Instrument Condition : Normal
Chamber Size (W*L*H): 56*40*48 cm

#### CHAMBER PERFORMANCE

Calibrate Piont (°C)	Average All Position Temp. (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
104.0	104.04	0.10	0.55	1.06
120.0	120.10	0.11	0.65	1.20
140.0	140.03	0.14	0.77	1.33
150.0	150.05	0.14	0.79	1.48

#### TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (± °C)
		#1	#2	#3	#4	Ref. 5	#6	#7	#8	#9	
104.0	104.0	104.34	104.25	104.10	104.00	104.05	103.61	103.93	103.57	104.54	0.38
120.0	120.0	120.39	120.38	120.27	120.06	120.13	119.57	119.98	119.52	120.56	0.46
140.0	140.0	140.47	140.39	140.24	139.99	140.01	139.39	139.94	139.30	140.54	0.46
150.0	150.0	150.55	150.49	150.32	150.00	149.98	149.35	149.97	149.25	150.57	0.46

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k =2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



CERTIFICATE No : 23M6754  
REFERENCE No : 69854-1

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE  
MANUFACTURER : SARTORIUS  
MODEL : BP210S  
SERIAL No : S0736477  
ID No : EQL-008  
CONDITION AS RECEIVED : USED ITEM  
SUBMITTED BY : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD.,  
SAMAEDAM, BANGKHUNTHIAN, BANGKOK  
10150

CALIBRATED BY : PRASERT D.

CALIBRATION DATE : 13-Jul-23

APPROVED BY :   
PONGSAK J.

ISSUED DATE : 17-Jul-23

RECEIVED DATE : 13-Jul-23





CERTIFICATE No : 23M6754

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : BP210S  
MANUFACTURER : SARTORIUS S/N : S0736477  
ID No : EQL-008 RECEIVED DATE : 13-Jul-23  
AIR PRESSURE : 1011mbar  $\pm$  1mbar CALIBRATION DATE : 13-Jul-23  
AMBIENT TEMPERATURE : 23°C  $\pm$  1°C RELATIVE HUMIDITY : 50 %RH  $\pm$  10 % RH

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS ADJUSTED USING INTERNAL WEIGHT TO ADJUST. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN. THE INTERNAL WEIGHT WAS CHECKED BY USING

### 2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD WEIGHT SET	E2	QK-I-151	M2302013S	02-Feb-25
2) STANDARD WEIGHT	E2	15843	M2302014S	02-Feb-25

3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

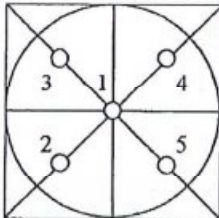
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY ( $\pm$ g)
0.0	0.0000	0.0000	0.000082
0.1	0.1000	0.0000	0.000083
0.2	0.2000	0.0000	0.000083
0.5	0.5000	0.0000	0.000083
1.0	1.0000	0.0000	0.000084
2.0	2.0000	0.0000	0.000084
5.0	5.0000	0.0000	0.000086
10.0	10.0000	0.0000	0.000089
20.0	20.0001	-0.0001	0.000094
50.0	49.9999	0.0001	0.00012
100.0	99.9999	0.0001	0.00019
200.0	199.9997	0.0003	0.00032

### 5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	99.9998
2	99.9997
3	99.9998
4	99.9998
5	99.9998
OFF-CENTER LOADING	0.0001

6. INTERNAL WEIGHT ERROR : 0.000499999999988177 g

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR  $k=2$ , PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT





CERTIFICATE No : 23M8800  
REFERENCE No : 70515-8

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE  
MANUFACTURER : AND  
MODEL : GR-200  
SERIAL No : 14243876  
ID No : EQL-130  
CONDITION AS RECEIVED : USED ITEM  
SUBMITTED BY : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKHUNTHIAN, BANGKOK 10150

CALIBRATED BY : PRASERT P.

CALIBRATION DATE : 11-Sep-23

APPROVED BY :   
PONGSAK J.

ISSUED DATE : 15-Sep-23

RECEIVED DATE : 11-Sep-23



CERTIFICATE No : 23M8800

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : GR-200  
MANUFACTURER : AND S/N : 14243876  
ID No : EQL-130 RECEIVED DATE : 11-Sep-23  
AIR PRESSURE : 1011mbar  $\pm$  1mbar CALIBRATION DATE : 11-Sep-23  
AMBIENT TEMPERATURE : 24° C  $\pm$  1° C RELATIVE HUMIDITY : 50 %RH  $\pm$  10 % RH

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

### 2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD WEIGHT SET	E2	QK-I-151	M2302013S	02-Feb-25
2) STANDARD WEIGHT	E2	15843	M2302014S	02-Feb-25

3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

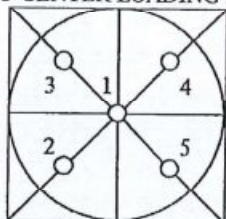
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY ( $\pm$ g)
0.0	0.0000	0.0000	0.000082
0.1	0.1000	0.0000	0.000083
0.2	0.2000	0.0000	0.000083
0.5	0.5000	0.0000	0.000083
1.0	1.0000	0.0000	0.000084
2.0	2.0000	0.0000	0.000084
5.0	5.0000	0.0000	0.000086
10.0	10.0000	0.0000	0.000089
20.0	20.0000	0.0000	0.000094
50.0	50.0000	0.0000	0.00012
100.0	100.0000	0.0000	0.00019
200.0	200.0000	0.0000	0.00032

### 5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	100.0000
2	100.0001
3	100.0001
4	99.9999
5	100.0001
OFF-CENTER LOADING	0.0001

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR  $k=2$ , PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



CERTIFICATE No : 23M11118  
REFERENCE No : 71188-2

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE  
MANUFACTURER : SARTORIUS  
MODEL : BCA3202I-1S  
SERIAL No : 0039407364  
ID No : EQL-257  
CONDITION AS RECEIVED : USED ITEM  
SUBMITTED BY : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD.,  
SAMAEDAM, BANGKHUNTHIAN, BANGKOK  
10150

CALIBRATED BY : PRASERT D.

CALIBRATION DATE : 09-Nov-23

APPROVED BY :   
PONGSAK J.

ISSUED DATE : 13-Nov-23

RECEIVED DATE : 09-Nov-23





CERTIFICATE No : 23M11118

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : BCA3202I-1S  
MANUFACTURER : SARTORIUS S/N : 0039407364  
ID No : EQL-257 RECEIVED DATE : 09-Nov-23  
AIR PRESSURE : 1010mbar  $\pm$  1mbar CALIBRATION DATE : 09-Nov-23  
AMBIENT TEMPERATURE : 23°C  $\pm$  1°C RELATIVE HUMIDITY : 49 %RH  $\pm$  10 % RH

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS NOT ADJUSTED BEFORE CALIBRATION. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

### 2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD WEIGHT SET	---	0094-51	23M1296	07-Feb-24
2) STANDARD WEIGHT	---	QK-I-009	23M1297	07-Feb-24
3) STANDARD WEIGHT	---	QK-I-010	M2302003S	01-Feb-25

3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND)

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

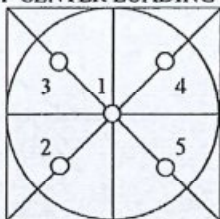
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 2500 g WAS 0 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY ( $\pm$ g)
0.0	0.00	0.00	0.012
10.0	10.00	0.00	0.012
20.0	20.00	0.00	0.012
50.0	50.00	0.00	0.012
100.0	100.00	0.00	0.012
200.0	200.00	0.00	0.012
500.0	500.00	0.00	0.012
700.0	700.00	0.00	0.012
1000.0	1000.00	0.00	0.012
2000.0	2000.00	0.00	0.012
3000.0	3000.00	0.00	0.012

### 5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	1000.00
2	1000.00
3	1000.00
4	1000.00
5	1000.00
OFF-CENTER LOADING	0.00

NOTE : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR  $k=2$ , PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT





# Certificate of Calibration

<b>Equipment:</b>	Balance	<b>Certificate No.:</b>	C01232449
<b>Model:</b>	BCA224I-1S	<b>Issued Date:</b>	08 July 2023
<b>Serial No. (or ID.):</b>	0043402017 (EQL - 268)	<b>Job No.:</b>	KSPR2310693
<b>Manufacturer:</b>	Sartorius	<b>Page:</b>	1 of 2
<b>Condition:</b>	New		

**Customer:** TEST TECH CO., LTD.  
30,32 Rama II Soi 63, Rama II Rd.,  
Samaedam, Bangkhuntien Bangkok 10150 Thailand.

**Environment Condition:** Temperature 23 °C ± 0.4 °C  
Humidity 59 %RH ± 4.2 %RH

**Calibration Place:** TEST TECH CO., LTD. ( 302 Room )  
30,32 Rama II Soi 63, Rama II Rd.,  
Samaedam, Bangkhuntien Bangkok 10150 Thailand.

**Calibration By:** Mr. Hattapong Pumnil

**Calibration Date:** 07 July 2023

**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. C02220533



(Mr. Hattapong Pumnil)

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.

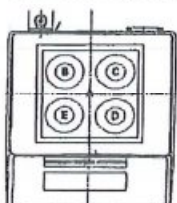
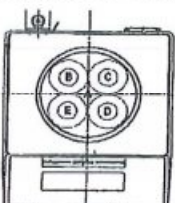
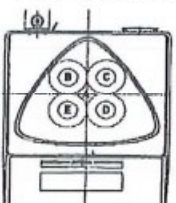
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor ( $k=2$ ) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

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.

### 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	
-	0.0000	0.0000	-0.0001	-0.0001	

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

Nominal test value (g)	Standard Deviation
20	0.00004
200	0.00005

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
0.001	0.00100	0.0010	0.0000	0.00010	2.03
0.01	0.01000	0.0100	0.0000	0.00010	2.03
0.1	0.10001	0.1000	0.0000	0.00010	2.03
0.5	0.50000	0.5000	0.0000	0.00010	2.03
1	1.00001	1.0000	0.0000	0.00010	2.03
2	2.00002	2.0000	0.0000	0.00010	2.03
5	5.00002	5.0000	0.0000	0.00011	2.03
10	10.00002	10.0000	0.0000	0.00011	2.03
20	20.00000	20.0000	0.0000	0.00011	2.02
25	25.00003	25.0000	0.0000	0.00012	2.02
50	49.99996	50.0000	0.0000	0.00013	2.01
100	100.00002	100.0000	0.0000	0.00017	2.00
120	120.00002	120.0000	0.0000	0.00021	2.00
150	149.99998	150.0000	0.0000	0.00023	2.00
200	200.00004	200.0000	0.0000	0.00029	2.00

### The End of Certificate

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด  
 DKSH Technology Limited  
 2533 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260  
 2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260  
 Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand



# Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.

Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100

Bangkok Tel : +668 9205 6851 , +669 8247 2360

Website : www.scieco.co.th

E-Mail : calibrate@scg.com



Certificate No. T230022

Page 1 of 4

## Certificate of Calibration

**Equipment** : Chamber ( Cooling Room )

**Manufacturer** : -

**Model** : -

**Serial No.** : -

**Customer Code** : EQL-167

**ID No.** : T1447A1

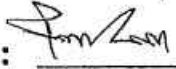
**Customer** : Test Tech Co.,Ltd

30, 32 Rama II Soi 63, Rama II Rd., Samaedam,  
Bangkhunthian Bangkok 10150

**Customer Location** : LABORATORY FLOOR 3

**Date of Receipt** : 13 January 2023

**Calibrated By** : Sujjar Naknakred ( Site Calibration Manager )

**Approved By** :  / Boonchai Suriyawong (Site Calibration Manager)

**Date of Issue** : 24 JAN 2023

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which 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 standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.



# Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.



Certificate No. T230022

Page 2 of 4

## Calibration Report

Equipment : Chamber ( Cooling Room )  
Date of Calibration : 18 January 2023  
Environment : Temperature : 25.0-27.2 °C  
Line Voltage : 221.9-227.3 V  
Relative Humidity : 55 - 65 %RH

### Condition of this results of calibration :

1. This equipment was calibrated by insert nine standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20 ( based on ASTM E145-94 ( Reapproved 2001) and AS2853-1986 ).  
All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

### 2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN141-TN150	T222123	5 October 2023
TC	TYPE T	TN151-TN160	T222123	5 October 2023
DATA LOGGER	34970A	T150	T222123	5 October 2023

### 3. This certificate is traceable to :

National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TISI-TIS 17025 CALIBRATION 0244.)

### 4. Condition of calibrated item : good

#### Equipment Description :

Time Constant 2 Hour 8 Minute At 3 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

### 5. Adjustment :

( ) without adjustment

( X ) after adjustment

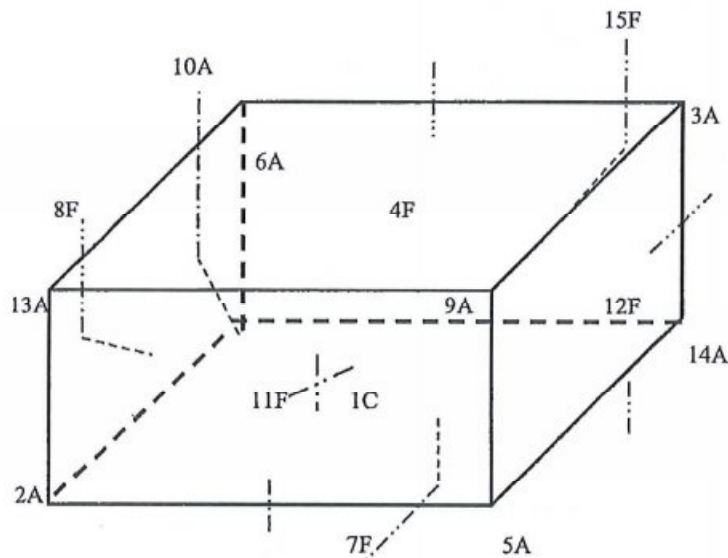
Approved By.



Certificate No. T230022

Page 3 of 4

## Calibration Report



C = Centre , F = Centre of Face , A = Corner , E = Centre of Edge

1C	=	TN141
2A	=	TN142
3A	=	TN143
4F	=	TN144
5A	=	TN145
6A	=	TN146
7F	=	TN147
8F	=	TN148
9A	=	TN149
10A	=	TN150

11F	=	TN151
12F	=	TN152
13A	=	TN153
14A	=	TN154
15F	=	TN155

Approved By. Sam Lani

Certificate No. T230022

Page 4 of 4

## Calibration Report

**Measurement Results:**

Average Standard Reading at each position (°C)										
Calibration Point	TN141	TN142	TN143	TN144	TN145	TN146	TN147	TN148	TN149	TN150
3	2.93	2.77	2.79	2.26	3.04	3.39	2.91	3.05	3.54	2.95
	TN151	TN152	TN153	TN154	TN155					
	3.32	3.28	3.00	2.96	2.90					

Chamber ( Cooling Room )			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (±°C)	Uniformity (°C)	Uncertainty (±°C)	Coverage Factor <i>k</i>
	Min , Max	Average					
3.0	2.9 , 3.1	3.0	3.01	0.47	1.04	0.98	2.00

\* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor *k* which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By. 



# Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.

Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100

Bangkok Tel : +668 9205 6851 , +669 8247 2360

Website : www.scieco.co.th E-Mail : calibrate@scg.com



Certificate No. T230121

Page 1 of 4

## Certificate of Calibration

**Equipment** : Chamber ( Cooling Room )

**Manufacturer** : -

**Model** : -

**Serial No.** : -

**Customer Code** : EQL-181

**ID No.** : T0399A5

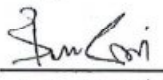
**Customer** : Test Tech Co.,Ltd

30, 32 Rama II Soi 63, Rama II Rd., Samaedam,  
Bangkhunthian Bangkok 10150

**Customer Location** : LABORATORY FLOOR 4

**Date of Receipt** : 26 January 2023

**Calibrated By** : Sujjar Naknakred ( Site Calibration Manager )

**Approved By** :  / Boonchai Suriyawong (Site Calibration Manager)  
01 FEB 2023

**Date of Issue** : \_\_\_\_\_

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which 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 standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.



# Metrological Center

SCI ECO Services Company Limited

33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.



Certificate No. T230121

Page 2 of 4

## Calibration Report

Equipment : Chamber ( Cooling Room )  
Date of Calibration : 30 January 2023  
Environment : Temperature : 25.0-27.2 °C  
Line Voltage : 221.9-227.3 V  
Relative Humidity : 55 - 65 %RH

### Condition of this results of calibration :

1. This equipment was calibrated by insert nine standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20 ( based on ASTM E145-94 ( Reapproved 2001) and AS2853-1986 ).  
All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .

### 2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN141-TN150	T222123	5 October 2023
TC	TYPE T	TN151-TN160	T222123	5 October 2023
DATA LOGGER	34970A	T150	T222123	5 October 2023

### 3. This certificate is traceable to :

National Institute of Metrology ( Thailand ) through Metrological Center ( NSC-TISI-TIS 17025 CALIBRATION 0244.)

### 4. Condition of calibrated item : good

#### Equipment Description :

Time Constant 1 Hour 30 Minute At 3 °C  
Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max  
☐ Close  
☒ Not Available

### 5. Adjustment :

( ) without adjustment

( X ) after adjustment

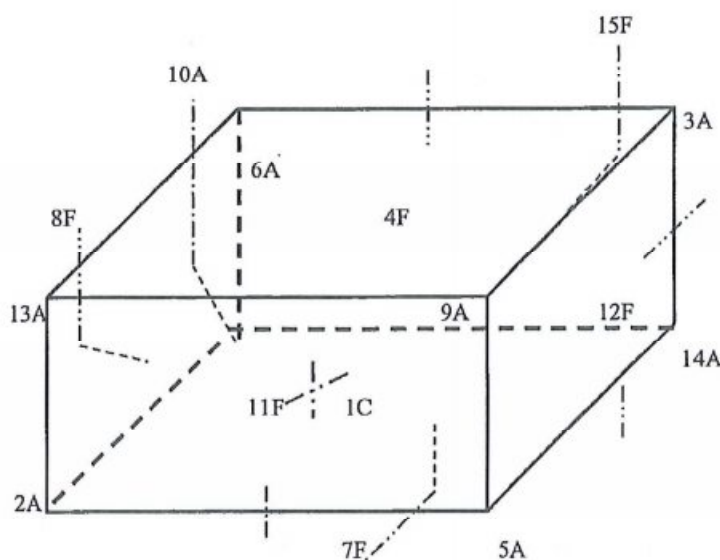
Approved By



Certificate No. T230121

Page 3 of 4

## Calibration Report



C = Centre , F = Centre of Face , A = Corner , E = Centre of Edge

1C	=	TN141
2A	=	TN142
3A	=	TN143
4F	=	TN144
5A	=	TN145
6A	=	TN146
7F	=	TN147
8F	=	TN148
9A	=	TN149
10A	=	TN150

11F	=	TN151
12F	=	TN152
13A	=	TN153
14A	=	TN154
15F	=	TN155

Approved By. Bm Loi

Certificate No. T230121

Page 4 of 4

## Calibration Report

**Measurement Results:**

Average Standard Reading at each position (°C)										
Calibration Point	TN141	TN142	TN143	TN144	TN145	TN146	TN147	TN148	TN149	TN150
3	2.84	2.89	3.01	3.07	3.13	3.19	3.04	2.99	3.15	2.94
	TN151	TN152	TN153	TN154	TN155					
	2.99	2.99	3.14	2.85	2.88					

Chamber ( Cooling Room )			Temperature Distribution				
S. g (°C)	Reading (°C)		Average (°C)	Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage
	Min , Max	Average					Factor <i>k</i>
3.0	2.8 , 3.1	3.0	3.01	0.48	0.93	0.99	2.00

\* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor *k* which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By. \_\_\_\_\_



**QUALITY CALIBRATION CO.,LTD.**

235 Petchkasem 63/2 Road, Laksong, Bangkoe, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com

CERTIFICATE No : 23T6749  
REFERENCE No : 69853-3

PAGE : 1 OF 2

**Certificate of Calibration**

**EQUIPMENT** : INCUBATOR

**MANUFACTURER** : MEMMERT

**MODEL** : INB 400

**SERIAL No** : E405.0946

**ID No** : EQL-087

**CONDITION AS RECEIVED** : USED ITEM

**SUBMITTED BY** : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKHUNTHIAN, BANGKOK 10150

**CALIBRATED BY** : CHAICHARN CH.

**CALIBRATION DATE** : 10-Jul-23

**APPROVED BY** :   
PONGSAK J.

**ISSUED DATE** : 17-Jul-23

**RECEIVED DATE** : 10-Jul-23



# QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

CERTIFICATE No : 23T6749

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : INCUBATOR  
MANUFACTURER : MEMMERT  
MODEL : INB 400  
ID No : EQL-087  
RECEIVED DATE : 10-Jul-23  
AMBIENT TEMPERATURE : 24 °C ± 1 °C  
S/N : E405.0946  
CALIBRATION DATE : 10-Jul-23  
RELATIVE HUMIDITY : 51 %RH ± 10 %RH

### CONDITION OF THIS RESULTS OF CALIBRATION

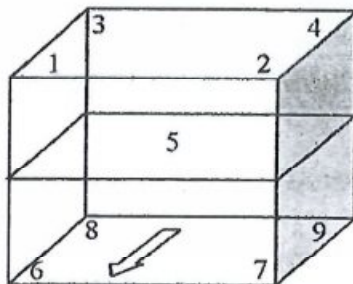
1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED RTD Pt100 UNDER NO LOAD CONDITION. THE TEMPERATURE PROBES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOMETER PROBE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOMETER PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH RTD	HYDRA 2635A	7301307	22T7508	10-Aug-23

3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.  
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.  
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-  
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



FRONT

#### GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 1
Overall Line Voltage (V) variation : 3
Instrument Condition : Normal
Chamber Size (W*L*H): 40*33*40 cm

#### CHAMBER PERFORMANCE

Calibrate Point (°C)	Average All Location (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
44.0	43.96	0.06	0.54	0.71
55.0	55.00	0.05	0.58	0.79
58.0	57.96	0.06	0.69	0.81

#### TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (± °C)
		#1	#2	#3	#4	Ref. 5	#6	#7	#8	#9	
43.5	43.5	43.72	43.78	43.73	43.75	44.22	43.86	44.17	44.06	44.34	0.36
54.5	54.5	54.75	54.78	54.76	54.75	55.30	54.83	55.27	55.07	55.47	0.36
57.5	57.5	57.67	57.74	57.62	57.67	58.28	57.86	58.28	58.11	58.38	0.36

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2: LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k =2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



**QUALITY CALIBRATION CO.,LTD.**

235 Petchkasem 63/2 Road, Laksong, Bangkac, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com

CERTIFICATE No : 23T1387  
REFERENCE No : 68174-5

PAGE : 1 OF 2

**Certificate of Calibration**

**EQUIPMENT** : INCUBATOR  
**MANUFACTURER** : MEMMERT  
**MODEL** : IF 110  
**SERIAL No** : D415.0802  
**Q No** : EQL-190  
**CONDITION AS RECEIVED** : USED ITEM  
**SUBMITTED BY** : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKHUNTHIAN, BANGKOK 10150

**CALIBRATED BY** : PRASERT P.**CALIBRATION DATE** : 13-Feb-23**APPROVED BY** :   
PONGSAK J.**ISSUED DATE** : 14-Feb-23**RECEIVED DATE** : 13-Feb-23



# QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkai, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

CERTIFICATE No : 23T1387

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : INCUBATOR  
MANUFACTURER : MEMMERT  
MODEL : IF 110  
ID No : EQL-190  
RECEIVED DATE : 13-Feb-23  
AMBIENT TEMPERATURE : 24 °C ± 1 °C  
S/N : D415.0802  
CALIBRATION DATE : 13-Feb-23  
RELATIVE HUMIDITY : 50 %RH ± 10 %RH

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED RTD Pt100 UNDER NO LOAD CONDITION. THE TEMPERATURE PROBES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOMETER PROBE 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 THERMOMETER PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

### REFERENCE STANDARD INSTRUMENTS :-

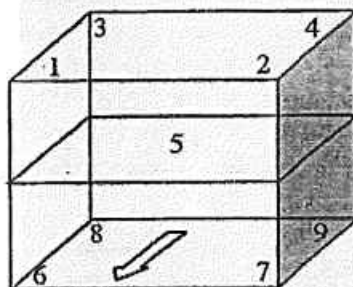
INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH RTD	HYDRA 2635A	6635300	22T7509	10-Jul-23

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-  
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



FRONT

### GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 5
Overall Line Voltage (V) variation : 8
Instrument Condition : Normal
Chamber Size (W*L*H): 56*40*48 cm

### CHAMBER PERFORMANCE

Calibration Point (°C)	Controller Temperature (°C)	Indicating Temperature (°C)	Average All Locations (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
37.0	37.0	37.0	36.93	0.07	0.16	0.26
44.0	44.0	44.0	44.17	0.07	0.22	0.27

### TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (± °C)
		#1	#2	#3	#4	Ref. 5	#6	#7	#8	#9	
37.0	37.0	36.97	36.95	36.94	36.96	36.94	36.92	36.91	36.90	36.84	0.25
44.0	44.0	44.21	44.23	44.09	44.23	44.23	44.13	44.21	44.15	44.07	0.36

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2: LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



**QUALITY CALIBRATION CO.,LTD.**

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com

CERTIFICATE No : 23T1386  
REFERENCE No : 68174-4

PAGE : 1 OF 2

**Certificate of Calibration**

EQUIPMENT : INCUBATOR

MANUFACTURER : MEMMERT

MODEL : IF 160

SERIAL No : D518.0082

No : EQL-205

CONDITION AS RECEIVED : USED ITEM

SUBMITTED BY : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKHUNTHIAN, BANGKOK 10150

CALIBRATED BY : PRASERT P.CALIBRATION DATE : 13-Feb-23APPROVED BY :   
PONGSAK J.ISSUED DATE : 14-Feb-23RECEIVED DATE : 13-Feb-23



# QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkoe, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

CERTIFICATE No : 23T1386

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : INCUBATOR  
MANUFACTURER : MEMMERT  
MODEL : IF 160  
ID No : EQL-205  
RECEIVED DATE : 13-Feb-23  
AMBIENT TEMPERATURE : 24 °C ± 1 °C  
S/N : D518.0082  
CALIBRATION DATE : 13-Feb-23  
RELATIVE HUMIDITY : 50 %RH ± 10 %RH

### CONDITION OF THIS RESULTS OF CALIBRATION

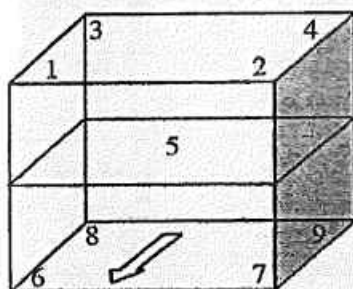
1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED RTD Pt100 UNDER NO LOAD CONDITION. THE TEMPERATURE PROBES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOMETER PROBE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOMETER PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

### REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH RTD	HYDRA 2635A	6635300	22T7509	10-Jul-23

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.  
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.  
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-  
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



FRONT

### GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 2
Overall Line Voltage (V) variation : 9
Instrument Condition : Normal
Chamber Size (W*L*H): 56*40*72 cm

### CHAMBER PERFORMANCE

Calibration Point (°C)	Controller Temperature (°C)	Indicating Temperature (°C)	Average All Locations (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
35.0	35.0	35.0	34.99	0.02	0.14	0.20
36.0	36.0	36.0	36.00	0.03	0.14	0.22
41.5	41.5	41.5	41.46	0.05	0.10	0.19

### TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (± °C)
		#1	#2	#3	#4	Ref. 5	#6	#7	#8	#9	
35.0	35.0	34.91	34.94	34.93	34.93	34.98	35.03	35.08	35.01	35.08	0.25
36.0	36.0	35.93	35.95	35.95	35.94	36.00	36.05	36.10	36.01	36.10	0.25
41.5	41.5	41.46	41.47	41.41	41.47	41.50	41.47	41.45	41.43	41.49	0.36

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2: LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY COVERAGE FACTOR k=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT





# QUALITY CALIBRATION CO.,LTD.

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Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584  
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CERTIFICATE No : 23T1385  
REFERENCE No : 68174-3

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : INCUBATOR  
MANUFACTURER : MEMMERT  
MODEL : IF 160  
SERIAL No : D518.0240  
ID No : EQL-218  
CONDITION AS RECEIVED : USED ITEM  
SUBMITTED BY : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKHUNTHIAN, BANGKOK 10150

CALIBRATED BY : PRASERT P.  
CALIBRATION DATE : 13-Feb-23

APPROVED BY :   
PONGSAK J.

ISSUED DATE : 14-Feb-23

RECEIVED DATE : 13-Feb-23



# QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkai, Bangkok 10160  
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

CERTIFICATE No : 23T1385

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : INCUBATOR  
MANUFACTURER : MEMMERT  
MODEL : IF 160  
ID No : EQL-218  
RECEIVED DATE : 13-Feb-23  
AMBIENT TEMPERATURE : 24 °C ± 1 °C  
S/N : D518.0240  
CALIBRATION DATE : 13-Feb-23  
RELATIVE HUMIDITY : 50 %RH ± 10 %RH

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED RTD Pt100 UNDER NO LOAD CONDITION. THE TEMPERATURE PROBES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOMETER PROBE 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 THERMOMETER PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

REFERENCE STANDARD INSTRUMENTS :-

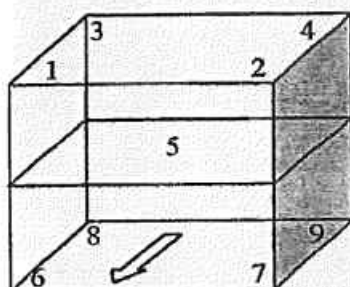
INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH RTD	HYDRA 2635A	6635300	22T7509	10-Jul-23

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-  
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



FRONT

### GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 2
Overall Line Voltage (V) variation : 12
Instrument Condition : Normal
Chamber Size (W*L*H): 56*40*72 cm

### CHAMBER PERFORMANCE

Calibration Point (°C)	Controller Temperature (°C)	Indicating Temperature (°C)	Average All Locations (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
35.0	35.0	35.0	35.00	0.05	0.15	0.26
36.0	36.0	36.0	36.00	0.04	0.16	0.26

### TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (± °C)
		#1	#2	#3	#4	Ref. 5	#6	#7	#8	#9	
35.0	35.0	34.94	34.98	34.93	34.97	35.07	35.10	34.94	35.04	35.05	0.25
36.0	36.0	35.94	35.97	35.92	35.96	36.07	36.11	35.95	36.05	36.05	0.25

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT

**QUALITY CALIBRATION CO.,LTD.**

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

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PAGE : 1 OF 2

CERTIFICATE No : 23T1384  
REFERENCE No : 68174-2**Certificate of Calibration**

EQUIPMENT : INCUBATOR  
MANUFACTURER : MEMMERT  
MODEL : IF 160  
SERIAL No : D519.0140  
D No : EQL-231  
CONDITION AS RECEIVED : USED ITEM  
SUBMITTED BY : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKHUNTHIAN, BANGKOK 10150

CALIBRATED BY : PRASERT P.  
CALIBRATION DATE : 13-Feb-23

APPROVED BY :   
PONGSAK J.

ISSUED DATE : 14-Feb-23

RECEIVED DATE : 13-Feb-23

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF  
QUALITY CALIBRATION CO., LTD.

F-G010 REV : 02





# QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

CERTIFICATE No : 23T1384

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : INCUBATOR  
MANUFACTURER : MEMMERT  
MODEL : IF 160  
ID No : EQL-231  
RECEIVED DATE : 13-Feb-23  
AMBIENT TEMPERATURE : 24 °C ± 1 °C  
S/N : D519.0140  
CALIBRATION DATE : 13-Feb-23  
RELATIVE HUMIDITY : 50 %RH ± 10 %RH

### CONDITION OF THIS RESULTS OF CALIBRATION

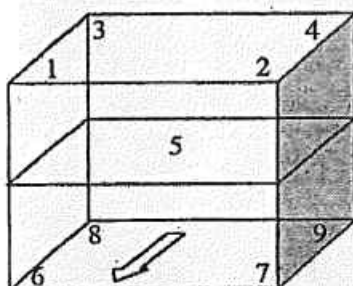
1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED RTD Pt100 UNDER NO LOAD CONDITION. THE TEMPERATURE PROBES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOMETER PROBE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOMETER PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH RTD	HYDRA 2635A	6635300	22T7509	10-Jul-23

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.  
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.  
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-  
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



FRONT

### GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 2
Overall Line Voltage (V) variation : 8
Instrument Condition : Normal
Chamber Size (W*L*H): 56*40*72 cm

### CHAMBER PERFORMANCE

Calibration Point (°C)	Controller Temperature (°C)	Indicating Temperature (°C)	Average All Locations (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
35.0	35.0	35.0	35.03	0.08	0.17	0.32
37.0	37.0	37.0	37.02	0.08	0.22	0.32
41.5	41.5	41.5	41.54	0.04	0.13	0.20

### TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (± °C)
		#1	#2	#3	#4	Ref. 5	#6	#7	#8	#9	
35.0	35.0	34.92	35.02	34.99	35.01	35.04	35.03	35.06	35.09	35.10	0.25
37.0	37.0	37.00	36.99	36.95	36.95	37.00	37.02	37.09	37.07	37.11	0.25
41.5	41.5	41.52	41.51	41.47	41.49	41.54	41.53	41.62	41.58	41.56	0.36

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k =2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT






# PinAAcle 900F Preventive Maintenance Report

Company Name: TEST TECH CO., LTD  
Instrument Location: 30,32 Rama II Soi 63 Rama II Road.  
Samaedam, Bankhuntien, Bangkok, 10510  
Instrument Serial No.: PFBS21091601  
Date: 27-Feb-2023

## ***PinAAcle 900F Preventive Maintenance (PM)***

Company Name:	TEST TECH CO., LTD		
Address (Instrument Location):	30,32 Rama II Soi 63 Rama II Road. Samaedam, Bangkhuntien, Bangkok, 10510		
Serial Number:	PFBS21091601	PM Number:	2/2
Customer Name (if applicable):	K. AOYJAI	Telephone Number:	02-877-3271
Customer Support Engineer Name:	K. DUANG	Service Order Number:	-
Date PM Performed: (DD-MMM-YYYY)	27-Feb-2023	Next PM Due Date: (DD-MMM-YYYY)	27-Feb-2024
Standard Labor Hours to Complete PM:		5 hours	

Part Number	Release	Publication Date	
09370145 Rev.9	A	January 2018	

### **Scope**

The purpose of this PM is to ensure the continued functionality of the PinAAcle 900F 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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PerkinElmer shall not be liable for incidental or consequential damages in connection with the furnishing or use of this document.

## 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
N3160156	O-Ring Kits for Sampling Introduction ( Stainless Steels Nebulizer)	N/A
N3160157	O-Ring Kits for Sampling Introduction ( Plastic Nebulizer)	N/A
N9301714	Replacement Acetylene Filter Cartridge	N/A
TH001022	Replacement Air Filter Cartridge	N/A

Additional Reagents and Standards Required for PM				
Part Number (if applicable)	Description	Quality	Batch/Lot #	Expired Date (MM/YY)
N9300183	1000 mg/L Copper Standard	AR		

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 #
N1013000	0.2A Neutral density filter	1	MG0-252
N1013002	1.0A Neutral density filter	1	MG0-358
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



## 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 lines for leaks and/or wear. Replace if needed.
- ☒ Clean exterior of the instrument.
- ☒ Inspect the burner head, burner chamber, and nebulizer. Clean if needed as stated in the Hardware Guide.
- ☒ Check burner head dimensions with the feeler gauge as stated in the Hardware Guide in the Maintenance chapter section on cleaning the burner head and checking sloth width. Replace if out of specification
- ☒ Check the condition of the end cap, burner head, and nebulizer O-rings. Replace if necessary.
- ☒ Check the drain system for signs of wear. Replace worn or damaged parts.
- ☒ Visually check for proper flame conditions when igniting the Air-C<sub>2</sub>H<sub>2</sub> and N<sub>2</sub>O-C<sub>2</sub>H<sub>2</sub> flames (if applicable).

### 4. Electrical:

- ☒ Inspect PC boards. Clean if necessary.
- ☒ Carefully check all internal and external cable connections.
- ☒ 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 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 acetylene filter and air filter element is dry. Replace if necessary.

## 7. Flame Interlock Check:

Description: Check to ensure that all safety interlocks are closed.

Parameter	Specification	Test Results	Pass/Fail
Flame Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Drain Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Nebulizer Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
C <sub>2</sub> H <sub>2</sub> Pressure Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Air Pressure Sensor	Air/C <sub>2</sub> H <sub>2</sub> Flame correctly shuts down	Active	Passed
Burner Head Sensor	Choosing Nitrous Oxide as the oxidant should trigger an interlock shuts down	Active	Passed

## 8. After PM Performance tests:

### 8.1 Detector Linearity with Barium

Description: Ensures that the detector is linear in the Visible Range.

Parameter	Specification	Certificate Value at 553.6 nm (Abs.)	Test Results	Pass/Fail
1.0 A ND Filter	± 5% from Cert.	0.9798	0.9796	Passed
0.2 A ND Filter	± 5% from Cert.	0.2042	0.2015	Passed

### 8.2 Baseline Noise at 1.0 Absorbance with Barium

Description: Ensures that a high absorbance will not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0010	Passed

### 8.3 AA Baseline Noise with Copper

Description: Check baseline noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.001	0.0001	Passed

#### 8.4 D<sub>2</sub> Background Compensation with Copper

Description: Verifies the instruments ability to compensate for Background absorption.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	$\leq 0.010$	0.0084	Passed

#### 8.5 AA-BG Baseline Noise with Copper

Description: Ensures that background correction does not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	$\leq 0.005$	0.0001	Passed

#### 8.6 AA-BG Baseline Noise with Arsenic

Description: Ensures that background correction does not produce excessive noise at a low wavelength.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	$\leq 0.005$	0.0003	Passed

#### 8.7 Flame Sensitivity

Description: Instrument Sensitivity checked against Copper standard.

Standard Copper Sensitivity	Specification	Results (Abs.)	Pass/Fail
5 mg/L Sensitivity SS Neb (if applicable)	$> 0.250$ Abs.	NA	Not Applicable
2 mg/L Sensitivity HS Neb (if applicable)	$> 0.250$ Abs.	0.3313	Passed

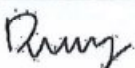

#### 10. Review:

- ☒ 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	
<b>PERFORMANCE TEST FOR FIAS</b>	
1. Characteristics mass for Mercury. (500 ul of 10 ug/l for Hg And 5 replicates). Characteristic Mass %RSD.	0.0693 Abs. 317.5 pg/0.0044 Abs.  2.02%
2. Characteristics mass for Arsenic. (500 ul of 10 ug/l for As And 5 replicates). Characteristic Mass %RSD.	0.1670 Abs. 131.7 pg/0.0044 Abs  2.42%
3. Characteristics mass for Serenium. (500 ul of 10 ug/l for Se And 5 replicates). Characterlstic Mass %RSD	0.2597 Abs. 84.7 pg/0.0044 Abs.  2.95%
 <b>Wavelength Accuracy Check</b>	
As 193.70 nm +/- 0.3 nm	193.70
Cu 324.75 nm +/- 0.3 nm	324.70
Ba 553.55 nm +/- 0.3 nm	553.60
K 766.49 nm +/- 0.3 nm	766.50

## Review

<i>The preventive maintenance checks and if applicable performance tests for PinAAcle 900F have been completed.</i>	
This PinAAcle 900F Passes <input checked="" type="checkbox"/> Fails <input type="checkbox"/> the preventive maintenance.	
<b>Review of Preventive Maintenance:</b>	
Authorized PerkinElmer Representative:	<div style="text-align: center;">  </div> <div style="text-align: right;"> Date: 27-Feb-2023 <small>(DD-MMM-YYYY)</small> </div>
Authorized Customer Representative:	<div style="text-align: center;">  </div> <div style="text-align: right;"> Date: 27-Feb-2023 <small>(DD-MMM-YYYY)</small> </div>





CERTIFICATE No : 23T8796  
REFERENCE No : 70515-4

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : WATER BATH  
MANUFACTURER : MEMMERT  
MODEL : WNE 45  
SERIAL No : L720.0266  
ID No : EQL-241  
CONDITION AS RECEIVED : USED ITEM  
SUBMITTED BY : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKHUNTHIAN, BANGKOK 10150

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 16-Aug-23

APPROVED BY :  RONGSAK J.

ISSUED DATE : 16-Aug-23

RECEIVED DATE : 16-Aug-23



# QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkac, Bangkok 10160

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CERTIFICATE No : 23T8796

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : WATER BATH  
MANUFACTURER : MEMMERT  
ID NUMBER : EQL-241  
RECEIVED DATE : 16-Aug-23  
AMBIENT TEMPERATURE : 25 °C ± 1 °C  
MODEL : WNE 45  
SERIAL NUMBER : L720.0266  
CALIBRATION DATE : 16-Aug-23  
RELATIVE HUMIDITY : 50 %RH ± 10 % RH

### CONDITION OF THIS RESULTS OF CALIBRATION

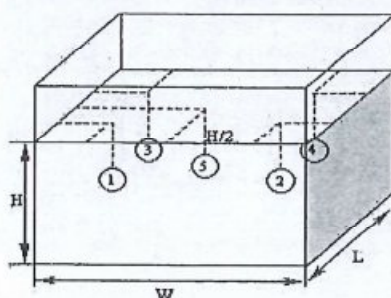
1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO ASTM E715-80 (REAPPROVED 2001) BY COMPARISON WITH CALIBRATED RTD. THE PROBES WERE PLACED ON FIVE POINTS AND LOCATED ONE PROBE IN EACH OF THE FOUR CORNERS OF THE BATH AND PLACED THE FIFTH RTD WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE WATER VOLUME (REFERENCE LOCATION) UNDER NO LOAD CONDITION.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH RTD	2625A	6603614	23T6642	19-Jul-24

3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.  
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.  
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-  
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

### RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



PROBE INSTALLATION  
POSITION IN THE BATH

### GENERAL INFORMATION

Overall Variation of Ambient Temperature around the Bath (°C) : 0.6
Overall Variation of Line Voltage (V) : 3
Instrument Condition : Normal
Bath Inner Size (W*L*H) : 59*35*20 cm

### BATH PERFORMANCE

Calibrate Point (°C)	Average All Position Temp. (±°C)	Temperature Stability (±°C)	Radius Uniformity (°C)	Axial Uniformity (°C)	Overall Variation (°C)
83.0	83.09	0.05	0.07	0.05	0.16
92.0	92.13	0.11	0.06	0.06	0.28

### TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations					Uncertainty (± °C)
		#1	#2	#3	#4	Ref. 5	
83.0	83.0	83.08	83.09	83.06	83.11	83.12	0.15
92.0	92.0	92.11	92.13	92.10	92.16	92.16	0.19

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE BATH.

NOTE 2 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR  $k=2$ , PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT

F-G010 REV : 03

**QUALITY CALIBRATION CO.,LTD.**

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CERTIFICATE No : 23T6748  
REFERENCE No : 69853-2

PAGE : 1 OF 2

**Certificate of Calibration**

**EQUIPMENT** : WATER BATH

**MANUFACTURER** : MEMMERT

**MODEL** : WPE 45

**SERIAL No** : L711.0024


**ID No** : EQL-147

**CONDITION AS RECEIVED** : USED ITEM

**SUBMITTED BY** : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKHUNTHIAN, BANGKOK 10150

**CALIBRATED BY** : CHAICHARN CH.

**CALIBRATION DATE** : 10-Jul-23

**APPROVED BY** :   
PONGSAK J.

**ISSUED DATE** : 17-Jul-23

**RECEIVED DATE** : 10-Jul-23

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CERTIFICATE No : 23T6748

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : WATER BATH  
MANUFACTURER : MEMMERT  
ID NUMBER : EQL-147  
RECEIVED DATE : 10-Jul-23  
AMBIENT TEMPERATURE : 24 °C ± 1 °C  
MODEL : WPE 45  
SERIAL NUMBER : L711.0024  
CALIBRATION DATE : 10-Jul-23  
RELATIVE HUMIDITY : 53 %RH ± 10 % RH

### CONDITION OF THIS RESULTS OF CALIBRATION

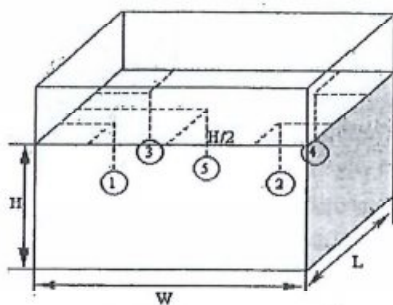
1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO ASTM E715-80 (REAPPROVED 2001) BY COMPARISON WITH CALIBRATED RTD. THE PROBES WERE PLACED ON FIVE POINTS AND LOCATED ONE PROBE IN EACH OF THE FOUR CORNERS OF THE BATH AND PLACED THE FIFTH RTD WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE WATER VOLUME (REFERENCE LOCATION) UNDER NO LOAD CONDITION.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH RTD	2625A	6603614	22T7514	05-Aug-23

3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.  
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.  
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-  
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

**RESULT OF CALIBRATION :-** WITHOUT ADJUSTMENT



PROBE INSTALLATION  
POSITION IN THE BATH

### GENERAL INFORMATION

Overall Variation of Ambient Temperature around the Bath (°C) : 1.4
Overall Variation of Line Voltage (V) : 3
Instrument Condition : Normal
Bath Inner Size (W*L*H) : 59*35*22 cm

### BATH PERFORMANCE

Calibrate Point (°C)	Temperature Stability (±°C)	Average All Location (±°C)	Radius Uniformity (°C)	Axial Uniformity (°C)	Overall Variation (°C)
41.5	0.03	41.49	0.03	0.02	0.07
44.5	0.04	44.50	0.02	0.01	0.11

### TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations					Uncertainty (± °C)
		#1	#2	#3	#4	Ref. 5	
41.5	41.5	41.48	41.50	41.49	41.51	41.48	0.14
44.5	44.5	44.50	44.51	44.50	44.49	44.51	0.14

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE BATH.

NOTE 2 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY COVERAGE FACTOR k =2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



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CERTIFICATE No : 23T6747

REFERENCE No : 69853-1

PAGE : 1 OF 2

**Certificate of Calibration**

**EQUIPMENT** : WATER BATH

**MANUFACTURER** : N/A

**MODEL** : N/A

**SERIAL No** : N/A

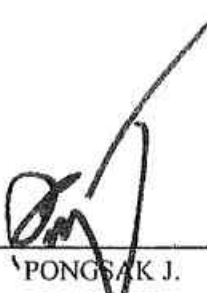
**ID No** : EQL-046

**CONDITION AS RECEIVED** : USED ITEM

**SUBMITTED BY** : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKHUNTHIAN, BANGKOK 10150

**CALIBRATED BY** : CHAICHARN CH.

**CALIBRATION DATE** : 10-Jul-23

**APPROVED BY** :   
PONGSAK J.

**ISSUED DATE** : 17-Jul-23

**RECEIVED DATE** : 10-Jul-23

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QUALITY CALIBRATION CO., LTD.



# QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com

CERTIFICATE No : 23T6747

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : WATER BATH  
MANUFACTURER : N/A  
ID NUMBER : EQL-046  
RECEIVED DATE : 10-Jul-23  
AMBIENT TEMPERATURE : 24 °C ± 1 °C  
MODEL : N/A  
SERIAL NUMBER : N/A  
CALIBRATION DATE : 10-Jul-23  
RELATIVE HUMIDITY : 53 %RH ± 10 % RH

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO ASTM E715-80 (REAPPROVED 2001) BY COMPARISON WITH CALIBRATED RTD. THE PROBES WERE PLACED ON FIVE POINTS AND LOCATED ONE PROBE IN EACH OF THE FOUR CORNERS OF THE BATH AND PLACED THE FIFTH RTD WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE WATER VOLUME (REFERENCE LOCATION) UNDER NO LOAD CONDITION.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
DATA LOGGER WITH RTD	2625A	6603614	22T7514	05-Aug-23

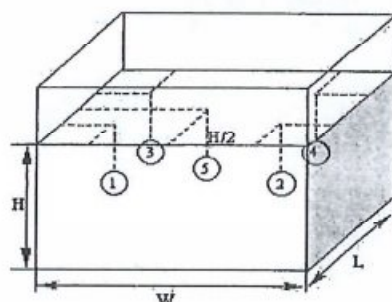
3. THE CERTIFICATE IS VALID FOR THE ITEM CALIBRATED AS SHOWN ON THE DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

**RESULT OF CALIBRATION :-** WITHOUT ADJUSTMENT



PROBE INSTALLATION  
POSITION IN THE BATH

### GENERAL INFORMATION

Overall Variation of Ambient Temperature around the Bath (°C) : 2.3

Overall Variation of Line Voltage (V) : 10

Instrument Condition : Normal

Bath Inner Size (W\*L\*H) : 45\*33\*13 cm

### BATH PERFORMANCE

Calibrate Point (°C)	Temperature Stability (±°C)	Average All Location (±°C)	Radius Uniformity (°C)	Axial Uniformity (°C)	Overall Variation (°C)
44.5	0.04	44.52	0.01	0.02	0.08
45.0	0.01	45.04	0.01	0.02	0.03
50.0	0.06	49.99	0.01	0.02	0.14

### TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations					Uncertainty (± °C)
		#1	#2	#3	#4	Ref. 5	
44.5	44.5	44.52	44.52	44.52	44.52	44.52	0.14
45.0	45.0	45.04	45.04	45.04	45.04	45.04	0.14
50.0	50.0	49.99	49.99	49.98	49.98	49.99	0.15

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE BATH.

NOTE 2 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT

**QUALITY CALIBRATION CO.,LTD.**

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CERTIFICATE No : 23T1391  
REFERENCE No : 68175-1

PAGE : 1 OF 2

**Certificate of Calibration**

**EQUIPMENT** : AUTOCLAVE

**MANUFACTURER** : HIRAYAMA

**MODEL** : HVE-50

**SERIAL No** : 30612085166

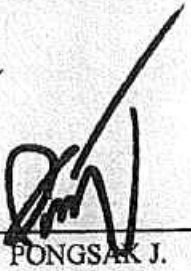
**No** : EQL-155

**CONDITION AS RECEIVED** : USED ITEM

**SUBMITTED BY** : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD.,  
SAMAEDAM, BANGKHUNTHIAN, BANGKOK  
10150

**CALIBRATED BY** : PRASERT P.

**CALIBRATION DATE** : 13-Feb-23

**APPROVED BY** :   
PONGSAK J.

**ISSUED DATE** : 14-Feb-23

**RECEIVED DATE** : 13-Feb-23

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF  
QUALITY CALIBRATION CO., LTD.

F-G010 REV : 02





# QUALITY CALIBRATION CO.,LTD.

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CERTIFICATE No : 23T1391

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : AUTOCLAVE  
MANUFACTURER : HIRAYAMA  
ID NUMBER : EQL-155  
RECEIVED DATE : 13-Feb-23  
AMBIENT TEMPERATURE : 30° C ± 1° C  
MODEL : HVE-50  
SERIAL NUMBER : 30612085166  
CALIBRATION DATE : 13-Feb-23  
RELATIVE HUMIDITY : 50 %RH ± 10 % RH

### CONDITION OF THIS RESULTS OF CALIBRATION

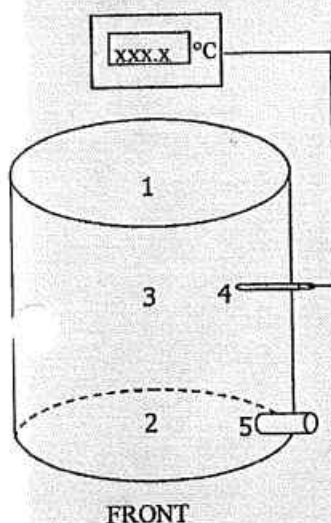
1. THIS INSTRUMENT WAS CALIBRATED BASED ON BS 2646 : Part 5 : 1993 BY COMPARISON WITH CALIBRATED THERMOCOUPLE TYPE K UNDER NO LOAD CONDITION. THE THERMOCOUPLES WERE PLACED ON FIVE LOCATIONS AS SHOWN IN THE PICTURE. TWO PROBES WERE PLACES NEAR TOP AND BOTTOM WALL AND EACH PROBE WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE THIRD PROBE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE INSTRUMENT CHAMBER. PROBE NUMBER 4 WAS ATTACHED TO THE LOAD TEMPERATURE PROBE, IF FITTED, WITHIN 20 mm OF ITS TIP. PROBE NUMBER 5 WAS PLACED IN THE CHAMBER DRAIN OR VENT WITHIN 100 mm OF ITS CONNECTION TO THE CHAMBER.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER	VALPROBE	S350, DV35, DN94	23T0885	27-Jan-24

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.  
4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.  
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-  
- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



### GENERAL INFORMATION

Overall Ambient Temperature around the Chamber variation : 1.2 °C  
Autoclave Condition : Normal  
Chamber Size (Diameter\*H): 30 \* 71 cm

### CHAMBER PERFORMANCE

Controller Temperature (°C)	Average All Locations (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)	Pressure (MPa)	Holding time (min)	Operating Cycle time (min)
116	116.48	0.09	0.10	0.27	0.090	15	60
122	122.43	0.09	0.13	0.27	0.130	15	60

### TEMPERATURE MEASUREMENT ACCURACY TEST(° C)

Cont Temp	Ind Temp	Measured Temperature (°C) at Spread Locations					Uncertainty (± °C)
		#1	#2	#3	#4	#5	
116	116	116.45	116.50	116.53	116.45	116.45	0.59
122	122	122.40	122.46	122.50	122.39	122.39	0.59

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT OF TEMPERATURE MEASUREMENT ACCURACY TEST EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : THE STABILITY TERM IN THE UNCERTAINTY BUDGET WAS REPLACED BY THE STANDARD REPEATABILITY.

NOTE 3 : LOCATION 3 WAS REFERENCE LOCATION.

NOTE 4 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT

F-G010 REV : 0



# Certificate of Calibration

Number of Page(s) 1 of 3

<b>Certificate No.</b>	BSCC-UV-163/23
<b>Equipment</b>	UV/Vis Spectrophotometer
<b>Model</b>	UV-1900i
<b>Manufacturer</b>	Shimadzu
<b>Serial No.</b>	A12535780311ML
<b>ID No.</b>	EQL-233
<b>Date of receipt</b>	27 April 2023
<b>Date of calibration</b>	27 April 2023
<b>Date of issue</b>	8 May 2023
<b>Customer name</b>	Test Tech Co., Ltd.
<b>Address</b>	30, 32 Rama II Soi 63, Rama II RD., Samaedam, Bangkhunthian, Bangkok 10150
<b>Temperature</b>	(23.5-24.4) °C (On site)
<b>Humidity</b>	(50.8-48.2) %RH (On site)
<b>Equipment condition</b>	Good Operation
<b>Calibration Location</b>	Clean Room Circubond
<b>Calibration Procedure</b>	In-house method WI-UV-702-01 based on ASTM E275-01
<b>Traceability</b>	Wavelength Accuracy is traceable to certificate No. 96367 and 96366 Photometric Accuracy is traceable to certificate No. 99925 and 96363 Stray Light is traceable to certificate No. 96346 The above certificate are traceable to SI unit through Starna Scientific Ltd. (UKAS accredited calibration laboratory NO. 0659)
<b>Calibrated by</b>	Mr.Poomjai Korsawatvorakul

Approved by



**Mr.Kanchit Choothep**  
Technical Manager

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.  
Advertising the report / Certificate and publicity of the results are prohibited and also shall not be reproduced  
except in full, without written approval of the Bara Scientific Co., Ltd.



**Bara Scientific**  
Solution of Success

**Bara Scientific Co., Ltd.**

968 U Chu Liang Building Floor7 Rama4 Road  
Sillom Bangrak Bangkok Thailand 10500  
Tel : 02-6324300 Fax : 02-6375496-7  
www.barascientific.com



# Certificate of Calibration

Certificate No.

**BSCC-UV-163/23**

Number of Page(s)

2 of 3

**Calibration Results:**

**1.Wavelength Accuracy**

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty ( $\pm$ nm)
279.44	279.17	-0.27	0.18
418.53	418.45	-0.08	0.18
536.52	536.58	0.06	0.18
684.50	684.62	0.12	0.18
879.41	879.43	0.02	0.18

**2.Photometric Accuracy (UV)**

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty ( $\pm$ A)
235	CNR	CNR	CNR	CNR
	CNR	CNR	CNR	CNR
257	0.0000	0.0000	0.0000	0.0075
	0.8552	0.8532	-0.0020	0.0075
313	CNR	CNR	CNR	CNR
	CNR	CNR	CNR	CNR
350	0.0000	0.0001	0.0001	0.0075
	0.6349	0.6336	-0.0013	0.0075

\*CNR = Customer not request

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# Certificate of Calibration

Certificate No.

BSCC-UV-163/23

Number of Page(s)

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## Calibration Results:

### 3. Photometric Accuracy (Visible)

Wavelength (nm)	Certified Absorbance (A)	UUC (A)	Error (A)	Uncertainty ( $\pm A$ )
420.0	0.0000	0.0000	0.0000	0.0042
	0.5472	0.5485	0.0013	0.0042
	0.7637	0.7637	0.0000	0.0042
	1.0480	1.0494	0.0014	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.5371	0.5384	0.0013	0.0042
	0.7457	0.7457	0.0000	0.0042
	1.0233	1.0247	0.0014	0.0042
465.0	CNR	CNR	CNR	0.0042
	CNR	CNR	CNR	0.0042
	CNR	CNR	CNR	0.0042
	CNR	CNR	CNR	0.0042
546.1	0.0000	0.0000	0.0000	0.0042
	0.5006	0.5017	0.0011	0.0042
	0.6961	0.6954	-0.0007	0.0042
	0.9563	0.9565	0.0002	0.0042
590.0	CNR	CNR	CNR	0.0042
	CNR	CNR	CNR	0.0042
	CNR	CNR	CNR	0.0042
	CNR	CNR	CNR	0.0042
635.0	0.0000	0.0000	0.0000	0.0042
	0.5137	0.5147	0.0010	0.0042
	0.6907	0.6900	-0.0007	0.0042
	0.9533	0.9536	0.0003	0.0042

\*CNR = Customer not request

### 4. Stray Light\*

Standard cut-off wavelength (nm)	Unit Under Calibration(UUC)		
	Wavelength (nm)	Transmission (%T)	Absorbance (A)
200.91 $\pm$ 0.11nm	200.55	0.9670	2.0147

The Stray light transmission reference is less than 1.0%T and Stray light absorbance reference is greater than 2.00A

\*Stray Light not NSC-ONSC Accredited.

The measurement uncertainty is base on a standard uncertainty multiplied by a coverage factor  $k=2$  providing a level of confidence of approximately 95%.

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

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.  
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## Certificate of Calibration

Equipment:	SPECTROPHOTOMETER	Certificate No.:	C06230165
Model:	DR6000	Issued Date:	24 April 2023
Serial No. (or ID.):	1693421 (EQL-197)	Job No.:	KSPR2306121
Manufacturer:	HACH	Page:	1 of 3
Condition:	In Condition		

**Customer:** TEST TECH CO., LTD.  
30,32 Rama II Soi 63, Rama II Rd.,  
Samaedam, Bangkhuntien Bangkok 10150 Thailand

**Environment Condition:**

Temperature	25.3	°C	±	0.2	°C
Humidity	48.9	%RH	±	1.7	%RH

**Calibration Place:** TEST TECH CO., LTD. (แผนกน้ำดี)  
30,32 Rama II Soi 63, Rama II Rd.,  
Samaedam, Bangkhuntien Bangkok 10150 Thailand

**Calibration By:** Mr. Atachai Ngamchanat  
**Calibration Date:** 21 April 2023  
**The Method used:** In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04

**Traceability:** This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Starna Scientific Limited.

The standard for Wavelength Certificate No. 93907 and 93914

The standard for Photometric Certificate No. 94010 and 93900

The standard for Stray light Certificate No. 93903 and 93902

The standard for Spectral resolution Certificate No. 103140

  
(Mr. Atachai Ngamchanat)

Person in charge

  
(Mr. Nitinun Srihawan)

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.

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด  
DKSH Technology Limited  
2533 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260  
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260  
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand



**Calibration Results:**
**Without Adjustment**

Wavelength Accuracy (nm), The spectral bandwidth of Std at 2 nm and UUC at 2 nm

Standard Wavelength	Unit Under Calibration	Correction	Uncertainty
418.61	418.5	0.11	0.13
536.66	536.7	-0.04	0.13
637.98	637.9	0.08	0.13
748.48	748.7	-0.22	0.13
807.03	807.5	-0.47	0.13

**Photometric Accuracy (Absorbance)**

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5816	0.580	0.0016	0.0045
	0.7130	0.712	0.0010	0.0045
	1.0151	1.013	0.0021	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.5649	0.563	0.0019	0.0045
	0.7012	0.699	0.0022	0.0045
	0.9982	0.996	0.0022	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.5249	0.524	0.0009	0.0045
	0.6621	0.661	0.0011	0.0045
	0.9420	0.939	0.0030	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5214	0.520	0.0014	0.0045
	0.6982	0.697	0.0012	0.0045
	0.9947	0.992	0.0027	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5549	0.553	0.0019	0.0045
	0.7736	0.771	0.0026	0.0045
	1.1041	1.101	0.0031	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.5621	0.561	0.0011	0.0045
	0.7630	0.761	0.0020	0.0045
	1.0890	1.086	0.0030	0.0045

**Calibration Results:**
**Without Adjustment**
**Photometric Accuracy (Absorbance)**

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
235 nm	0.0000	0.000	0.0000	0.0080
	0.7440	0.737	0.0070	0.0080
257 nm	0.0000	0.000	0.0000	0.0080
	0.8635	0.855	0.0085	0.0080
313 nm	0.0000	0.000	0.0000	0.0080
	0.2902	0.288	0.0022	0.0080
350 nm	0.0000	0.000	0.0000	0.0080
	0.6409	0.634	0.0069	0.0080

**Stray light \***

Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%T)	Absorbance (A)
260.51 +/- 0.11 nm	260.5	0.7	2.155
391.84 +/- 0.11 nm	391.8	1.2	1.921

**Spectral Resolution \***

Nominal Concentration 0.02 % v/v	Peak	Trough	Ratio	SBW
Standard Wavelength ( nm )	268.73	266.77	1.35	2.00
UUC: Wavelength (nm)	268.6	266.6		
Std Absorbance ( A )	0.4237	0.2591		
Absorbance ( A )	0.385	0.285		

\* Calibration Marked " Not TISI Accredited " in this Certificate have been included for completeness.

**The End of Certificate**

การดูแลบำรุงรักษาเชิงป้องกัน

Preventive Maintenance



บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด

ฝ่ายบริการหลังการขาย

โทร 0 2 639 7000 E-mail: [service.tec.th@dksh.com](mailto:service.tec.th@dksh.com)

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โทร 0 2 639 7000 E-Mail : [marketing.tec.th@dksh.com](mailto:marketing.tec.th@dksh.com)

Website : [www.dksh.co.th/technology/scientific-thailand](http://www.dksh.co.th/technology/scientific-thailand)

## เงื่อนไขการให้บริการ Preventive Maintenance

บริษัทฯ จะส่งวิศวกรผู้ชำนาญ เพื่อให้บริการตามขอบข่ายของการบริการ เฉพาะ ในวันและเวลา ราชการ หากมีความประสงค์ที่จะรับบริการนอกเหนือจากวัน เวลา ราชการ (วันหยุดเสาร์ – อาทิตย์ หรือวันหยุด นักชดฤดู) บริษัทฯ จะคิดค่าบริการเพิ่มเติมตามอัตราที่กฎหมายแรงงานกำหนดไว้

### ขอบข่ายการบริการ

- ตรวจสอบสภาพการทำงานต่าง ๆ ของเครื่องมือ
- ทดสอบประสิทธิภาพการทำงานของเครื่องมือ
- รายการผลการตรวจสอบเครื่องมือ

### หมายเหตุ

- ราคานี้ไม่รวมถึงค่าบริการซ่อม หรือ เปลี่ยนอะไหล่ที่ชำรุดเสียหาย หรือหมดสภาพการใช้งาน
- ในกรณีที่ผู้รับบริการอยู่นอกเขตพื้นที่ให้บริการ บริษัทฯ จำเป็นต้องคิดค่าใช้จ่ายเพิ่มเติม ได้แก่ ค่าเดินทาง เป็นต้น
- บริษัทฯ ขอสงวนสิทธิ์ในการเปลี่ยนแปลงราคา โดยไม่แจ้งให้ทราบล่วงหน้า



## ช่องทางการติดต่อ



DKSH Technology Limited (บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด)  
เลขที่ 2533 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพฯ 10260  
เลขประจำตัวผู้เสียภาษี 010-555-001-4547 (สำนักงานใหญ่)



Call center 0 2 639 7000



DKSH Scientific



[www.dksh.com/scientific-thailand](http://www.dksh.com/scientific-thailand)



[marketing.tec.th@dksh.com](mailto:marketing.tec.th@dksh.com)



@dkshscientific

## Preventive Maintenance Contract

จำนวนในการทำสัญญาบริการ .....1..... ครั้ง ต่อ ปี  
ครั้งที่ 1/1 วันที่ 28 Mar 2023

### รายละเอียดผู้รับบริการ

หน่วยงาน	บริษัท เทสท์ เทค จำกัด		
ที่อยู่	30,32 ซอยพระรามที่ 2 ซอย 63 ถนนพระรามที่ 2 แขวงสามตำ เขตบางขุนเทียน กรุงเทพมหานคร 10150		
โทรศัพท์	0-2893-4211-7	แฟกซ์	0-2893-4218

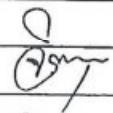
### ผู้ติดต่อ

ชื่อ - นามสกุล	คุณมาริส วิเศษสังข์			
ตำแหน่ง	หัวหน้าส่วน			
โทรศัพท์	0-2893-4211-7	เบอร์ต่อ		แฟกซ์ 0-2893-4218
E-mail	Lab_center@testtech.co.th			

### รายละเอียดผู้ให้บริการ

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด (ฝ่ายบริการหลังการขาย) (สำนักงานใหญ่)	
เลขที่ 2533 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพฯ 10260	
โทรศัพท์ 0 2 693 7000 Email: siriporn.sy@dksh.com Line ID : siripon3007	
เจ้าหน้าที่ประสานงาน : คุณศิริพร อยู่ทองจ้อย โทรศัพท์ 090 678 6924 , 02 301 7467	
เจ้าหน้าที่ผู้ให้บริการ	นายจิรายุส สเลอาด
ตำแหน่ง	Specialist, Technical Service.
โทรศัพท์	0938138736 แฟกซ์ -
E-mail	Jirayut.js@dksh.com

ลงนามผู้รับบริการ	
ตัวบรรจง	(.....)
ตำแหน่ง	
วันที่ / ประทับตราบริษัท	

ลงนามผู้ให้บริการ	
ตัวบรรจง	(นายจิรายุส สเลอาด...)
ตำแหน่ง	Specialist, Technical Service
วันที่ / ประทับตราบริษัท	28/3/2023

JOB No: Lspr2302591

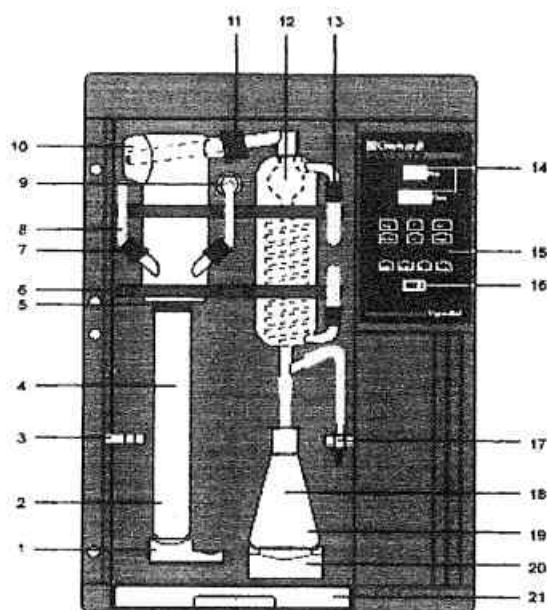
MODEL: Vap30

S/N: 003718

Part : Operational Qualification (OQ)

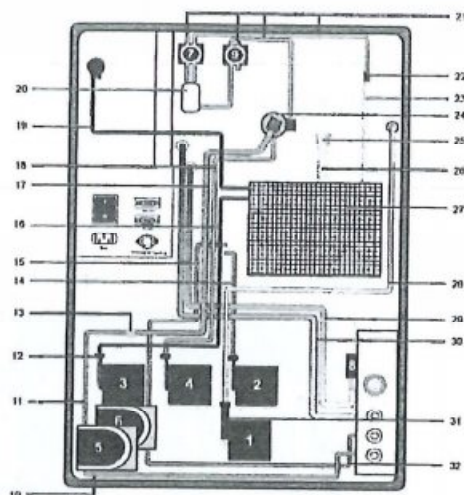
ตรวจสอบสภาพเครื่อง

FRONT



	Pass	Fail	N/A	Remark
1.Quick clamping device with wedge	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
2. Kjeldatherm digestion tube	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
3. Holder for steam inlet tubing	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
4. PTFP-Inlet tubing, steam	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
5. Viton-cone	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
6. Clamping for glassware	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
7. Screw cap GL18 with silicone seal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
8. PTFP-Inlet tubing, NaOH	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
9. PP-Distributor with PP-threaded joint	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
10. Distribution head, glass	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
11. Screw cap GL32 with silicone seal	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
12. Distillation condenser	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
13. Screw cap GL14 with plastic screw connection	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
14. Display	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
15. Keyboard, chemical-resistant	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
16. Main switch, green	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
17. Ventilation valve	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
18. Distillate outlet tubing	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
19. Erlenmeyer flask	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
20. Platfrom	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
21. Drip tray	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....

REAR



	Pass	Fail	N/A	Remark
1. Diaphragm pump NaOH	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
2. Diaphragm pump H <sub>3</sub> BO <sub>3</sub>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	vap 40 only
3. Diaphragm pump H <sub>2</sub> O for steam generator	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
4. Diaphragm pump H <sub>2</sub> O for sample	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	vap 30,40 only
5. Peristaltic pump for suction sample	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	vap 30,40 only
6. Peristaltic pump for suction receiver	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	option
7. Pinch-solenoid valve, steam	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
8. Magnetic valve with pressure control	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
9. Pinch-solenoid valve, shut-off	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
10. Verprene-tubing 4x8 mm.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
11. Verprene-tubing 4x8 mm.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	vap 30,40 only
12. Non-return valve for diaphragm pumps	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
13. Tubing reduction PP 51x10x5 mm.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	vap 30,40 only
14. Silicone tubing 4x7 mm.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	vap 40 only
15. Silicone tubing 4x7 mm.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	option
16. Silicone -tubing 4x7 mm.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
17. Verprene-tubing 8x12 mm.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	vap 30,40 only
18. Verprene tubing 4x7 mm.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	vap 30,40 only
19. Silicone tubing 4x7 mm.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
20. Ventilation glass	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
21. Novoprene-tubing 4.8x8 mm.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
22. Tubing reduction	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
23. Silicone tubing 6x10 mm.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
24. PP-distributor with PP-thread	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
25. SKT-valve (built in with brass fitting)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
26. Silicone tubing 8x16x80 mm.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
27. Steam generator	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
28. PTFE-inlet tubing NaOH	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
29. Silicone tubing 8x16 for cooling water inlet	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
30. Silicone tubing 8x16 for cooling water outlet	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
31. Viton-tubing 6x12*50 mm.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
32. Silicone tubing 4x7 mm.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	option



## รายละเอียดการตรวจสอบ

### ขั้นตอนการบริการ

#### ตรวจสอบระบบไฟฟ้า (Electrical Test)

- ความต้านทานทางไฟฟ้าของเครื่องกับกราวด์
- กระแสไฟฟ้าที่ใช้งาน

#### ตรวจสอบสภาพเครื่อง (Optical Test)

- Main cable
- Electric wiring
- Pumps
- Distribution Head
- Condensor
- Steam generator
- Tubing
- Viton cone

#### ตรวจสอบ Function การทำงาน (The Function Test)

- ระบบสร้างและควบคุมความดันของ Steam
- ระบบการเติมน้ำเข้า Sample Tube
- ระบบการเติม Na OH
- ระบบการ Suction ตั้ง Sample Tube และ Receiver

## รายงานผลการให้บริการ

### 1. TECHNICAL DATA

	Pass	Fail	N/A	Remark
Main Supply 220 volt + 10% 50 Hz with ground	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Normal current	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	..... 6 a .....

#### 1.1 COOLING WATER BATH

	Pass	Fail	N/A	Remark
Temperature 15-20 °C	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Cooling Water Outlet	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Control Temperature	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....

#### 1.2 OPTICAL TEST VAP...30...

	Pass	Fail	N/A	Remark
Screw cap GL14	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Screw cap GL18	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Screw cap GL32	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Distillation Head	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Condensor	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Viton Cone	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Ventilation Valve	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Micro Switch Sample	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....

### 2. SYSTEM COOLING WATER INLET

	Pass	Fail	N/A	Remark
Cooling Water Inlet	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Cooling Water Outlet	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Magnetic valve	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....

### 3.SYSTEM CONTROL

	Pass	Fail	N/A	Remark
Key Board	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Display	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Program	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Adding H <sub>2</sub> O	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	vap 30,40 only
Adding NaOH	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Adding H <sub>3</sub> BO <sub>3</sub>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	vap 40 only
Suction Sample	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	vap 30,40 only

### 4.SYSTEM DISTILLATION

	Pass	Fail	N/A	Remark
Boiler	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Level Sensor	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Novoprene-Tubing	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Solenoid Valve Shut-Off	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Solenoid Valve Steam	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Excess Pressure Detector	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Ventilation Valve	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Heater	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....

### 5. PUMP

	Pass	Fail	N/A	Remark
Pump H <sub>2</sub> O Steam	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
- Non-Return Valve	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Pump H <sub>2</sub> O Sample	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
- Non-Return Valve	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Pump NaOH	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
- Non-Ruturn Valve	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Pump H <sub>3</sub> BO <sub>3</sub>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	.....
- Non-Ruturn Valve	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	.....
Pump Suction	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....

### 6. The Following Program Run :

	Pass	Fail	N/A	Remark
Addition H <sub>2</sub> O 0-99 sec.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Addition NaOH 0-99 sec.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Addition H <sub>3</sub> BO <sub>3</sub> 0-99 sec.	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	.....
Reaction Time 0-99 min.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Distillation Time 0-99 min	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Steam Capacity 30%-100%	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
Suction Time 0-99 sec.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
The Instrument is in perfect technical shape	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....

Remark :

.....

.....

**Part : ข้อมูลสนับสนุนด้านเทคนิค (General Technical Support)**

**การบำรุงรักษาทั่วไป ( Basic maintenance)**

**Cleaning**

Glass parts and suction pump should be cleaned before long periods of non-usage (i.e. holidays). This way blockages caused by crystalline deposits are avoided.

The following program should be run:

Addition $H_3BO_3$	0	s
Addition $H_2O$ :	13	s
Addition NaOH:	0	s
Reaction time:	0	s
Distillation time:	7	min.
Steam capacity:	100	%
Suction time:	20	s





Place an empty digestion tube and an Erlenmeyer flask into position, and start the program.

In case of extreme deposits in the glassware you can clean the system by putting about 10 ml of sulphuric acid into the digestion tube.



## Error Code


The micro-processor continually surveys all the functions of the distillation system. As soon as an error arises it is shown on the display and accompanied by an acoustic signal.

Error message	Measures
No tap water	Check cooling water inlet for blockages. Ensure the tap is turned on → 
No sample tube	Insert tube → 
Check chemicals	Check set of tanks → 
Low water Press Enter	Check the water inlet distilled H <sub>2</sub> O → 
↓ Filling Steam generator	This message disappears as soon as steam generator is filled

After the above mentioned errors are corrected, the following message is displayed.

Error message	Measures
Stop Prog.No. x continue=Enter	Enter = continue of interrupted program Reset = Standby-mode

### Other error messages

Error message	Measures
Wait for steam	Message disappears as soon as stand-by is reached
Add sol. > 1min Continue=Enter	Check programming Enter=continue of interrupted program Reset=Standby-mode
Program undefined	Check programming → 
Excess steam pressure	Switch the system off and call service
Sensor error	Switch the system off and call service