

## เอกสารแนบ จ

เอกสารการสอบเทียบเครื่องมือตรวจวัด



เอกสารการสอบเทียบเครื่องมือตรวจวัด  
บริษัท เอ็นไวรอนเมนต์ รีเสิร์ช แอนด์ เทคโนโลยี จำกัด



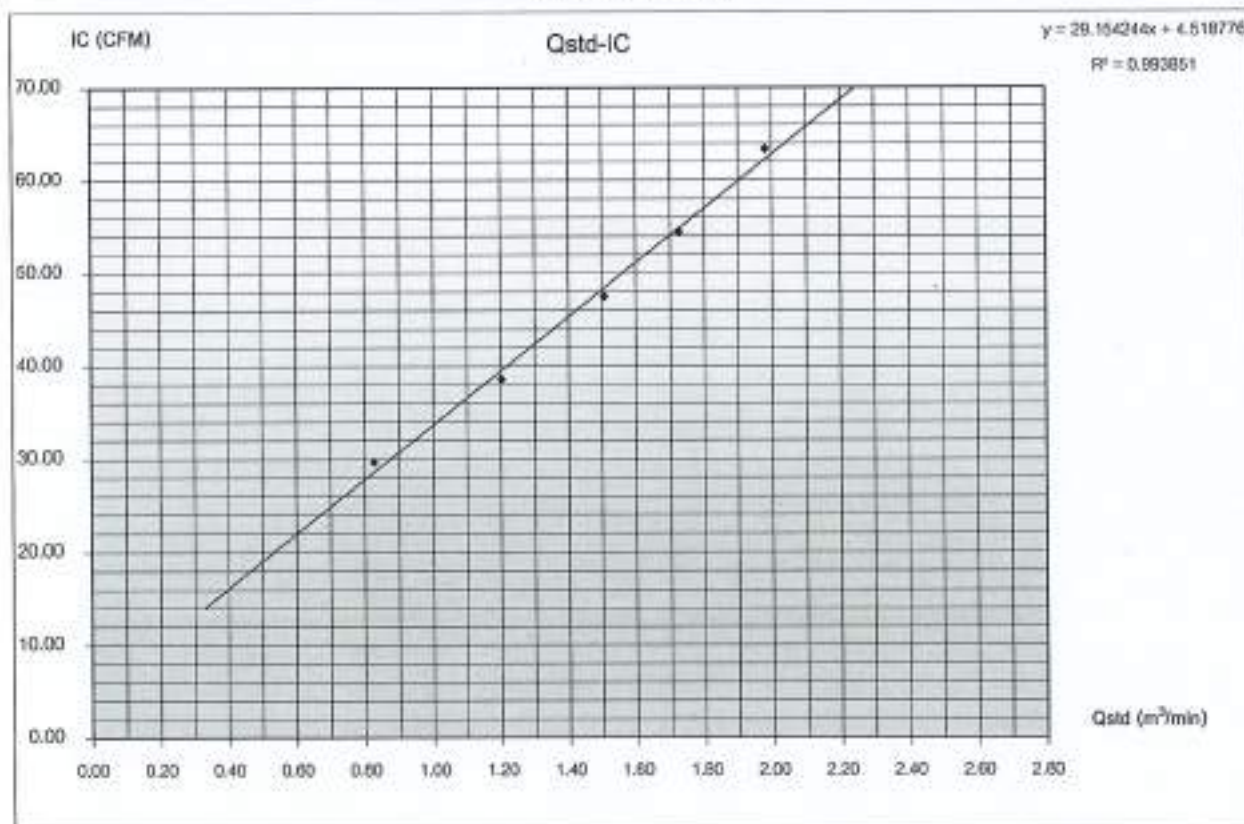
# TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	November 10, 2022
At : กรมวิทยาศาสตร์สิ่งแวดล้อม (กรมวิทยาศาสตร์)				Start Time	11:56 AM
Sampler Number	TSP No.A27	Transfer Standard Type	Office	Stop Time	12:06 PM
Instrument Model	HINDOL-SBCBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Anon songsojjanak
Motor Serial Number	2215	Calibrator Serial Number	2716		
Recorder Serial Number	2133				

Rate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter	
	Pressure Drop Across Orifice (inH <sub>2</sub> O)			$(\Delta H_D \times P_{std} / (T_{std} / T_{act}))^{1.25}$	$Q_{std} = (1/IC) \times (A \times I)$	Sample Flow Rate Indicator	$IC = (P_{std} / P_{act}) \times (T_{std} / T_{act})^{1.25}$	(°K = °C + 273)	(mmHg)			
	Positive	Negative	$\Delta H_D$		(m <sup>3</sup> /min)	(l/min)						
5	1.2	1.2	2.4	1.53434	0.62666	30.0	29.71	303.0	758.0			
7	2.5	2.5	5.0	2.21462	1.20227	39.0	38.63	303.0	758.0			
10	3.9	3.9	7.8	2.79935	1.50658	48.0	47.54	303.0	758.0			
13	5.1	5.1	10.2	3.16311	1.72599	55.0	54.47	303.0	758.0			
16	6.7	6.7	13.4	3.62549	1.98035	64.0	63.38	303.0	758.0			
Linear Regression Y ON X : Y= ax + b							Average	303.0	758.0			
1	Slope (a)			1.81211	Linear Equation			r <sup>2</sup>	0.993851	Passing Hg	700.0	
2	Intercept (b)			0.00597	Set Point Flow Rate (X) (m <sup>3</sup> /min)			1.133	r	0.9993268	T <sub>std</sub>	298.0
3	Correlation Coefficient (r)			0.99999	Final Set Flow Rate = (I)			0	(P <sub>std</sub> /P <sub>act</sub> ) <sup>1.25</sup> × (T <sub>std</sub> /T <sub>act</sub> )	0.980918196		
Result									C = (P <sub>std</sub> /P <sub>act</sub> ) <sup>1.25</sup> × (T <sub>std</sub> /T <sub>act</sub> ) <sup>0.5</sup>	0.990408100		

COMMENT

Andersen Instruments, Inc.



Checked By

( Mr. Prayun Detida )  
Technician



Approved By

( Mr. Panupon Podang )  
Environmental Scientist



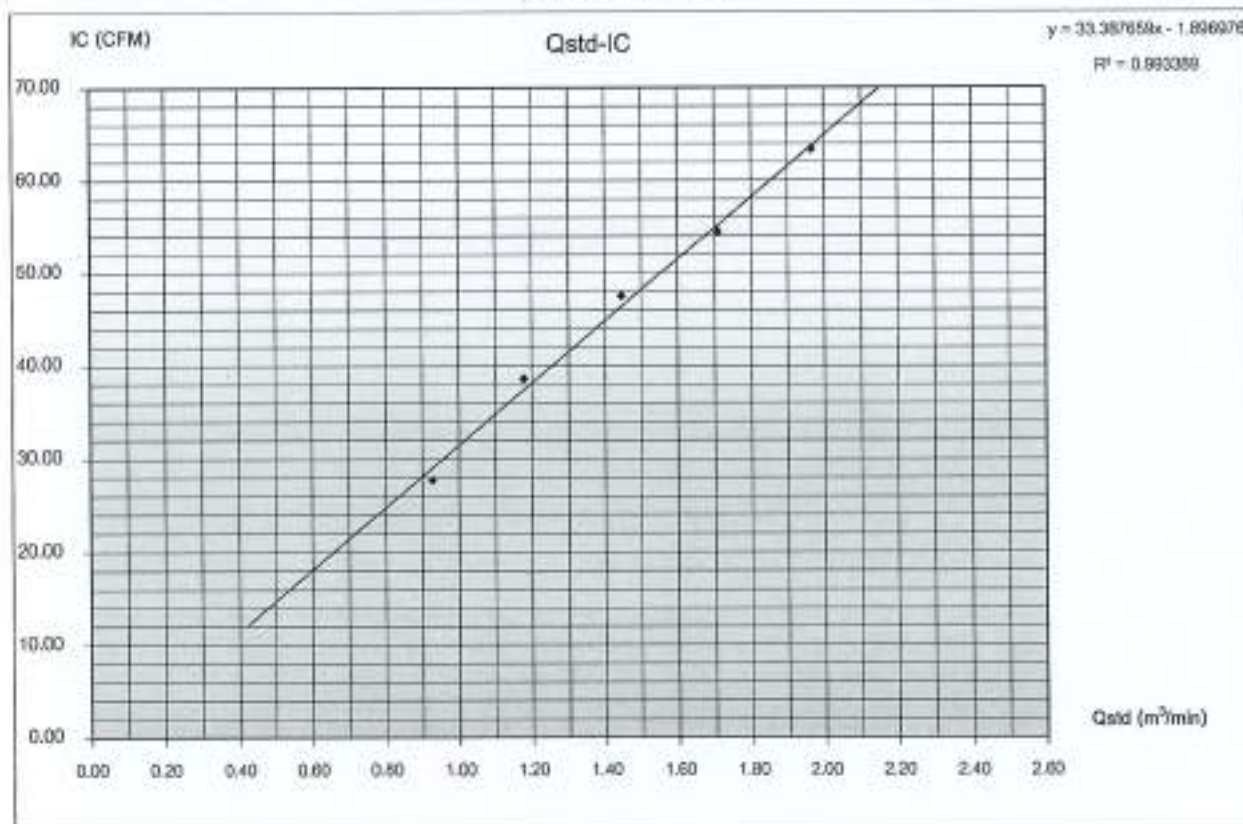
# TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	November 10, 2565
A2 : บริเวณลานจอดรถที่ 8				Start Time	11:07 AM
Sampler Number	TSP No.A22	Transfer Standard Type	Office	Stop Time	11:17 AM
Instrument Model	HVCL-8BCBE	Calibrator Model	TE-5525A	Calibrated By	Mr.Anon songgoemok
Motor Serial Number	2054	Calibrator Serial Number	2716		
Recorder Serial Number	2187				

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (inH <sub>2</sub> O)			$[\Delta H_D(P_{atm}P_{std}/T_{std}T_a)]^{1/2}$	$Q_{std} = (5V)(A-b)$ (m <sup>3</sup> /min)	Sample Flow Rate Indicator (L/min)	$IC = [(P_{atm}P_{std}/T_{std}T_a)]^{1/2}$	[°K = °C+273]	(mmHg)		
	Positive	Negative	$\Delta H_D$								
5	1.5	1.5	3.0	1.71544	0.92660	28.0	27.73	303.0	756.0		
7	2.4	2.4	4.8	2.16668	1.17750	39.0	38.63	303.0	756.0		
10	3.0	3.0	7.2	2.85755	1.44670	48.0	47.54	303.0	756.0		
13	5.0	5.0	10.0	3.13193	1.70649	55.0	54.67	303.0	756.0		
16	6.0	6.0	13.2	3.59833	1.86587	64.0	63.39	303.0	756.0		
Linear Regression Y ON X : Y= mX + b								Average	303.0	759.0	
1	Slope (m)			1.81211	Linear Equation			r <sup>2</sup>	0.993359	Pressure(Hg)	700.0
2	Intercept (b)			0.00597	Set Point Flow Rate (X) (m <sup>3</sup> /min)		1.133	r	0.999889	T <sub>gas</sub>	298.0
3	Correlation Coefficient (r)			0.99999	Final Set Flow Rate = (I)		0	(P(atm)P(std)/T(std)T(a))			0.00010156
Result								C= [P(atm)P(std)/T(std)T(a))^-0.5]			0.000408106

COMMENT

Anderson Instruments, Inc.



Checked By

( Mr. Prayun Detkha )  
Technician



Approved By

( Mr. Panupon Podang )  
Environmental Scientist



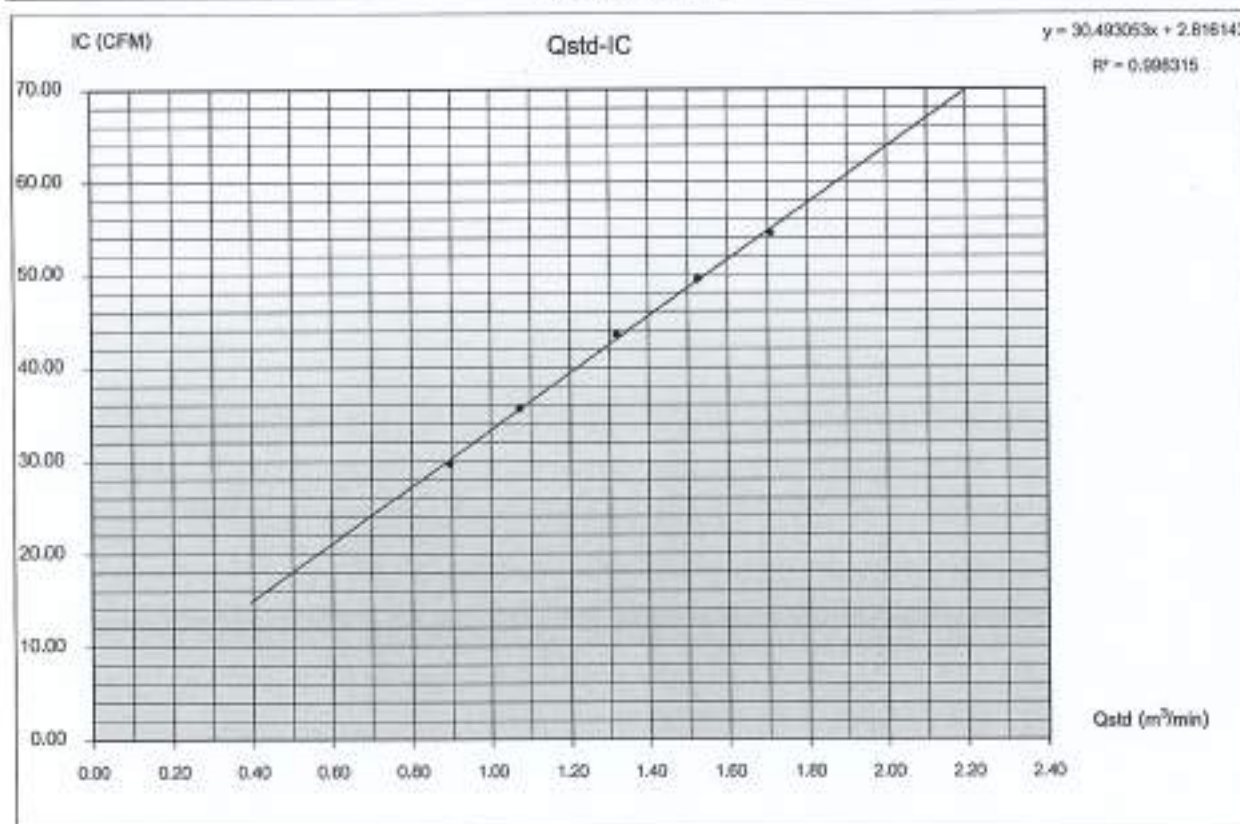
# TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	November 10, 2022
AG : บริเวณวัดบ้านนาหว้า 2				Start Time	11:55 AM
Sampler Number	TSP No.A31	Transfer Standard Type	Orifice	Stop Time	12:05 PM
Instrument Model	HVCL-B5CBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Anan kongngoenok
Motor Serial Number	57-007	Calibrator Serial Number	2716		
Recorder Serial Number	007-012				

Plate No.	{Delta H}			{A}	{X}	{I}	{Y}	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Pressure Drop Across Orifice (mH <sub>2</sub> O)			$[\Delta H_2O/P_{std}(T_{std}/T_a)]^{1/2}$	Q <sub>std</sub> = (1/n)(IA/b) (m <sup>3</sup> /min)	single Flow Rate Indicator (l <sup>3</sup> /min)	IC = [(P <sub>a</sub> /P <sub>std</sub> )(T <sub>std</sub> /T <sub>a</sub> )] <sup>1/2</sup>	T°K = °C+273.15	(mmHg)		
	Positive	Negative	ΔH <sub>2</sub> O								
5	1.4	1.4	2.8	1.05727	0.09470	30.0	29.71	303.0	758.0		
7	2.0	2.0	4.0	1.99882	1.07325	36.0	36.86	303.0	758.0		
10	3.0	3.0	6.0	2.42660	1.31892	44.0	43.58	303.0	758.0		
13	4.0	4.0	8.0	2.89120	1.52603	50.0	49.52	303.0	758.0		
18	5.0	5.0	10.0	3.13195	1.70649	55.0	54.47	303.0	758.0		
Linear Regression Y ON X: Y= mX + b							Average	303.0	758.0		
1	Slope (m)			1.81211	Linear Equation			r <sup>2</sup>	0.998315	Factorial	758.0
2	Intercept (b)			0.03567	Set Point Flow Rate (X) (m <sup>3</sup> /min)			1.135	r	0.9991571	T <sub>std</sub>
3	Correlation Coefficient (r)			0.99999	Final Set Flow Rate = (I)			0	(Pa/Pstd)*(Tstd/Ta)	0.99910195	
Result:		C=(Pa/Pstd)*(Tstd/Ta)*0.5								0.999409166	

COMMENT

Andersen Instruments, Inc.



Checked By

( Mr. Prayun Detkla )  
Technician



Approved By

( Mr. Panupon Podang )  
Environmental Scientist

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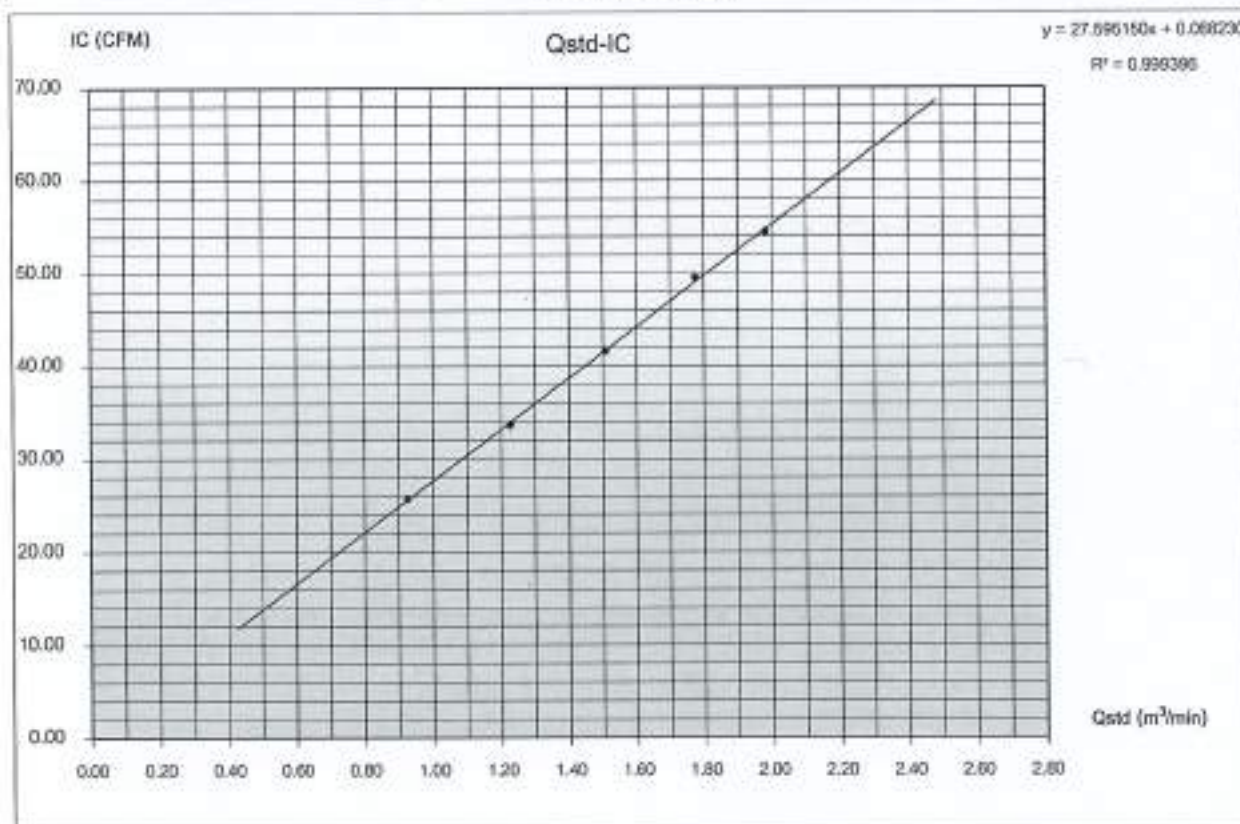
# TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	November 10, 2022
At : กรุงเทพมหานครจตุจักรวชิร 5				Start Time	10:12 AM
Sampler Number	TSP No.A30	Transfer Standard Type	Office	Stop Time	10:22 AM
Instrument Model	HVGL-58CBE	Calibrator Model	TE-5025A	Calibrated By	Mr.Anon kasingsanont
Motor Serial Number	2213	Calibrator Serial Number	2716		
Recorder Serial Number	2136				

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter	
	Pressure Drop Across Orifice (inH <sub>2</sub> O)			$[\Delta H_2O(Pa/P_{atm})(T_{atm}/T_a)]^{1/2}$	$Q_{std} = (1/9)(A-b)$ (m <sup>3</sup> /min)	Sample Flow Rate Indicator (l/min)	$IC = [(Pa/P_{atm})(T_{atm}/T_a)]^{1/2}$	(°C = °C+273)	(mmHg)			
	Positive	Negative	$\Delta H_2O$									
5	1.5	1.5	3.0	1.71544	0.00660	20.0	25.75	303.0	758.0			
7	2.0	2.0	5.2	2.25848	1.22040	34.0	33.67	303.0	758.0			
10	3.9	3.9	7.8	2.76935	1.50058	42.0	41.02	303.0	758.0			
13	5.4	5.4	10.8	3.25482	1.77630	50.0	49.52	303.0	758.0			
18	6.7	6.7	13.4	3.62548	1.99085	55.0	54.47	303.0	758.0			
Linear Regression Y ON X : Y = aX + b							Average	303.0	758.0			
1	Slope (m)			1.81211	Linear Equation			r <sup>2</sup>	0.999096	Pa/mmHg	700	
2	Intercept (b)			0.00597	Set Point Flow Rate (X) (m <sup>3</sup> /min)		1.193	r	0.999066	T <sub>atm</sub>	228	
3	Correlation Coefficient (r)			0.99999	Fixed Set Flow Rate = (I)		0	(Pa/P <sub>atm</sub> )*(T <sub>atm</sub> /T <sub>a</sub> )		0.99991096		
Result									C = (Pa/P <sub>atm</sub> )*(T <sub>atm</sub> /T <sub>a</sub> ) <sup>0.5</sup>		0.999400100	

COMMENT

Andersen Instruments, Inc.



Checked By

( Mr. Prayun Detida )  
Technician



Approved By

( Mr. Panupon Podang )  
Environmental Scientist





Environmental



RECALIBRATION

DUE DATE:

February 8, 2023

# Certificate of Calibration

## Calibration Certification Information

Cal. Date: February 8, 2022      Roots-meter S/N: 438320      Ta: 294 °K  
Operator: Jim Tisch      Pa: 750.1 mm Hg  
Calibration Model #: TE-5025A      Calibrator S/N: 2716

Run	Vol. Inlet (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	3	2	1	1.3090	3.2	2.00
2	3	4	1	0.9160	6.4	4.00
3	5	6	1	0.8140	7.9	5.00
4	7	8	1	0.7760	8.8	5.50
5	9	10	1	0.6380	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)
0.9963	0.7609	1.4145	0.9957	0.7607	0.8854
0.9918	1.0828	2.0004	0.9915	1.0824	1.2521
0.9898	1.2160	2.2365	0.9895	1.2156	1.3999
0.9886	1.2740	2.3456	0.9883	1.2735	1.4683
0.9833	1.5412	2.8289	0.9829	1.5407	1.7708
QSTD	m=	1.81211	QA	m=	1.13472
	b=	0.03597		b=	0.02252
	r=	0.99999		r=	0.99999

## Calculations

Vstd = $\Delta Vol \{ (Pa - \Delta P) / Pstd \} (Tstd / Ta)$	Va = $\Delta Vol \{ (Pa - \Delta P) / Pa \}$
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:	roots-meter 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







## CERTIFICATE OF CALIBRATION

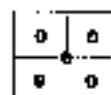
Result of Calibration

Certificate no.: PSL-0000-03

Page no.: 1 of 1

3 by certificate

Test load at least 1/3 of the maximum capacity, placed between 1/2 and 1/3 of the distance from the center of the load receiver to the edge.



Weighting Range 1

Test Load	100	10
Position	1	2
1	100.0000	
2	100.0000	
3	100.0000	
4	100.0000	
5	100.0000	
Max Deviation	0.0001	

Weighting Range 2

Test Load	50
Position	1
1	
2	
3	
4	
5	
Max Deviation	

Standard methods

The calibration was performed by using calibration laboratory's standard calibration methods: OIML R111 based on "OIML R111 - Calibration of weighing machines" version 1 October 2005

Reference standards information

Instrument	OML Code	SN	Certificate No.	Date
Standard Weight Set	01	4000021440	NM 0135-00	December 8, 2011
Standard Weight Set	-	-	-	-
Standard Weight Set	-	-	-	-
Standard Weight Set	-	-	-	-

Measurement uncertainty

The given measurement uncertainty is the standard of the measurement multiplied by an extension factor, which corresponds to a confidence level of about 95% for a normal distribution. The standard uncertainty was calculated according to EN 60903

Traceability: The measurement is traceable to national standards, which realize the physical unit of measurement, [2]

- National Institute of Metrology - Thailand metrology calibration laboratory

--- UNOFFICIAL ---



## Calibration Data of NOx Analyzer

### Analyzer Performance Test

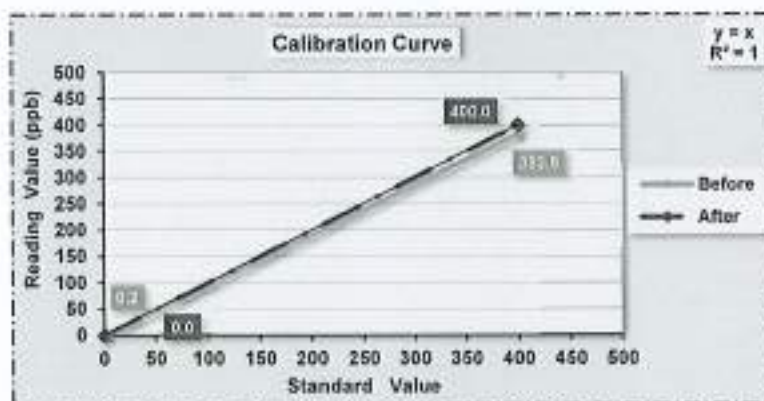
Equipment	Gas Analyzer ( NOx )	Customer Name	โพนศิริ คณบดีกุล
Manufacture	HORIBA	Location	Envi Research
Model	APNA-370	Scientist	Panupon
Serial No.	U65W031M	Calibration Date	November 9, 2022
Analyzer Unit	ppb	Time	2:46 PM

### Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300T	0172
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	1.1	0.0	0.2	0.0	0.9	0.0	-	-	-
Span	400	384.7	400.0	382.9	400.0	1.8	0.0	-	-	4.3



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

Parameter	Unit	Observed Value		Nominal Range
		Before Adjust	After Adjust	
Range	ppb	500	500	0 - 500 Standard
Signal NO	mV	0.8	0.9	Voltage of the measured NO value
Signal NOx	mV	13.1	13.8	Voltage of the measured NOx value
Detector	°C	42.2	42.1	43 °C ± 5 °C
Ambient	kPa	101.7	101.6	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	-	0.96213	1.06900	0.50000 - 2.0000
NOx Slope	-	0.95726	1.06900	0.50000 - 2.0000

Calibrate By :

(MR.PANUPON PODANG)

November 9, 2022

Checked By :

(MS.SUTATIP IM-NOI)

November 9, 2022



## Calibration Data of NOx Analyzer

### Analyzer Performance Test

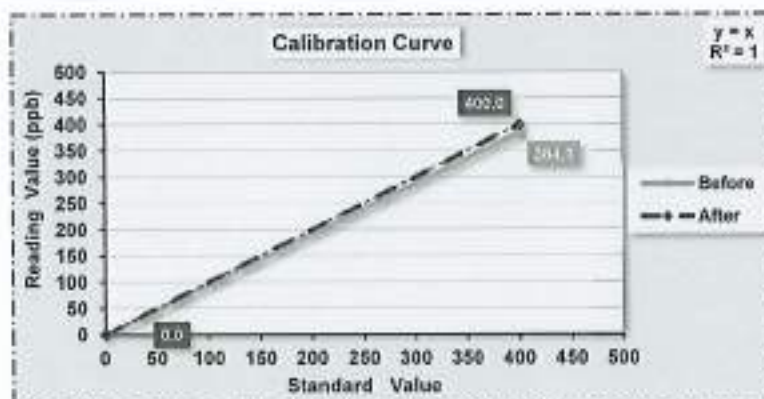
Equipment	Gas Analyzer ( NOx )	Customer Name	บริษัท เอนวิ รีเสิร์ช
Manufacture	HORIBA	Location	Envi Research
Model	APNA-370	Scientist	Panupon
Serial No.	NT2CRTL2	Calibration Date	November 9, 2022
Analyzer Unit	ppb	Time	1:51 PM

### Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300T	0172
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	-0.2	0.0	0.0	0.0	-	-	-
Span	400	386.2	400.0	384.1	400.0	2.1	0.0	-	-	4.0



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

Parameter	Unit	Observed Value		Nominal Range
		Before Adjust	After Adjust	
Range	ppb	500	500	0 - 500 Standard
Signal NO	mV	0.6	0.7	Voltage of the measured NO value
Signal NOx	mV	9.5	12.2	Voltage of the measured NOx value
Detector	°C	42.0	42.0	43 °C ± 5 °C
Ambient	kPa	101.8	101.1	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	-	0.98526	1.25400	0.50000 - 2.0000
NOx Slope	-	0.07111	1.15920	0.50000 - 2.0000

Calibrate By :

(MR.PANUPON PODANG)

November 9, 2022



Checked By :

(MS.SUTATIP IM-NOI)

November 9, 2022



## Calibration Data of NOx Analyzer

### Analyzer Performance Test

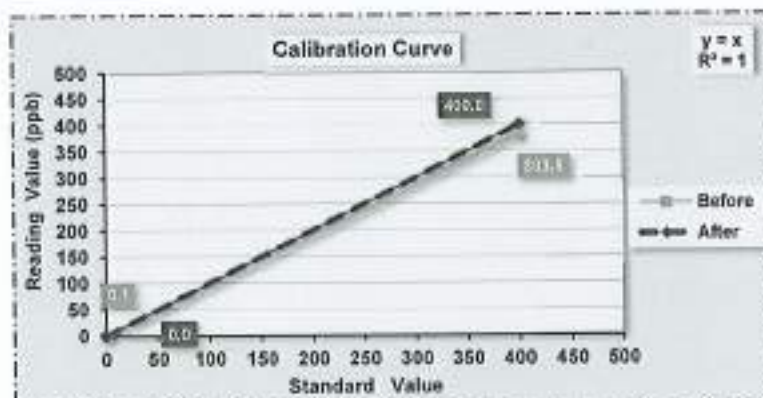
Equipment	Gas Analyzer ( NOx )	Customer Name	บริษัท เอนวิ รีเสิร์ช
Manufacture	HORIBA	Location	Envi Research
Model	APNA-370	Scientist	Panupon
Serial No.	M4285P23	Calibration Date	November 9, 2022
Analyzer Unit	ppb	Time	2:43 PM

### Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300T	0172
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	0.0	0.0	-	-	-
Span	400	385.4	400.0	383.5	400.0	1.9	0.0	-	-	4.1



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

Parameter	Unit	Observed Value		Nominal Range
		Before Adjust	After Adjust	
Range	ppb	500	500	0 - 500 Standard
Signal NO	mV	0.9	1.1	Voltage of the measured NO value
Signal NOx	mV	11.4	12.9	Voltage of the measured NOx value
Detector	°C	41.3	41.2	43 °C ± 5 °C
Ambient	kPa	101.6	101.6	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	-	0.99387	1.03440	0.50000 - 2.0000
NOx Slope	-	1.01150	1.04940	0.50000 - 2.0000

Calibrate By :

(MR.PANUPON PODANG)

November 9, 2022

Checked By :

(MS.SUTATIP IM-NOI)

November 9, 2022



## Calibration Data of NOx Analyzer

### Analyzer Performance Test

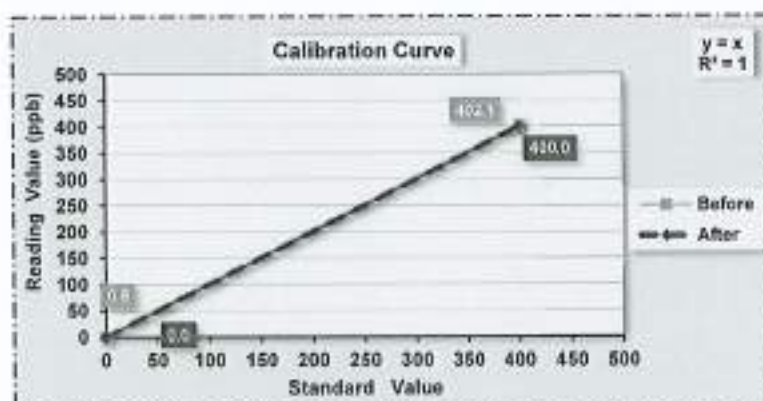
Equipment	Gas Analyzer ( NOx )	Customer Name	โพธิ์ณิกร วัฒนกุล
Manufacture	HORIBA	Location	Envi Research
Model	APNA-370	Scientist	Panupon
Serial No.	KCDVY226	Calibration Date	November 9, 2022
Analyzer Unit	ppb	Time	11:50 AM

### Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300T	0172
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	0.6	0.0	0.5	0.0	0.1	0.0	-	-	-
Span	400	403.0	400.0	402.1	400.0	0.9	0.0	-	-	0.5



### 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	0.8	1.0	Voltage of the measured NO value
Signal NOx	mV	5.6	4.0	Voltage of the measured NOx value
Detector	°C	41.4	41.4	43 °C ± 5 °C
Ambient	kPa	101.1	100.9	Current atmospheric pressure
DC 24V	V	23.7	23.7	24V ±0.5
DC 5V	V	5.0	5.0	5V ±0.5
NO Slope	-	1.28580	1.26580	0.50000 - 2.0000
NOx Slope	-	1.27480	1.24950	0.50000 - 2.0000

Calibrate By :

(MR.PANUPON PODANG)  
November 9, 2022



Checked By :

(MS.SUTATIP IM-NOI)  
November 9, 2022



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

#### Analyzer Performance Test

Equipment	Gas Analyzer ( SO <sub>2</sub> )	Customer Name	โพนพิสัย คลังสิ่งแวดล้อม
Manufacture	Thermo	Location	Envi Research
Model	43C	Scientist	Panupon
Serial No.	0335804022	Calibration Date	November 9, 2022
Analyzer Unit	ppb	Time	11:29 AM

#### Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300T	0172
Standard Gas Components	CO = 4.616 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	0.6	0.0	-	-	-
Span	400	389.0	400.0	-	-	2.8



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

Parameter	Display As	Unit	Observed Value		Nominal Range
			Before Adjust	After Adjust	
Range	RANGE	ppb	500	500	0 - 500 standard
Internal Temperature	INTERNAL	°C	34.0	31.5	8.0 °C to 47.0 °C
Chamber Temp	CHAMBER	°C	45.1	44.8	43.0 °C to 47.0 °C
Pressure	PRESSURE	mmHg	721.1	720.2	400.0 to 1,000
Sample Flow	SAMP FLOW	LPM	0.357	0.363	0.350 to 1,000
Lamp Intensity	INTENSITY	Hz	24,008	24,215	20,000 to 50,000
Lamp Voltage	LAMP VOLTAGE	V	906	922	750 to 1,200
SO <sub>2</sub> Concentration	SO <sub>2</sub> CONCENTRATION	ppb	1.6	1.7	0 to 10,000
Motherboard Status	MOTHERBOARD STATUS	-	OK	OK	OK
Interface Status	INTERFACE STATUS	-	OK	OK	OK

Calibrate By :

(MR.PANUPON PODANG)  
November 9, 2022



Checked By :

(MS.SUTATIP IM-NOI)  
November 9, 2022



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

#### Analyzer Performance Test

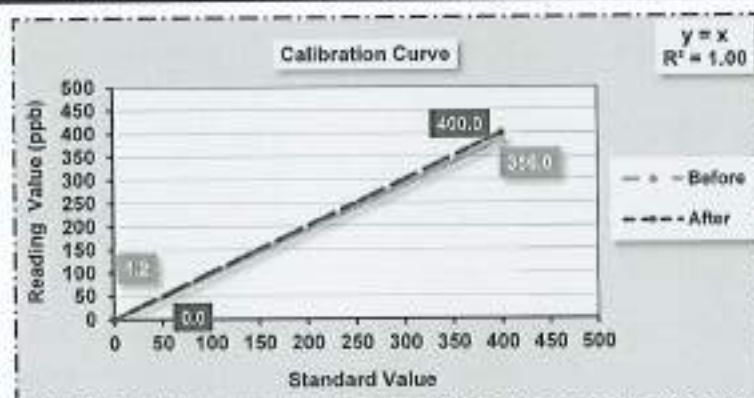
Equipment	Gas Analyzer ( SO <sub>2</sub> )	Customer Name	ไพฑูริ์ กาญจนะกุล
Manufacture	Thermo	Location	Envi Research
Model	43C	Scientist	Panupon
Serial No.	0611116460	Calibration Date	November 9, 2022
Analyzer Unit	ppb	Time	2:02 PM

#### Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419629
Dynamic Dilution Calibrator	Tanabyte	300T	0172
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	1.2	0.0	-	-	-
Span	400	386.0	400.0	-	-	3.5



#### 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	33.6	32.1	6.0 °C to 47.0 °C
Chamber Temp	CHAMBER	°C	44.4	44.5	43.0 °C to 47.0 °C
Pressure	PRESSURE	mmHg	736.7	736.6	400.0 to 1,000
Sample Flow	SAMP FLOW	LPM	1.167	1.171	0.350 to 1,000
Lamp Intensity	INTENSITY	Hz	23,452	23,609	20,000 to 50,000
Lamp Voltage	LAMP VOLTAGE	V	864	864	750 to 1,200
SO <sub>2</sub> Concentration	SO <sub>2</sub> CONCENTRATION	ppb	2.8	1.7	0 to 10,000
Motherboard Status	MOTHERBOARD STATUS	-	OK	OK	OK
Interface Status	INTERFACE STATUS	-	OK	OK	OK

Calibrate By :

(MR.PANUPON PODANG)  
November 9, 2022



Checked By :

(MS.SUTATIP IM-NOI)  
November 9, 2022



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

#### Analyzer Performance Test

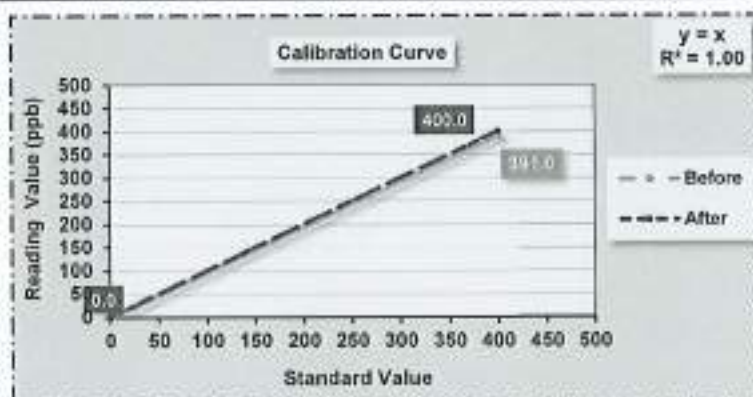
Equipment	Gas Analyzer ( SO <sub>2</sub> )	Customer Name	โพธิ์เพชร คลานชีลแลนส์
Manufacture	Thermo	Location	Envir Research
Model	43C	Scientist	Panupon
Serial No.	64390-343/2	Calibration Date	November 9, 2022
Analyzer Unit	ppb	Time	11:45 AM

#### Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyle	300T	0172
Standard Gas Components	CO = 4.516 ppm		
Cylinder No : EB0123013	NO = 55.3 ppm		
Expire Date : Oct 22, 2027	SO <sub>2</sub> = 54.9 ppm		

#### Single Point Calibration

Standard Gas	Standard Gas Value	Analyzer Value ( ppb )		Stability		% Abs Error
		Before	After	Before	After	
Zero	0	-0.4	0.0	-	-	-
Span	400	391.0	400.0	-	-	2.3



#### 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	36.4	34.5	8.0 °C to 47.0 °C
Chamber Temp	CHAMBER	°C	45.7	45.6	43.0 °C to 47.0 °C
Pressure	PRESSURE	mmHg	720.7	719.2	400.0 to 1,000
Sample Flow	SAMP FLOW	LPM	0.660	0.661	0.350 to 1,000
Lamp Intensity	INTENSITY	Hz	21,753	21,583	20,000 to 50,000
Lamp Voltage	LAMP VOLTAGE	V	885	899	750 to 1,200
SO <sub>2</sub> Concentration	SO <sub>2</sub> CONCENTRATION	ppb	1.1	1.9	0 to 10,000
Motherboard Status	MOTHERBOARD STATUS	-	OK	OK	OK
Interface Status	INTERFACE STATUS	-	OK	OK	OK

Calibrate By :

(MR.PANUPON PODANG)  
November 9, 2022

Checked By :

(MS.SUTATIP IM-NOI)  
November 9, 2022



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

#### Analyzer Performance Test

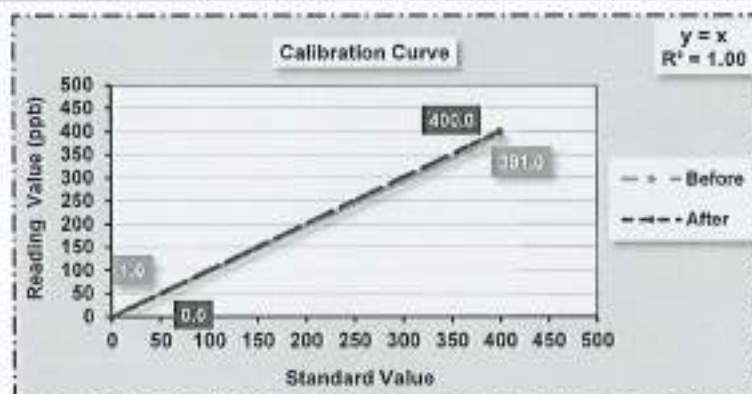
Equipment	Gas Analyzer ( SO <sub>2</sub> )	Customer Name	โพธิ์ชัย คลังชัยมงคล
Manufacture	Thermo	Location	Envi Research
Model	43C	Scientist	Panupon
Serial No.	0335804029	Calibration Date	November 9, 2022
Analyzer Unit	ppb	Time	2:25 PM

#### Instruments for Calibration

Instruments	Manufacture	Model	Serial Number
Zero Air Supply	Thermo Env.	111	0700419829
Dynamic Dilution Calibrator	Tanabyte	300T	0172
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	1.0	0.0	-	-	-
Span	400	391.0	400.0	-	-	2.3



#### 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	30.1	8.0 °C to 47.0 °C
Chamber Temp	CHAMBER	°C	43.8	43.8	43.0 °C to 47.0 °C
Pressure	PRESSURE	mmHg	724.8	724.7	400.0 to 1,000
Sample Flow	SAMP FLOW	LPM	0.644	0.644	0.350 to 1.000
Lamp Intensity	INTENSITY	Hz	26,828	26,574	20,000 to 50,000
Lamp Voltage	LAMP VOLTAGE	V	819	823	750 to 1,200
SO <sub>2</sub> Concentration	SO <sub>2</sub> CONCENTRATION	ppb	2.2	1.2	0 to 10,000
Motherboard Status	MOTHERBOARD STATUS	-	OK	OK	OK
Interface Status	INTERFACE STATUS	-	OK	OK	OK

Calibrate By :

(MR.PANUPON PODANG)  
November 9, 2022



Checked By :

(MS.SUTATIP IM-NOI)  
November 9, 2022



# **CERTIFICATE OF ANALYSIS**

## **Grade of Product: EPA Protocol**

Part Number:	E04N199E15A0292	Reference Number:	160-401604495-1
Cylinder Number:	FB0123013	Cylinder Volume:	141.4 Cubic Feet
Laboratory:	124 - Pottsville - PA	Cylinder Pressure:	2035 PSIG
PCVP Number:	A12019	Valve Outlet:	6HO
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 Gases to Calibration Standards (May 2012) document 15-110014-12-031, 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.

Gas Not Used 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	55.03 PPM	55.27 PPM	G1	+/- 0.8% NIST Traceable	10/14/2019 - 10/22/2019
NITRIC OXIDE	55.03 PPM	55.27 PPM	G1	+/- 0.8% NIST Traceable	10/14/2019 - 10/22/2019
SULFUR DIOXIDE	55.03 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	16010735	KAL004419	97.89 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021
NTRM	08012019	KAL004620	4557 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 27, 2024

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
MKS FTIR - CO - 000929781	FTIR	Sep 20, 2019
MKS FTIR - NO - 000929781	FTIR	Oct 18, 2019
MKS FTIR - NOx - 000929781	FTIR	Oct 18, 2019
MKS FTIR - SO2 - 000929781	FTIR	Oct 03, 2019

Triad Data Available Upon Request

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



*[Signature]*  
Approved for Release



## THAI METEOROLOGICAL DEPARTMENT

4553 Sakitama c. Eucema, 819gkak 13260 Tel. 031-454-2464. 13775-6479

## Calibration Certificate

revised by: Catherine S. Lee; Section: Vascular/Endovascular Interventions; 2004a

Безопасность 4.1-го кв. 2022

Conference No. 21575

Page - 1 of 1

240 SCI WATER RESOUR

kanaladure 24.5137.0012.00.

Page 40 Page 40

NAME	FILE	ADDRESS	DATE
...	...	...	...

**Customer:** Environment Research & Technology Co., Ltd.  
251/10111 Moo 5 Soi Chinnak 1, Nongnongwan Road,  
Tuchasachong Subur, Bangkok 10210

Cell Culture Condition: Temperature	25 ° C	Barometric Pressure	1009.2 mmHg
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NATIONAL STANDARD WIND TUNNEL

THEO. NORTON-ANDERSON 642 515 553

• POC: GATE NO 1626      Postcode: 600095      Phone: 98401 0000      Email: [info@gate.ac.in](mailto:info@gate.ac.in)

U.S. - 100% Reciprocity Number: 15164143/

• 2540212-98765 20-30 10000

U.S. Patent & Trademark Office      35 U.S.C. § 101      (continued on TP-005A-4)

Serial Number : 10190220 User ID : 170820390

APR 2 1974

• **Documente** în număr de 24 0 - 250 mîneci

### STANDARD THERMOMETER

: Fredrick E. Smith Dr. V. G. G. M. Smith, B. S. C.

11-11-1994

Collected by

Not signed

**P.O. Box 900000 • Silverdale**

## Technical Notes

## THAI METEOROLOGICAL DEPARTMENT

4953 Sukhumvit Rd., Bangkok 10260 Tel: 001-454-2314, 8-1392-8469

### The Result of Calibration

Confidential No. 21221

16 June 2022

Page 2 of 2

Standard	HCOX GAGE NO. 1421			TESTED ANEMOMETER	
	Pressure	Vacuum	Static	Velocity	Current
mm Hg	mm Hg	mm Hg	mm Hg	ft/min	amps
1.00	-	-	-	0.4	0.50
5.00	-	-	-	2.0	0.62
5.07	-	-	-	4.9	1.10
10.00	-	-	-	9.7	1.37
10.00	-	-	-	16.5	0.62
11.51	-	-	-	16.7	0.21
13.01	-	-	-	17.4	1.31
15.01	-	-	-	14.8	0.21
15.21	-	-	-	16.2	0.42
19.62	-	-	-	19.5	1.22

594 63: Flying Bird

LS DEPARTMENT OF COYVERT WEATHER SURVEILL

WIND DIRECTION	TESTED WIND DIRECTION
0	0
30	90
150	180
270	270

Collected by:

Mr. Thompson: Good.

Medical history:







## THAI METEOROLOGICAL DEPARTMENT

433 Sukhumvit, Bangna, Bangkok 10561 Tel. 011-456-2864,8-2299-0469

### The Result of Calibration

Calibration No. 21523

14 Jan. 2022

Page : 1 of 1

Standard Temp.	Temperature Sensor Reading	
	Fielding °C	Container °C
25.1	25.1	25.0
30.5	30.5	30.0
35.3	35.3	35.1

Calibrated by :

Mr. Wachampol Suen

Mechanics Engineer







# THAI METEOROLOGICAL DEPARTMENT

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

## Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 28 December, 2021

Certification No. 547/21

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : Davis Instruments Inc.

Type : Weather Wizard III Product No. 7425

Serial No. : WE9101GA18 ID No. : Nu.7

Customer : Environment Research & Technology Company Limited.  
25/13-114 Mo0 6 Soi Chanaeet 1, Ngamwongwan Road,  
Toongsonghong, Lakki, Bangkok 10210.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1014.6 hPa

### NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91563

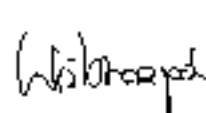
: HOOK GAGE NO 1425 Pilot Tube Treadler Friedrichs Typm 0500.0000 serial 9073

N.I.S.I. Test Reference Number 731/241460

: Ultrasonic Anemometer Model DA-650-31V (sensor 1X-90A-II)

Serial Number 113730029 (sensor 120620586)

### JAPAN QUALITY ASSURANCE ORGANIZATION

Calibrated by : 

Mr. Watcharapol Subwat

Mechanical Engineer

Signed :

Mr. Pissod Promsat







# THAI METEOROLOGICAL DEPARTMENT

435A Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-0469

## The Result of Calibration

Certification No. 547/21

28 December, 2021

Page : 2 of 2

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuuming	Velocity	Velocity	Correction
m/sec	mbar H2O	mbar Hg	m/sec	m/sec	m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.2	0.82
5.00	-	-	-	4.5	0.50
7.04	-	-	-	6.7	0.34
9.02	-	-	-	8.5	0.52
11.01	-	-	-	10.7	0.31
13.01	-	-	-	12.5	0.51
15.01	-	-	-	14.3	0.71
17.02	-	-	-	16.5	0.52
20.02	-	-	-	19.1	0.92

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

*Watcharaporn*

Mr. Watcharaporn Subwat

Mechanical Engineer







# THAI METEOROLOGICAL DEPARTMENT

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

## Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 9 February, 2022

Certification No. 040/22

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : Davis Instruments Inc.

Type : Weather Wizard III Product No. 7425

Serial No. : WC20516A50 ID No. : No.13

Customer : Environment Research & Technology Company Limited  
25/113-114 Moo 6 Soi Chinakri, 1, Ngamwongwan Road,  
Toongsongkhong, Lakse, Bangkok 10210

Calibration Condition : Temperature : 25.1 °C Barometric Pressure : 1012.9 hPa

### NATIONAL STANDARD WIND TUNNEL

Thermal Anemometer G42 S/N 01563

HOOK GAGE NO 1425 Filter Tube Thru-hole Products Type 0600 0000 serial 9023

NIST Test Reference Number : 731/241460

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

Serial Number : 10730029 (sensor 120629066)

### JAPAN QUALITY ASSURANCE ORGANIZATION

Calibrated by :

Mr. Watchanapol Suhwat

Mechanical Engineer

Signed

Mr. Pongsak Thonsut







# THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-4469

## The Result of Calibration

Certification No. 040/22

9 February, 2022

Page : 1 of 1

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1435			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
	hPa (100)	hPa (100)	m/sec	m/sec	m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.5	0.50
7.04	-	-	-	6.7	0.34
9.02	-	-	-	8.5	0.52
11.01	-	-	-	10.7	0.31
13.01	-	-	-	12.1	0.91
15.01	-	-	-	14.7	0.31
17.02	-	-	-	16.1	0.92
20.02	-	-	-	19.7	0.32

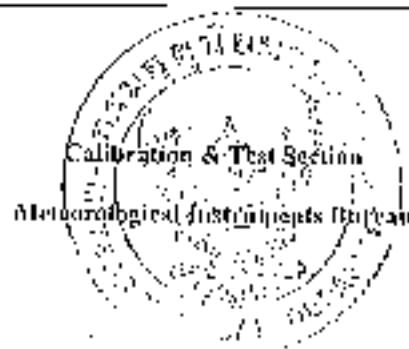
Wind Aft Plotting Board	
U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated by :

*Wacharaporn Subwat*

Mr. Wacharaporn Subwat

Mechanical Engineer







# THAI METEOROLOGICAL DEPARTMENT

4353 Suddumvit, 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. 788/22

Page : 1 of 2

Object : Wind speed and wind direction

Manufacturer : Davis Instruments Inc.

Type : Weather Wizard III Product No. 7425

Serial No. : WC10801A97 ID No. : No 16

Customer : Environment Research & Technology Company Limited.  
25/113-114 Mou 6 Soi Chinakel 1, Ngamwongwan Road,  
Tonngsonghong, Laksi, Bangkok 10220.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1005.2 hPa

### NATIONAL STANDARD WIND TUNNEL :

: Micromanometer Treddor Friedrichs F2014 Serial No. 9310119

: HOOK GAGE NO 1425 Pilot Tube Theodolite Friedrichs Type 0820.0002 serial 9023

N.I.S.I. Test Reference Number : 31/241460 : Standard velocity at 30 - 30 m/sec

: Ultrasonic Anemometer Model DA-650-31V (sensor TR-90AH)

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0.70 m/sec

Calibrated by :   
Mr. Wacharapol Subwat  
Mechanical Engineer

Signed :   
Mr. Pisob Promsat







# THAI METEOROLOGICAL DEPARTMENT

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

## The Result of Calibration

Certification No. 288/22

10 August, 2022

Page : 2 of 2

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1475			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	mm Hg	inches Hg	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	-	-	-	8.5	0.52
11.01	-	-	-	10.7	0.31
13.01	-	-	-	13.0	0.01
15.01	-	-	-	14.8	0.21
17.02	-	-	-	17.0	0.02
20.02	-	-	-	19.7	0.32

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

Calibrated by :

*Wattanasakul*

Mr. Wattanasakul Sibwat

Mechanical Engineer















THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0768

MITC No. EEL. BP. 33/0965

## CALIBRATION CERTIFICATE

**Submitted by** : Environment Research & Technology Co., Ltd.  
**Address** : 25/114 Moo 6, Soi Chinakiet 1, Ngamwongwan Road, Toongsongkhong, Laksi, Bangkok 10210.  
**Calibrated at** : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.  
 : Soi 1C, Bangpon Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated :		Ambient Environment	
Description	: Sound Calibrator	Temperature	: $(23 \pm 3) ^\circ\text{C}$
Manufacturer	: BSWA	Relative Humidity	: $(50 \pm 15) \%$
Model	: CA114	Ambient Pressure	: $(101.325 \pm 1.500) \text{ kPa}$
Serial No.	: 590048		

**Standards used** :

1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier Brüel&Kjær 2636 S/N 1517484.
3. Programmable Attenuator Tanigawa TPA-303A S/N OF 2214.
4. Digital Multimeter Agilent 34401A S/N MY44005560.
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
6. Audio Analyzer Panasonic VP-7722A S/N 041477D122.
7. Condenser Microphone Brüel&Kjær 4186 S/N 2633526.

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

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

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

**Date of Receipt** : 16 Sep. 2022

**Date of Calibration** : 23 Sep. 2022

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

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FM.BL.MTC.002 Rev.4

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

**Office/Laboratory**  
 Soi 1C, Bangpon Industrial Estate, Sukhumvit Road,  
 Amphoe Muang Changsat Samutprakan 10280, Thailand  
 Tel. (66) 0 2323 1672-30 ext. 115, 116  
 Fax. (66) 0 2323 9165  
 E-mail : tistr@tistr.or.th

**Office**  
 196 Pathayayintha Road, Chatuchak, Bangkok 10900,  
 Thailand  
 Tel. (66) 0 2579 1121-30 ext. 5212, 5225, 5217  
 Fax. (66) 0 2579 8597  
 E-mail : sumalee@tistr.or.th





## THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0768

MTC No. EEL DP. 33/0965

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

Nominal Output of Unit Under Test = 94 dBA re 20µPa at 1000 Hz

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

## 1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Brüel&Kjaer 4180	93.91	0.09	± 0.10	± 0.75 dB

## 2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Brüel&Kjaer 4180	1000.5	0.5	± 1.5	± 2.0%

## 3. Total distortion

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

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

W R  
(Mr. Weerachai Deechaiyue)

Approved by :

Prasert Kluyapa  
(Mr. Prasert Kluyapa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 23 Sep. 2022

Date of Issue : 26 Sep. 2022

Ref : 2011265091604083001

End of Certificate

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I.M.B.L/MTC 002 Rev.1

Head Office  
25 Mu. 3 Tambon Khlong Ha, Amphoe Khlong Luang,  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax. (66) 0 2577 9309  
E-mail : rumpai@tistr.or.th Website : www.tistr.or.th

Office/Laboratory  
Soi 10, Bangpu Industrial Estate, Sukhumvit Road,  
Amphoe Bangpu, Changwat Samutprakan 10280, Thailand  
Tel. (66) 0 2921 1612-80 ext. 115, 116  
Fax. (66) 0 2923 9165  
E-mail : info@tistr.or.th

Office  
196 Phahonyothin Road, Chatuchak, Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217  
Fax. (66) 0 2572 8992  
E-mail : sumee@tistr.or.th



<b>Support Equipment Type</b>	: Sound Level Calibrator
<b>Manufacture</b>	: Quest Technologies QC-10
<b>Model</b>	: QC-10
<b>Serial No.</b>	: QI9010208
<b>Range of Calibrator</b>	
- Sound Pressure Level	: 114.2 dB.
- Frequency	: 1,000 Hz.
<b>Calibrated By</b>	: Mr.Nitad Sirichad
<b>Calibration Date</b>	: November 14, 2022
<b>Customer Name</b>	: บริษัท ไฟร์เทียร์ คอนซัลแตนต์ จำกัด : โครงการผลิตไอน้ำและไฟฟ้าขนาดเล็ก ของบริษัท บี.กริม เพาเวอร์ (อย่างทอง) 1 จำกัด

Checked By

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

Page 2/2





THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-654032

MTC No. FEL. BP. 96/0865

## CALIBRATION CERTIFICATE

**Submitted by** : Environment Research & Technology Co.,Ltd.  
**Address** : 25/114 Moo 6, Soi Chinaket 1, Ngamwongwan Road, Toungsonghung, Laksi, Bangkok, 10210.  
**Calibrated at** : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.  
 : Soi 1C, Bangsoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

### Instrument Calibrated :

**Description** : Acoustic Calibrator  
**Manufacturer** : Quest Technologies  
**Model** : QC-10  
**Serial No** : Q19010208

### Ambient Environment

**Temperature** :  $(23 \pm 3) ^\circ\text{C}$   
**Relative Humidity** :  $(50 \pm 15) \%$   
**Ambient Pressure** :  $(101.325 \pm 1.500) \text{ kPa}$

**Standards used** :

1. Digital Function Synthesizer NF Electronic DF-192A S/N 122037.
2. Measuring Amplifier Briel&Kjaer 2636 S/N 1537484.
3. Programmable Attenuator Yamagawa TPA-303A S/N OF 7214.
4. Digital Multimeter Agilent 34401A S/N MY44005560.
5. Pressure Transmitter Vaisala PTB702AD S/N T0650001.
6. Audio Analyzer Panasonic VP-7722A S/N 041477D122.
7. Condenser Microphone B&K 4180 S/N 2633526.

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

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

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

**Date of Receipt** : 29 Aug. 2022

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

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

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FM&I MTC.002 Rev.4

Head Office  
 35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,  
 Changwat Pathumthani 12120, Thailand  
 Tel. (66) 0 2577 9036  
 Fax (66) 0 2577 9009  
 E-mail : mtpa@tistr.or.th Website: www.tistr.or.th

Office/Laboratory  
 Soi 1C, Bangsoo Industrial Estate, Sukhumvit Road,  
 Amphoe Muang, Changwat Samutprakan 10260, Thailand  
 Tel. (66) 0 2323 1672-80 ext. 115, 116  
 Fax (66) 0 2323 7165  
 E-mail : mtr@tistr.or.th

Office  
 180 Phahonyothin Road, Chatuchak, Bangkok 10900,  
 Thailand  
 Tel. (66) 0 2579 1121-30 ext. 3219, 3225, 5214  
 Fax (66) 0 2579 8592  
 E-mail : vimala@tistr.or.th





## THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0732

MTC No. EETL-BP-96/0865

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

Nominal Output of Unit Under Test = 114 dB re 20  $\mu$ Pa at 1000 HzAcoustic Output in dB re 20  $\mu$ Pa, Corrected to Reference Conditions: 101.325 kPa, 23.0 °C and 50 %RH.

## 1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjær 4180	114.18	0.18	$\pm 0.10$	$\pm 0.40$ dB

## 2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjær 4180	997.3	2.7	$\pm 1.5$	+1.0%

## 3. Total Distortion

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

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

(Mr. Weerachai Deechaiyao)

Approved by :

(Mr. Prawat Kludaya)  
Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 6 Sep. 2022

Date of Issue : 7 Sep. 2022

Ref : 2011265082903844602

End of Certificate

2 / 2

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

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FM/ELMTC-002 Rev.0

Head Office  
35 Mu 3 Tambon Khlong Ha Amphoe Arany Luang  
Changwat Pathumthani 12120, Thailand  
Tel. (66) 0 2577 9000  
Fax (66) 0 2577 9709  
E-mail : tistr@tistr.muth.go.th Website : www.tistr.muth

Office/Laboratory  
Sci 10 Bangkok Industrial Estate, Sukhumvit Road,  
Amphoe Muang, Changwat Nakhon Phanom 10280, Thailand  
Tel. (66) 0 2323 1670 ext. 115, 116  
Fax (66) 0 2323 9265  
E-mail : mtc@tistr.muth

Office  
156 Phahonyothin Road, Chit Lhak Bangkok 10900,  
Thailand  
Tel. (66) 0 2579 1121 ext. 3219, 5225, 5237  
Fax (66) 0 2579 8592  
E-mail : kumte@tistr.muth



เอกสารการสอบเทียบเครื่องมือตรวจวัด  
บริษัท เทสท์ เทค จำกัด



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ใบรับรองการสอบเทียบ "เทอร์โมมิเตอร์"

(Calibration Certificate of Liquid in Glass Thermometer)





TECHNOLOGY PROMOTION ASSOCIATION (TITAJAPAN-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
534/4 RATTANAKATIN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL. 0-2717-4000-24 FAX. 0-2719-9484



## Certificate of Calibration

Certificate No. : 22T781

Page : 1 of 2

Equipment : Digital Thermometer With Sensor  
Manufacturer : Testo  
Model : 925  
Serial No. : 609280110250914  
ID No. : EQJL-058

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.

Condition As-Received: Used Item

Received Date: 07 April 2022

Calibration Date: 19 April 2022  
In 22 April 2022

Reference: 2204-0167DN

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

Ambient Temperature: ( 25 ± 3 ) °C

Relative Humidity: ( 53 ± 20 ) %

30/32 Rama II Soi 63, Rama II Rd., Sarnardam,  
Bangchunthian, Bangkok 10150

Procedure used: Calibration were conducted using in-house calibration procedure CP-TC1 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 :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Slack Slack Thermometer	1560	80454	21 567	22 May 2022
2) PRT Scanner Module	2562	A01303	211567	22 May 2022
3) Industrial Platinum Resistance Thermometer	5627-12	571971	211567	22 May 2022
4) Digital Thermometer	1529	A06176	2111248	18 Nov 2022
5) Industrial Platinum Resistance Thermometer	5627	739435	2111248	18 Nov 2022

2. The certificate is valid only in the item calibrated on date and place of calibration.

3. This Certificate is traceable to the International System of Unit maintained at:

- National Institute of Metrology Thailand (NIMT)

Calibrated by : Chalchanan Chankong  
Issue Date : 28 April 2022

Approved Signatory :

( | Pralinee Prabparai  
| Chalchawan Khunpluek  
| ✓ Wanlop Lerpkan

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Cert. No.: 22T781

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	3.0047	2.9	-0.1047	0.26
150	20.0045	20.0	-0.0045	0.24
150	35.0029	34.9	-0.1029	0.24
150	103.0039	102.8	-0.2039	0.36
150	104.0025	103.8	-0.2025	0.36
150	120.0027	119.8	-0.2027	0.42
150	140.0026	139.6	-0.4026	0.47
150	150.0038	149.6	-0.4038	0.49
150	170.0025	169.6	-0.4025	0.55
150	180.0068	179.5	-0.5068	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 5 mm, Length 112 mm. Sheath material : Stainless Steel

Immersion Depth ( mm )	Standard Temperature ( °C )	UUC* Reading ( °C )	Error ( °C )	Uncertainty of Measurement ( ± °C )
150	41.5024	41.4	-0.1024	0.24
150	45.0039	44.8	-0.2039	0.24
150	60.0039	49.8	-0.2039	0.24
150	83.0046	82.7	-0.3046	0.31
150	92.0037	91.8	-0.2037	0.33
150	95.0038	94.6	-0.4038	0.34
150	150.0033	149.3	-0.7033	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%.

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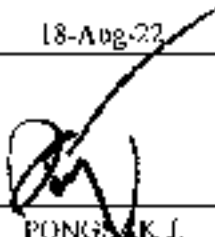


CERTIFICATE No : ZUT8762  
REFERENCE No : 66179-2

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : LIQUID IN GLASS THERMOMETER  
MANUFACTURER : PRECISION  
MODEL : ---  
SERIAL No : 8925  
ID No : EQL-102  
RESOLUTION : 0.1 °C  
TYPE : TOTAL IMMERSION  
CONDITION AS RECEIVED : USED ITEM  
SUBMITTED BY : TEST TECH CO., LTD.  
70,72 RAMA II SOI 63, RAMA II RD., SAMAEK DAM,  
BANGKHUNTHIAN, BANGKOK 10150

CALIBRATED BY : CHARUKIT L.  
CALIBRATION DATE : 18-Aug-22  
APPROVED BY :   
PONGKARN J.  
ISSUED DATE : 18-Aug-22  
RECEIVED DATE : 14-Aug-22





# QUALITY CALIBRATION CO., LTD.

235 Petchkasorn 64/2 Road, Lat-sung, Bang-gae, Bangkok 10150

Tel (662) 421 5402 (662) 444-0152-3, Fax (662) 803-1584

www.qcclibration.com

CERTIFICATE No : 22T8762

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT	:	LIQUID IN GLASS THERMOMETER		
MANUFACTURER	:	PRECISION		
MODEL	:	~		
ID No	:	EQC-105	SERIAL NUMBER	: 8925
RESOLUTION	:	0.1 °C	TYPE	: TOTAL IMMERSION
RECEIVED DATE	:	11-Aug-22	CALIBRATION DATE	: 18-Aug-22
AMBIENT TEMPERATURE	:	23 °C ± 3 °C	RELATIVE HUMIDITY	: 56%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) IN O LIQUID BATH TEMPERATURE CONTROLLER. THE TEMPERATURE SCALE USED WAS BASED ON ITS-90.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
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 (1°C)
30.0214	20.9	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





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
5344 PATTAKARN ROAD NO. 18, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL. 0-2711-3000-24 FAX. 0-2719-9184



## Certificate of Calibration

Certificate No. : 2242157

Page : 1 of 2

Equipment : Dual Thermo-Hygrometer  
Manufacturer : Rarigo  
Model : -  
Serial No. : -  
ID No. : FOL 064  
Condition As-Received: Used Item  
Received Date: 17 October 2022  
Calibration Date: 25 October 2022  
to 28 October 2022  
Reference: 2210-0401DN  
Ambient Temperature:  $( 25 \pm 3 ) ^\circ\text{C}$   
Relative Humidity:  $( 50 \pm 20 ) \%$

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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 VI Soi (3), Rama VI Rd.,  
Samsatani, Bangkokkhan, Bangkok 10150

**Procedure used:** Calibration was 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 :

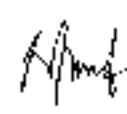
Instrument	Model	Serial No.	Certificate No.	Due Date
1) Chilled-Mirror Hygrometer	Dew Master	41292	110846	03 Nov 2022
2) Handheld Thermometer With Sensor	1523	3240076	221249	02 Mar 2023

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 Phansudho  
Issue Date : 01 November 2022

Approved Signatory :   
[ ☒ ] Chakrit Wutwanjua  
[ ☐ ] Pornthipasa Taneyakul  
[ ☐ ] Viporn Tanliyawuti





Cert. No.: 22-H2197

Page: 2 of 2

**Result of Calibration:-**

Without Adjustment

Function:

Humidity measurement.

Reference Temperature (°C)	Standard Humidity (%RH)	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 based on standard uncertainty multiplied by coverage factor  $k = 2.00$ , providing confidence level approximately 95%.

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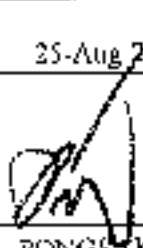


CERTIFICATE No : 21T3008  
REFERENCE No : 62147-1

PAGE: 1 OF 2

## Certificate of Calibration

EQUIPMENT : LIQUID IN GLASS THERMOMETER  
MANUFACTURER : PRECISION  
MODEL : G12004  
SERIAL No : ---  
ID No : EQ1-111  
RESOLUTION : 1 °C  
TYPE : TOTAL IMMERSION  
CONDITION AS RECEIVED : USED ITEM  
SUBMITTED BY : TEST TECH CO., LTD.  
1032 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKIJUNTHIAN, BANGKOK 10150

ALIBRATED BY : CHARUKIT L.  
CALIBRATION DATE : 25-Aug-21  
APPROVED BY :   
PONGSAK J.  
ISSUED DATE : 25-Aug-21  
RECEIVED DATE : 18-Aug-21



**QUALITY CALIBRATION CO.,LTD.**

235 Prachinwong 67/2 Road, Lakang, Bangkok, Bangkok 10160

Tel (662) 421-5492, (662) 444-0132-3, Fax (662) 809-4584

www.qcalibration.com

CERTIFICATE No. : 21T8228

PAGE : 2 OF 2

**Calibration Report**

EQUIPMENT	:	LIQUID IN GLASS THERMOMETER	SERIAL NUMBER	:	---
MANUFACTURER	:	PRECISION	TYPE	:	TOTAL IMMERSION
MODEL	:	Q13004	CALIBRATION DATE	:	25-Aug-21
ID No	:	EQ1-11	RELATIVE HUMIDITY	:	50 %RH $\pm$ 10 %RH
RESOLUTION	:	1 °C			
RECEIVED DATE	:	18-Aug-21			
AMBIENT TEMPERATURE	:	23 °C $\pm$ 3 °C			

**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 :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD THERMOMETER	1529	A22167	20T12169	10-Dec-21
2) SPRT PROBE	3512	583112	20T12169	10-Dec-21
3) PRECISION BATH	7320	A21105	20T12163	16-Dec-21

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

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE LINE 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)	LUC* READING (°C)	IMMERSION DEPTH (mm)	CORRECTION (°C)	EMERGENT STEM TEMPERATURE (°C)	UNCERTAINTY OF MEASUREMENT (°C)
114.9054	115.0	110	-0.0946	N/A	0.14
120.9149	121.0	120	-0.0851	N/A	0.14

\* LUC : 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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ใบรับรองการสอบเทียบ "เครื่องวัดความนำไฟฟ้า"  
(Calibration Certificate of Conductivity Meter)





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES  
45/4 PATTANAKARN ROAD SOI 13, SUANLUANG, SUANLUANG DISTRICT, BANGKOK 10310  
TEL. 0-2717-1100-21 FAX. 0-2719-9181



Cert.No.: 22CH120

Page.: 1 of 3

## Certificate of Calibration

Equipment :	Conductivity Meter
Manufacturer :	TOA DKK
Model :	CM-41X
Serial No. :	842572
ID No. :	EOL-211
Condition As-Received:	Used Item
Received Date :	24 January 2022
Calibration Date :	28 January 2022
Reference :	2201-0646DN-1
Submitted by :	TEST TECH CO.,LTD (HEAD Office) 30/32 Rama II Soi 63, Rama II Rd., Samaedam, Bangkhuntian, 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 Lomgagtrakul

Approved by :

Approved Signatory

- ☒ Matee Bulkrass  
☐ Saithip Meangmai  
☐ Warakorn Lomgagtrakul

Issue Date : 3 February 2022

The Uncertainties are for a confidence probability of approximately 95%

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

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Cert.No.: 22CH120

Page: 2 of 3

**Condition of this result of calibration****1. Reference Standard Instrument :-**

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Certificate No.</u>	<u>Due date</u>
1) Thermometer	1963878	130RC096	211377	17 Sep 2022
2) Ref. Std. Thermometer	4982054	110RC044	2111201	26 Oct 2022

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

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

**2. Certified Reference Material's :-**

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

<u>Conductivity Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
147.0 $\mu\text{S/cm}$	CPA Chem	761020	02 Aug 2022
1.413 $\text{mS/cm}$	CPA Chem	761021	02 Aug 2022
12.8806 $\text{mS/cm}$	CPA Chem	754037	28 June 2022

- 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, 12880.6  $\mu\text{S/cm}$ 

Conductivity Electrode Serial No.: B06F0005

<u>Standard Conductivity Solution</u>	<u>Before Adjustment UUC* Reading</u>	<u>After Adjustment UUC* Reading</u>	<u>Uncertainty of Measurement (<math>\pm</math>)</u>	<u>Coverage factor k</u>
147.0 $\mu\text{S/cm}$	149.1 $\mu\text{S/cm}$	146.9 $\mu\text{S/cm}$	0.99 $\mu\text{S/cm}$	2.00
1.413 $\text{mS/cm}$	1.424 $\text{mS/cm}$	1.413 $\text{mS/cm}$	0.0092 $\text{mS/cm}$	2.00
12.8806 $\text{mS/cm}$	12.81 $\text{mS/cm}$	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 =  $98.4\text{m}^{-1}$ - 1.413  $\text{mS/cm}$  Adjustment Cell constant =  $99.2\text{m}^{-1}$ - 12.8806  $\text{mS/cm}$  Adjustment Cell constant =  $100.7\text{m}^{-1}$ 

a 1092322





Cert.No.: 22CH-120

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	25.1	0.097	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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ใบรับรองการสอบเทียบ "ตุ้มน้ำหนักมาตรฐาน"  
(Calibration Certificate of Standard Weights)





## Certificate of Calibration

Certificate No. : 22M193

Page : 1 of 2

Equipment : Standard Weight

Manufacturer: LS

Model : -

Serial No. : -

ID No. : COL-121

Condition As-Received: Used Item

Received Date: 03 February 2022

Calibration Date: 08 February 2022

Reference: 2202-0110DN

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

Ambient Temperature:  $( 23 \pm 2 ) ^\circ\text{C}$

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

Atmospheric Pressure: 1011 mbar

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.

30,52 Rama II Soi 53, Rama II Rd , Samaeberm,  
Bangkhunhian, 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  $1.2 \text{ kg/m}^3$  and a temperature  
of  $23 ^\circ\text{C}$  material density of weight is  $8000 \text{ kg/m}^3$

### 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-0102-20	13 Jul 2022

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.

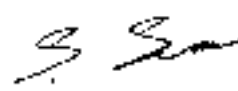
4. This Certification is traceable to the International System of Unit maintained at:-

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suwal Wulhicharoenmongkol

Issue Date : 08 February 2022

Approved Signatory :

  
[ ] Phallnee Prabpaipai  
[x] Sura Suwannas  
[ ] Chaowalit Ritirak





Cert No.: 22M106

Page: 2 of 2

**Result of calibration**

Without adjustment

Nominal Value	Conventional mass	Uncertainty of Measurement ( $\pm$ )	Maximum Permissible error ( $\pm$ )
50 g	50.0008 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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
3344 WITANAKARN ROAD SOI 13, SUANLUANG, SUANLUANG, BANGKOK 10250  
TEL. 0-2717-9099-24 FAX. 0-2715-9434



## Certificate of Calibration

Certificate No. : 22M1063

Page : 1 of 2

Equipment : Standard Weight

Manufacturer :

Model :

Serial No. : M 205571

ID No. : EOL-139

Condition As-Received: Used Item

Received Date: 15 August 2022

Calibration Date: 24 August 2022

Reference: 2253-D438DN

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

Ambient Temperature:  $(23 \pm 2) ^\circ\text{C}$

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

Atmospheric Pressure: 1009 mbar

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

30, 32 Rama II Soi 53, Rama II Rd.,

Samaedam, Bangkokhuan, 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  $1.2 \text{ kg/m}^3$  and a temperature of  $23.0 ^\circ\text{C}$  (material density of weight is  $8000 \text{ kg/m}^3$ )

### 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	30202965	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 : Chawalit Rittak

Issue Date : 25 August 2022

Approved Signatory : \_\_\_\_\_

☐ Phaloon Pratsarpai

☒ Sure Suwanasuri

☐ Chawalit Rittak

B 0295804





Cert No.: 22M1503

Page 2 of 7

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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TECHNOLOGY PROMOTION ASSOCIATION (TPA) AND JAPAN  
CORPORATE SERVICES 3. EQUIPMENT CALIBRATION AND TESTING SERVICES  
3344 PATTAKARN ROAD SOI 13, SUKHUANG, SUKHUANG, BANGKOK 10250  
TEL. 0-2717-5000-24 FAX. 0 2719-9414



## Certificate of Calibration

Certificate No. : 21M1548

Page : 1 of 2

Equipment : Standard Weight  
Manufacturer: Mettler Toledo  
Model : -  
Serial No.: 11119459  
ID No.: ECL-149  
Condition As-Received: Used Item  
Received Date: 25 August 2021  
Calibration Date: 01 September 2021  
Reference: 2108-07724/N  
Ambient Temperature:  $(23 \pm 2) ^\circ\text{C}$   
Relative Humidity:  $(40 \pm 15) \%$   
Atmospheric Pressure: 1006 mbars

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 53, Rama II Rd., Samsaen,  
Bangkhunjan, 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 weighing at an average air density of  $1.2 \text{ kg/m}^3$  and a temperature  
of  $23.0 ^\circ\text{C}$  material density of weight is  $8000 \text{ kg/m}^3$ .

### 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)	MC531-712-00	50202965	MM-0102-20	13 Jul 2022

2. This certificate is not verified 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 : Chawalit Rattarak  
Issue Date : 02 September 2021

Approved Signatory :

[x] Phalinee Praphaipal  
[ ] Sura Suwannasri  
[ ] Chawalit Rattarak





Cert No.: 21M1540

Page: 2 of 2

Result of calibration Without adjustment

Nominal Value	Conventional mass	Uncertainty of Measurement ( $\pm$ )	Maximum Permissible error ( $\pm$ )
20 g	20.000018 g	0.050 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 %

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ใบรับรองการสอบเทียบ “เครื่องวัดความขุ่น”  
(Calibration Certificate of Turbidimeter)



## Certificate of Calibration

Equipment:	TURBIDIMETER	Certificate No.:	008220157
Model:	2100N	Issued Date:	21 September 2022
Serial No. (or ID.):	97040003415 (EQL-024)	Job No.:	KSPR2211615
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.  
1194 Sol Wachirathamsathit 57, Sukhumvit 101/1 Rd.,  
Bangchak, Prakhnong, Bangkok 10260 Thailand

**Calibration By:** Mr. Wasan Nuchnabee

**Calibration Date:** 21 September 2022


**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 StabCal accepted by United States Environmental Protection Agency (EPA) through Hach Company Certificate No. A1075 , A1074 , A1091 , A1074 , A1074



(Mr. Wasan Nuchnabee)

Person in charge



(Mr. Thalerngkeat Pongngam)

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.

DKSH Technology (Thailand) Co., Ltd.  
DKSH Technology Limited  
2531 Sukhumvit Road, Bangkok, Prakhnong, Bangkok 10260  
2628 Sukhumvit Road, Bangkok, Prakhnong, Bangkok 10260  
Phone: 166 2628 7000 Email: info.dksh@dksh.com Website: www.dksh.com/thailand/bkk-office



## Calibration Results:

### Before Adjustment

Std Turbidity (NTU)	UUC Reading	Correction	Deviation	Uncertainty
0.060	0.048	0.012	0.0004	0.070
20.40	20.1	0.30	0.05	1.0
206.0	204	2.0	0.5	10
1020.0	1013	7.0	1.2	50
4065.0	3875	190.0	1.8	200

### After Adjustment

Std Turbidity (NTU)	UUC Reading	Correction	Deviation	Uncertainty
0.060	0.057	0.003	0.0015	0.070
20.40	20.5	-0.10	0.04	1.0
206.0	206	0.0	0.5	10
1020.0	1018	2.0	0.5	50
4065.0	4064	1.0	0.5	200

**The End of Certificate**



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ใบรับรองการสอบเทียบ "เครื่องวัด pH"  
(Calibration Certificate of pH Meter)





CERTIFICATE No : 22E0980  
REFERENCE No : 63904 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., SAMARDAM,  
BANGKIUUNTHUAN, BANGKOK 10150

CALIBRATED BY : PRASERT P.  
CALIBRATION DATE : 02-Feb-22

APPROVED BY :   
PONGSAK J.

ISSUED DATE : 02-Feb-22

RECEIVED DATE : 02-Feb-22





CERTIFICATE No : 22E0980

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT	:	pH METER	MODEL	:	EM-25R
MANUFACTURER	:	DEK-TOA	SERIAL NUMBER	:	750205
ID No	:	EQF-183	CALIBRATION DATE	:	02-Feb-22
RECEIVED DATE	:	02-Feb-22	RELATIVE HUMIDITY	:	57 %RH $\pm$ 10 % RH
AMBIENT TEMPERATURE	:	25°C $\pm$ 1°C			

### CONDITION OF THIS RESULTS OF CALIBRATION

- THIS INSTRUMENT WAS CALIBRATED BY DIRECT MEASUREMENT METHOD BASED ON WI-TQ-052. 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.
- REFERENCE STANDARD INSTRUMENTS :

INSTRUMENT	MODEL	SERIAL No/ LOT No	CERTIFICATE No	DUE DATE
1) pH STANDARD SOLUTION	00651-06	CC719281	4880-12119147	05-Apr-23
2) pH STANDARD SOLUTION	00651-08	CC718727	4881-12110709	31-Mar-23
3) pH STANDARD SOLUTION	00651-10	CC717045	4882-12365356	17-Mar-23
4) PROCESS CALIBRATOR	744	7514008	21F1392	29-Apr-22
5) BATH	263014	1247 48374	21T9121	10-Sep-22
6) THERMOMETER WITH PROBE	421504	55900379	21T9129	14-Sep-22
7) STANDARD THERMOMETER	2560	A14546	USL-T0049/64	23-Nov-22

- THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.
- THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.
- 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 SN: 002F0035 MK

STANDARD pH BUFFER SOLUTION (pH)	UUC READING (pH)	CORRECTION (pH)	ACTUAL READING (mV)	UNCERTAINTY OF MEASUREMENT ( $\pm$ pH)	COVERAGE FACTOR k
4.007	4.01	-0.003	174	0.013	2.0
7.003	7.00	0.003	0.0	0.013	2.0
10.014	10.01	0.004	-172	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 ( $\pm$ °C)
25.003	25.1	80	-0.097	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



CERTIFICATE No : 21B11277  
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



**QUALITY CALIBRATION CO., LTD.**

235 Petchakosin 63/2 Road, Lakasing, Bangkok 10160

Tel (662) 421 5402, (662) 444-0152-3, Fax (662) 839-4384

CERTIFICATE No. 21E11277

PAGE. 2 OF 2

**Calibration Report**

EQUIPMENT : pH METER  
 MANUFACTURER : HANNA  
 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 WL-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	10651-06	CC719181	4880-12113147	05-Apr-23
2) pH STANDARD SOLUTION	00651-08	CC718727	4881-12110709	31-Mar-23
3) pH STANDARD SOLUTION	00651-10	CU717045	4882-12063386	17-Mar-23
4) PROCESS CALIBRATOR	744	7514008	21E1352	29-Apr-22
5) BATH	260014	1247 48074	21T9121	10-Sep-22
6) THERMOMETER WITH PROBE	421304	3500379	21T9129	14-Sep-22
7) STANDARD THERMOMETER	2563	A14546	PSL-TOM49/54	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, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



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ใบรับรองการสอบเทียบ “เครื่องวัดอุณหภูมิ-ความชื้นสัมพัทธ์”  
(Calibration Certificate of Thermo - Hygrometer)





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)  
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES  
333H PATTANAKARN ROAD NO. 18 SUKHUMVADI, SUKHUMVANG, BANGKOK 10250  
TEL. 0 2717 3000-74 FAX. 0 2717 6489



## Certificate of Calibration

Certificate No. : 22H2187

Page : 1 of 2

Equipment : Dett Thermohygrometer

Manufacturer: Barga

Model : -

Serial No : -

ID No.: EQL-064

Condition As-Received: User Item

Received Date: 17 October 2022

Calibration Date: 25 October 2022  
to 26 October 2022

Reference: 2210 04E1DN

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

Ambient Temperature: ( 25 ± 3 ) °C

Relative Humidity: ( 50 ± 20 ) %

30, 32 Rama II Soi (3, Rama II Rd.,

Sampradun, Bangchunthan, Bangkok 10150

**Procedure used:** Calibration were conducted using in-house calibration procedure CP1102 according to comparison with standard chilled mirror sensor for humidity measurement function and comparison with standard temperature probe for temperature measurement function in 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	41282	19848	03 Nov 2022
2) Handheld Thermometer With Sensor	1523	324007E	221248	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 Phansudno  
Issue Date : 01 November 2022

Approved Signatory :

[Signature]  
[Signature] : Chakrit Wisawarjue

[Signature] : Pornthipra Taneyakul

[Signature] : Viporn Tantiyawutti





Cert. No.: 72112197

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	70.5	-4.7	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 based on standard uncertainty multiplied by coverage factor  $k = 2.00$ , providing confidence level approximately 95%

-000-

*[Signature]*

a 1133179



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ใบรับรองการสอบเทียบ “ตู้อบ”  
(Calibration Certificate of Oven)





CERTIFICATE No : 22T9917  
REFERENCE No : 66549-4

PAGE 1 OF 2

## Certificate of Calibration

EQUIPMENT : HOT AIR OVEN  
MANUFACTURER : MEMMERT  
MODEL : UTE 500  
SERIAL No : GS08.0791  
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,  
BANGKHUNTIAN, BANGKOK 10150

CALIBRATED BY : CHAICHARN CH

CALIBRATION DATE : 15-Sep-22

APPROVED BY : PONGSAK J.

ISSUED DATE : 21-Sep-22

RECEIVED DATE : 15-Sep-22





# QUALITY CALIBRATION CO., LTD.

235 Petchkasorn 65/2 Road, Laksoeng, Bangkok, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-1, Fax (662) 809-4384

CERTIFICATE No : 22T9917

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT	HOT AIR OVEN	S/N	G508.0791
MANUFACTURER	MEMMERT	CALIBRATION DATE	15-Sep-22
MODEL	UFE 503	RELATIVE HUMIDITY	51 %RH $\pm$ 10 %RH
ID No	EQL-128		
RECEIVED DATE	15-Sep-22		
AMBIENT TEMPERATURE	25 °C $\pm$ 1 °C		

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TIAS G-70 BY COMPARISON WITH CALIBRATED RTD PLUG 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 :

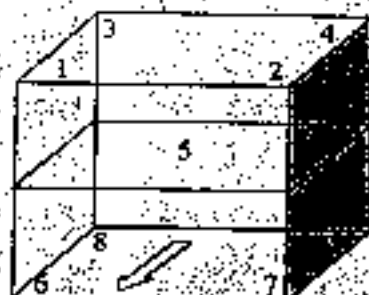
INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH RTD	HYDRA 2635A	6635300	22T7509	10-Jul-23

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

4. THIS RESULT EXCLUDES 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 Point (°C)	Average All Position Temp (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
104.0	104.32	0.15	0.62	1.02
180.0	180.09	0.29	1.23	1.85

### 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	104.23	103.89	104.54	104.02	104.33	104.63	104.42	104.48	104.39		0.38
180.0	180.0	180.16	179.12	180.46	179.35	179.79	180.66	180.36	180.29	180.61		0.91

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 : 22T9919  
REFERENCE No : 66549-6

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., SAMAEKRAM, BANGKIJUNTHIAN, BANGKOK 10150

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 15-Sep-22

APPROVED BY :  PONGSAK J.

ISSUED DATE : 21-Sep-22

RECEIVED DATE : 15-Sep-22





CERTIFICATE No : 22T9919

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT	HOT AIR OVEN	S/N	0414,0764
MANUFACTURER	MEMMERT	CALIBRATION DATE	15-Sep-22
MODEL	UF 110	RELATIVE HUMIDITY	51 %RH ± 10 %RH
ID No.	RQL-169		
RECEIVED DATE	15-Sep-22		
AMBIENT TEMPERATURE	25 °C ± 1 °C		

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO IAS G-20 BY COMPARISON WITH CALIBRATED RTD PROBE 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-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



#### GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 2
Overall Line Voltage (V) variation : 4
Instrument Condition : Normal
Chamber Size (W*H): 56*40*40 cm

#### CHAMBER PERFORMANCE

Calibrate Point (°C)	Average All Probes Temp (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
104.0	104.04	0.25	0.51	0.79
180.0	179.85	0.40	1.56	2.23

#### TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (±°C)
		#1	#2	#3	#4	#5	#6	#7	#8	#9	
104.0	104.0	104.32	103.97	104.32	104.09	103.95	103.81	104.07	103.87	103.97	0.38
180.0	180.0	180.37	179.84	180.63	179.72	179.53	179.28	180.77	179.46	179.18	0.11

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

NOTE 2: LOCATION 1 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: 22T9918  
REFERENCE No: 66549-5

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.  
10,32 RAMA II SOI 63, RAMA II RD., SAMAEDAM,  
BANGKHUNTHIAN, BANGKOK 10150.

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 15-Sep-22

APPROVED BY :   
PONGSAK J.

ISSUED DATE : 15-Sep-22

RECEIVED DATE : 15-Sep-22





CERTIFICATE No : 22T9918

PAGE 2 OF 2

## Calibration Report

EQUIPMENT : HOT AIR OVEN  
MANUFACTURER : MEMMERT  
MODEL : UFE 500  
ID No : EQL-161  
RECEIVED DATE : 15-Sep-22  
AMBIENT TEMPERATURE : 25 °C ± 1 °C

S/N :  
CALIBRATION DATE : 0512.2023  
RELATIVE HUMIDITY : 15-Sep-22  
51 %RH ± 10 %RH

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TIAS G-20 BY COMPARISON WITH CALIBRATED RTD P160 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 BACK 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

D DATA LOGGER WITH RTD

HYDRA 2635A

7301307

22T7508

10-Jul-23

2. 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 : 1

Overall Line Voltage (V) variation : 8

Instrument Condition : Normal

Chamber Size (W\*L\*H): 56\*40\*48 cm

#### CHAMBER PERFORMANCE

Calibrate Point (°C)	Average All Position Temp. (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
104.0	103.98	0.12	0.91	1.00
120.0	119.98	0.13	1.06	1.23
140.0	140.09	0.13	1.35	1.39
150.0	150.03	0.14	1.38	1.49

#### 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	104.07	104.09	104.21	103.98	103.58	103.79	103.99	103.78	104.36		0.38
120.0	120.0	120.03	120.13	120.34	119.94	119.53	119.69	119.94	119.71	120.48		0.38
140.5	140.5	140.15	140.30	140.44	140.10	139.56	139.74	140.03	139.80	140.72		0.46
150.5	150.5	150.04	150.25	150.54	150.35	149.46	149.55	149.83	149.60	150.67		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



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ใบรับรองการสอบเทียบ "เครื่องชั่ง"

(Calibration Certificate of Electronic Balance)





CERTIFICATE No : 22M9915  
REFERENCE No : 66549-2

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 P.

CALIBRATION DATE : 15-Sep-22

APPROVED BY : PONGSAK J.

ISSUED DATE : 21-Sep-22

RECEIVED DATE : 15-Sep-22









CERTIFICATE No: 22M9914  
REFERENCE No: 66549-1

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.,  
SAMARDAM, BANGKHUNTHIAN, BANGKOK  
10150

CALIBRATED BY : PRASERT P.

CALIBRATION DATE : 15-Sep-22

APPROVED BY :   
PONGSAK J.

ISSUED DATE : 21-Sep-22

RECEIVED DATE : 15-Sep-22





CERTIFICATE No. 22M9914

PAGE: 2 OF 2

## Calibration Report

EQUIPMENT	ORIGNAL BALANCE	MODEL	GR-200
MANUFACTURER	AND	SN	14243876
ID No	EQL-130	RECEIVED DATE	15-Sep-22
ATR PRESSURE	1011mbars ± 1mbars	CALIBRATION DATE	15-Sep-22
AMBIENT TEMPERATURE	21° C ± 1° C	RELATIVE HUMIDITY	53 %RH ± 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 WEIGHT OF QUALITY CALIBRATION 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.

### 2. REFERENCE STANDARD INSTRUMENTS:

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD WEIGHT SET	E2	QK-1-151	CU2210413	09-Feb-23
2) STANDARD WEIGHT	E2	15843	CU2210419	10-Feb-23
3) STANDARD WEIGHT	E2	QK-1-349	M21032358	26-Mar-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.

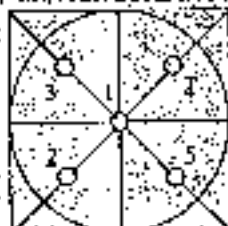
5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS & MEASURES

### RESULT OF CALIBRATION - WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION: NORMAL
2. TARE FUNCTION: NORMAL
3. REPEATABILITY OF READING AT 200 g WAS 0.000045 g
4. DEPARTURE FROM NOMINAL VALUE: LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (± g)
0.00	0.0000	0.0000	0.000078
0.10	0.1000	0.0000	0.000078
0.20	0.2000	0.0000	0.000078
0.50	0.5000	0.0000	0.000079
1.00	1.0000	0.0000	0.000079
2.00	2.0000	0.0000	0.000080
5.00	5.0000	0.0000	0.000081
10.00	10.0000	0.0000	0.000084
20.00	20.0001	-0.0001	0.000089
50.00	50.0004	-0.0004	0.00011
100.00	100.0001	-0.0001	0.00019
200.00	200.0000	0.0000	0.00032

### 5. OFF CENTER LOADING ERROR



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

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT PRODUCTION 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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ใบรับรองการสอบเทียบ "ห้องเย็น"  
(Calibration Certificate of Cool Room)





# Metrological Center

SCI ECO Services Company Limited

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

Saraburi Tel : +66 3627 3056 Fax : +66 3627 3100

Bangkok Tel : +668 8205 6351 , +669 8247 2360

Website : [www.scieco.co.th](http://www.scieco.co.th) E-Mail : [calibrate@scg.co.th](mailto:calibrate@scg.co.th)



Certificate No. T220021

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

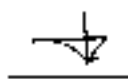
30, 32 Rama II Soi 63, Rama II Rd., Samadarn,

Bangkhunthian Bangkok 10150

Customer Location : LABORATORY FLOOR 3

Date of Receipt : 12 January 2022

Calibrated By : Watcharapon Sangtong (Technician)

Approved By :  / Sujjar Nakhakred ( Site Calibration Manager )

Date of Issue : 19 JAN 2022

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



## Calibration Report

**Equipment** : Chamber ( Cooling Room )  
**Date of Calibration** : 19 January 2022  
**Environment** : Temperature : 24.2-26.8 °C  
                             Line Voltage : 221.6-225.5 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 WT-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	TN161-TN170	T210009	31 January 2022
DATA LOGGER	34970A	T149	T210009	31 January 2022

### 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

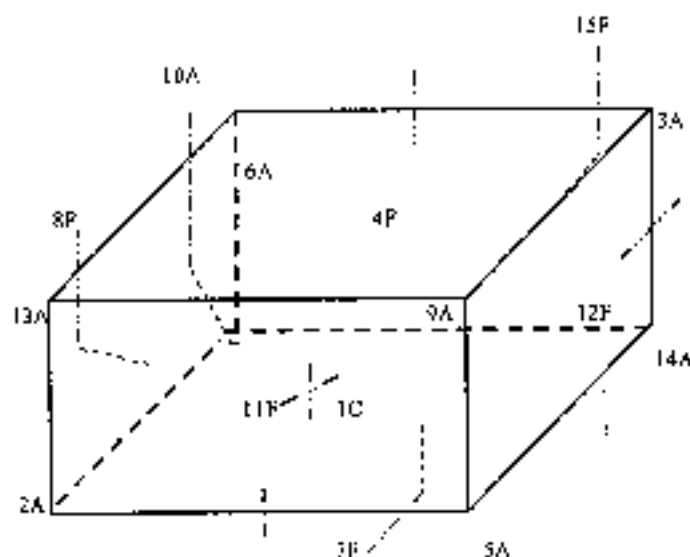
Approved By. 



Certificate No. T221021

Page 3 of 4

## Calibration Report



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

1C	=	TN161
2A	=	TN162
3A	=	TN163
4F	=	TN164
5A	=	TN165
6A	=	TN166
7P	=	TN167
8P	=	TN168
9A	=	TN169
10A	=	TN170

11P	=	TN171
12F	=	TN172
13A	=	TN173
14A	=	TN174
15P	=	TN175

Approved By. 



Certificate No. T220021

Page 4 of 4

## Calibration Report

### Measurement Results:

Calibration Point	Average Standard Reading at each position (°C)									
	TN161	TN162	TN163	TN164	TN165	TN166	TN167	TN168	TN169	TN170
3	3.15	3.01	3.03	3.25	3.15	3.42	3.15	2.50	3.02	2.93
	TN171	TN172	TN173	TN174	TN175					
	2.94	2.47	2.60	2.55	2.60					

Chamber ( Cooling Room )			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability ( $\pm$ °C)	Uniformity (°C)	Uncertainty ( $\pm$ °C)	Coverage
	Min , Max	Average					Factor k
3.0	2.9 , 3.1	3.0	2.94	0.47	1.02	0.93	2.00

\* The quoted uncertainty excludes " 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.Banpo, A.Kaengkhro, Saraburi 18110, Thailand.

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

Bangkok Tel : +668 9265 6851 , +669 8247 2360

Website : [www.sci-eco.co.th](http://www.sci-eco.co.th) E-Mail : [calibrate@scg.co.th](mailto:calibrate@scg.co.th)



Certificate No.T220242

Page 1 of 4

## Certificate of Calibration

Equipment : Chamber ( Cooling Room )

Manufacturer : -

Model : -

Serial No. : -

Customer Code : EQL-181

ID No. : T0399A5

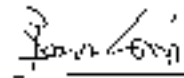
Customer : Test Tech Co.,Ltd

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

Customer Location : LABORATORY FLOOR 4

Date of Receipt : 3 February 2022

Calibrated By : Watcharasak Puttarat (Technician )

Approved By :  / Boonchai Suriyawong (Site Calibration Manager)

Date of Issue : 11 FEB 2022

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.



Certificate No. T220242

Page 2 of 4

## Calibration Report

**Equipment** : Chamber (Cooling Room)  
**Date of Calibration** : 7 February 2022  
**Environment** : **Temperature** : 16.4-17.9 °C  
**Line Voltage** : 221.4-230.2 V  
**Relative Humidity** : 55 - 65 %RH

### Condition of this results of calibration :

1. This equipment was calibrated by insert 15 standard thermocouples type T into its chamber, the other use standard thermocouples type T use for ambient temperature measurement. The calibration was done in according to WI-120 (based on ASTM E145-94 (Reapproved 2001) and AS2353-1986).

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 J	TN141-TN150	T210743	21 April 2022
TC	TYPE T	TN151-TN160	T210743	21 April 2022
1 DATA LOGGER	3497CA	T150	T210743	21 April 2022

### 3. This certificate is traceable to :

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

### 4. Condition of calibrated item : good

Equipment Description :

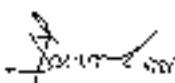
Time Constant : 2 Hour 20 Minute At 3 °C  
 Fresh Air Damper : ☐ Open ☐ Min ☐ Medium ☐ Max  
                           ☐ Close  
                           ☒ Not Available

### 5. Adjustment :

( X ) without adjustment

( ) after adjustment

Approved By

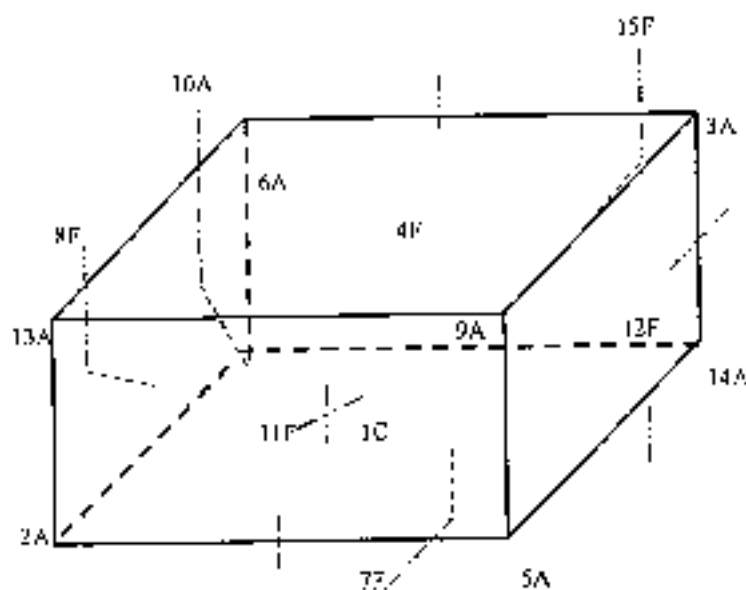




Certificate No. T220242

Page 3 of 4

## Calibration Report



C = Centre, F = Centre of Face, A = Corner, B = 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 \_\_\_\_\_



## Calibration Report

### Measurement Results

Calibration Point	Average Standard Reading at each position (°C)									
	TN141	TN142	TN143	TN144	TN145	TN146	TN147	TN148	TN149	TN150
	3.03	2.89	2.89	3.19	2.90	3.03	3.02	3.00	2.89	3.12
	TN151	TN152	TN153	TN154	TN155					
	3.21	3.20	3.25	2.93	3.17					

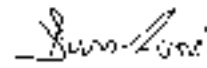
Chamber (Cooling Room)			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (± °C)	Uniformity (°C)	Uncertainty (± °C)	Coverage Factor k
	Min, Max	Average					
3.0	2.93, 3.3	3.0	3.07	1.09	1.30	1.50	2.06

\* The Accrued 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. 



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ใบรับรองการสอบเทียบ "ตู้บ่มเชื้อ"

(Calibration Certificate of Incubator)





CERTIFICATE No : 22T1725  
REFERENCE No : 04109-1

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : INCUBATOR  
MANUFACTURER : MEMMERT  
MODEL : IF 110  
SERIAL No : D415.0802  
ID No : EQ1-190  
CONDITION AS RECEIVED : USED ITEM  
SUBMITTED BY : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEADAM,  
BANGKRUATHIAN, BANGKOK 10150

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 21-Feb-22

APPROVED BY :   
PONGSAK J.

ISSUED DATE : 22-Feb-22

RECEIVED DATE : 21-Feb-22





CERTIFICATE No : ZCT1725

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT	:	INCUBATOR			
MANUFACTURER	:	MEMMERT			
MODEL	:	IF 110			
ID No	:	EQL-190	S/N	:	D115.9802
RECEIVED DATE	:	21-Feb-22	CALIBRATION DATE	:	21-Feb-22
AMBIENT TEMPERATURE	:	24 °C $\pm$ 1 °C	RELATIVE HUMIDITY	:	50 %RH $\pm$ 10 %RH

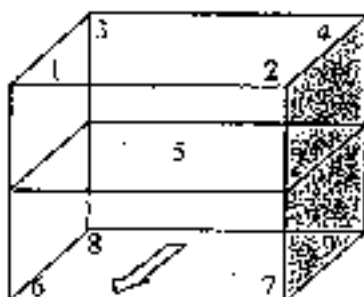
### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TIS 0-20 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 2615A	7496027	21T6766	15-Jul-22
2. 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
Over-all Line Voltage (V) variation : 8
Instrument Condition : Normal
Chamber Size (W*H*E): 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	36.91	0.07	0.22	0.28
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	36.84	36.96	36.94	36.92	35.91	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 : THIS 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. 22T1726  
REFERENCE No. 64109-2


PAGE - 1 OF 2

## Certificate of Calibration

EQUIPMENT : INCUBATOR  
MANUFACTURER : MEMMERT  
MODEL : IF 160  
SERIAL No : D518.0082  
ID No : HQL-205  
CONDITION AS RECEIVED : USED ITEM  
SUBMITTED BY : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD., SAMAEJAM,  
BANGKIUENTHAN, BANGKOK 10150

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 21-Feb-22

APPROVED BY :   
PONGKAJ J.

ISSUED DATE : 22-Feb-22

RECEIVED DATE : 21-Feb-22





CERTIFICATE No : 2111726

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : INCUBATOR  
MANUFACTURER : MEMMERT  
MODEL : IF 160  
ID No : EQ1-205  
RECEIVED DATE : 21-Feb-22  
AMBIENT TEMPERATURE : 24 °C ± 1 °C

S/N : D518.0082  
CALIBRATION DATE : 21-Feb-22  
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 PROBE 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

6635000

2176705

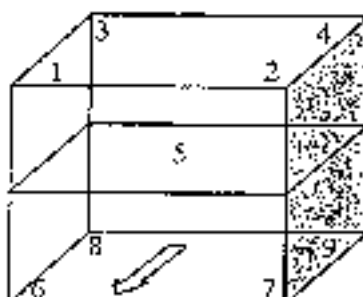
18-Jul-22

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 TRACABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT - NATIONAL INSTITUTE OF METROLOGY (JEPAN) 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\*H\*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	0.16	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	35.01	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 A COVERAGE FACTOR K=2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT





CERTIFICATE No : 21T7075  
REPORT NO : 61873-3

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,  
BANGKIJUNTIAN, BANGKOK 10150

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 20-Jul-21

APPROVED BY : PONGSAK J.

ISSUED DATE : 21-Jul-21

RECEIVED DATE : 20-Jul-21





CERTIFICATE No. 2117075

PAGE 2 OF 2

## Calibration Report

EQUIPMENT : INCUBATOR  
MANUFACTURER : MEMMERT  
MODEL : INR 400  
ID No : EQ1. 057  
RECEIVED DATE : 20-Jul-21  
AMBIENT TEMPERATURE : 24 °C ± 1 °C

S/N : E405 0946  
CALIBRATION DATE : 20-Jul-21  
RELATIVE HUMIDITY : 50 %RH ± 10 %RH

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO JAS G-20 BY COMPARISON WITH CALIBRATED STD P100 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

1) DATA LOGGER WITH RTD

#### MODEL

HYDRA 2035A

#### SERIAL No

7301307

#### CERTIFICATE No

2116764

#### DUE DATE

18 Jul-22

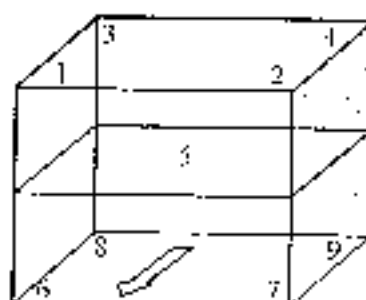
3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON PAGE AND PLACE OF CALIBRATION ONLY

4. THIS RESULT EXCLUDED 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 : 9

Instrument Condition : Normal

Chamber Size (W\*L\*H) : 40\*33\*40 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)
44.0	43.5	43.5	44.15	0.17	1.25	1.27
55.0	54.5	54.5	55.06	0.27	1.47	1.50

#### 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	43.75	43.82	43.87	43.82	43.62	44.62	44.52	44.61	44.65	0.16
54.5	54.5	54.63	54.67	54.77	54.68	54.46	55.47	55.64	55.52	55.67	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



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ใบรับรองการทดสอบ "เครื่อง Atomic Absorption Spectrophotometer"  
( Calibration Certificate of Atomic Absorption Spectrophotometer )






# PinAAcle 900F Preventive Maintenance Report

Company Name: TEST TECH CO.,LTD  
Instrument Location: 30, 32 Rama II Soi 63 Rama II Road.  
Samaedam, Bangkhuntien, Bangkok, 10510  
Instrument Serial No.: PFBS21091601  
Date: 06-Jul-2022



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

Company Name:	TEST TECH CO., LTD		
Address (Instrument Location):	30,32 Rama 1 Sor 63 Rama II Road, Sarnandam, Bangkok, Bangkok, 10610		
Serial Number:	PF0521091601	PM Number:	1/2
Customer Name (If applicable):	K. AOYJAI	Telephone Number:	02-877 3271
Customer Support Engineer Name:	K. GUANG	Service Order Number:	WO-01931526
Date PM Performed: (DD-MM-YY)	Jul 6, 2022	Next PM Due Date: (DD-MM-YY)	Jan 6, 2023
Standard Labor Hours to Complete PM:		5 hours	

Part Number	Release	Publication Date	
00370145 Rev.B	A	January 2018	

### **Scope**

The purpose of this PM is to ensure the continued functionality of the PinAcle 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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## Component List

Component / Specific Model	Serial #	Configuration Notes

## Parts Lists

Parts Included with the PM		
Part Number (if applicable)	Description	Quantity
B2501596	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
N5101714	Replacement Acrylene Filter Cartridge	N/A
TH003022	Replacement Air Filter Cartridge	N/A

Additional Reagents and Standards Required for PM				
Part Number (if applicable)	Description	Quantity	Batch/Lot #	Expired Date (mm/yy)
N0300183	1000 mg/L Copper Standard	AR	25-76CJY1	30-Oct-2022

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



Additional Tools Required for PM			
Part Number (if applicable)	Description	Quantity	Serial #
N1013000	0.2A Neutral density filter	1	VG0-252
N1013001	1.0A Neutral density filter	1	VG0-358
E3030997	System 2 EOL Driver	1	03030997
N3050005	As System 2 EOL	1	16148
N2050121	Cu Lumina HCL	1	092216-010140
N3050134	Ba Lumina HCL	1	102416-040160
N3050139	K Lumina HCL	1	110716-010060
N2050151	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, backed, 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 slot 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 PL 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 with in the Advanced function of the Spectrometer page. Check the results in the service log folder in the Spectrometer BIA Log Viewer.

### 5. Optics:

- ☒ Inspect and clean the sample compartment windows, if needed.
- ☒ Inspect optics. Clean or replace if necessary.

### 6. Gases:

- ☒ Verify that the Gases supplied to the instrument are within the pressure and purity specifications found in the FinAAcile 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 PIM 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	0.9836	Passed
0.2 A ND Filter	+ 5% from Cert.	0.2042	0.2008	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	0.0005	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	≤ 0.010	0.0067	Passed

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

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

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0003	Passed

#### 8.6 AA-RG 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	≤ 0.005	0.0001	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.	0.9565	Passed

#### 10. Review:

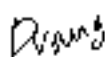
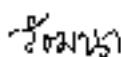
- ☒ Review with the customer PM work performed.
- ☒ Review with the customer routine maintenance procedures.
- ☒ Discuss recommended customer supplied materials to have on hand.
- ☒ Attach PM sticker



## Additional Comments

Additional Comments Regarding the PM	
<b>PERFORMANCE TEST FOR FIAS</b>	
1. Characteristic mass for Mercury	0.0674 Abs.
(500 ul of 10 ug/l for Hg And 5 replicates)	326.4 pg/ 0.0044 Abs.
Characteristic Mass	
% RSD	1.62%
2. Characteristic mass for Arsenic	0.1031 Abs.
(500 ul of 10 ug/l for As And 5 replicates)	1.3e+03 pg/ 0.0044 Abs.
Characteristic Mass	
% RSD	1.29%
3. Characteristic mass for Selenium	0.3055 Abs.
(500 ul of 10 ug/l for Se And 5 replicates)	72.0 pg/ 0.0044 Abs.
Characteristic Mass	
% RSD	0.92%
<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	553.50)
[K 766.49 nm +/-0.3 nm	766.60)

## Review

The preventive maintenance checks and if applicable performance tests for PinAAcle 900F have been completed.	
This PinAAcle 900F Passes <input checked="" type="checkbox"/> Fails <input type="checkbox"/> the preventive maintenance.	
Review of Preventive Maintenance:	
Authorized PerkinElmer Representative:	<div style="text-align: center;">   Date: 06-Jul-2022  <small>(DD-MMM-YYYY)</small> </div>
Authorized Customer Representative:	<div style="text-align: center;">   Date: 06-Jul-2022  <small>(DD-MMM-YYYY)</small> </div>



**ซ12**

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**ใบรับรองการทวนสอบ "เครื่องอ่างไอน้ำ"**  
( Calibration Certificate of Water bath )





CERTIFICATE No : 2218990  
REFERENCE No : 66263-3

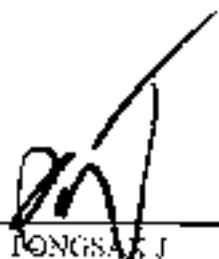
PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : WATER BATH  
MANUFACTURER : MEMMERT  
MODEL : WNE 45  
SERIAL No : 1.720.0266  
ID No : EQL-241  
CONDITION AS RECEIVED : USED ITEM  
SUBMITTED BY : TEST TECH CO., LTD.  
30,32 RAMA II SOI 63, RAMA II RD , SAMAEKRAM,  
BANGKHUNTIAN, BANGKOK 10150

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 19-Aug-22

APPROVED BY :   
PONGSAK J.

ISSUED DATE : 19-Aug-22

RECEIVED DATE : 19-Aug-22



**QUALITY CALIBRATION CO., LTD.**

225 Petchkasart Road, Laksoong, Bangkok, Thailand 10120

Tel (662) 421-5412, (662) 421-0152-3, Fax (662) 805-4584

www.qcalibration.com

CERTIFICATE No. 2218990

PAGE 2 OF 2

**Calibration Report**

EQUIPMENT : WATER BATH  
 MANUFACTURER : MEMMERT  
 ID NUMBER : FQI-241  
 RECEIVED DATE : 19-Apr-22  
 AMBIENT TEMPERATURE : 27°C ± 1°C

MODEL : WRE 45  
 SERIAL NUMBER : 172806266  
 CALIBRATION DATE : 19-Apr-22  
 RELATIVE HUMIDITY : 51 %RH ± 10 % RH

**CONDITION OF THIS RESULTS OF CALIBRATION**

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO ASTM E75-8C (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

2628A

6803614

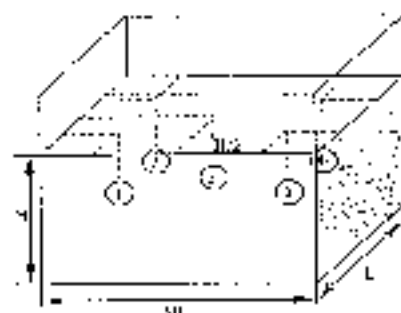
2217514

05-Jul-23

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN IN 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) : 0.5

Overall Variation of Line Voltage (V) : 1

Instrument Condition : Normal

Bath Inner Size (W\*H) : 59\*35\*22 cm

**BATH PERFORMANCE**

Calibrate Point (°C)	Average All Position Temp. (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
83.0	82.97	0.03	0.03	0.09
92.0	91.95	0.07	0.03	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	
83.0	83.0	82.97	82.97	82.96	82.98	82.99	0.14
92.0	92.0	91.95	91.97	91.94	91.96	91.95	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



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ใบรับรองการพวนสอบ "เครื่องนึ่งฆ่าเชื้อ"  
(Calibration Certificate of Autoclave)





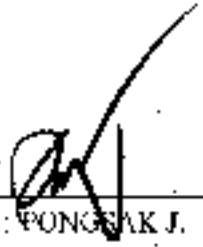
CERTIFICATE No : 2211750  
REFERENCE No : 64199-6

PAGE : 1 OF 2

## Certificate of Calibration

EQUIPMENT : AUTOCLAVE  
MANUFACTURER : HIRAYAMA  
MODEL : HVE-50  
SERIAL No : 30612085166  
ID No : EQL-155  
CONDITION AS RECEIVED : USED ITEM  
SUBMITTED BY : TEST TECH CO., LTD.  
30,32 RAMA II SOI 62, RAMA II RD.,  
SAMAEDAM, BANGKHUNTHIAN, BANGKOK  
10150

CALIBRATED BY : CHAICHARN CH.  
CALIBRATION DATE : 21-Feb-22

APPROVED BY :   
PONGSAK J.

ISSUED DATE : 22-Feb-22

RECEIVED DATE : 23-Feb-22





# QUALITY CALIBRATION CO., LTD.

215 Perchakorn 63/2 Road, Laksong, Bangkok, Bangkok 10160

Tel: (662) 421-5402, (662) 441-0122-3, Fax: (662) 869-4584

www.qualitycalibration.com

CERTIFICATE No: 22T1730

PAGE: 2 OF 2

## Calibration Report

EQUIPMENT : AUTOCLAVE  
MANUFACTURER : HIRAYAMA  
ID NUMBER : EQL-135  
RECEIVED DATE : 21-Feb-22  
AMBIENT TEMPERATURE : 30°C  $\pm$  1°C

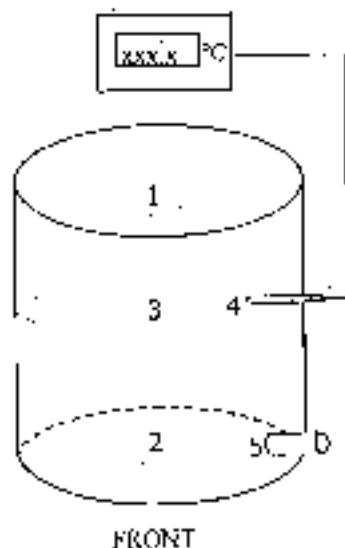
MODEL : HVS-50  
SERIAL NUMBER : 30612855165  
CALIBRATION DATE : 21-Feb-22  
RELATIVE HUMIDITY : 50 %RH  $\pm$  10 % RH

### CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BASED ON BS 2646 Part 5 : 1993 BY COMPARISON WITH CALIBRATED THERMOCOUPLES 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 | VALPROB | S250, DV35, DN34 | 22T0541        | 21-Jan-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



### 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 ( $\pm$ °C)
		#1	#2	#3	#4	#5	
116	116	116.45	116.50	116.53	116.48	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



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ใบรับรองการทวนสอบ "เครื่อง Spectrophotometer"  
(Calibration Certificate of Spectrophotometer)





Bara Scientific Co., Ltd.  
969 U-Old Lungs Building Floor 7 Rama4 Road  
Silom Bangkok Bangkok, Thailand 10500  
Tel : 02-6324300 Fax : 02 6375486-7  
www.barascientific.com



# Certificate of Calibration

Number of Page(s) 1 of 3

Certificate No. BSOC-UV-173/22  
Equipment UVVis Spectrophotometer  
Model UV-1900i  
Manufacturer Shimadzu  
Serial No. A125A5780311 ML  
ID No. EQL-233  
Date of receipt 19 May 2022  
Date of calibration 19 May 2022  
Date of issue 26 May 2022

Customer name Fosi Tech Co., Ltd.

Address 30, 32 Rama 11 Soi 63, Rama 11 RD., Samaedam, Bangkhunthian, Bangkok, 10150.

Temperature (23.7-24.3) °C (On site)  
Humidity (47.5-48.2) %RH (On site)

Equipment condition Good Operation

Calibration Location Water Room

Calibration Procedure In-house method WI-UV-702-01 based on ASTM E275-07

Traceability Wavelength Accuracy is traceable to certificate No 96367 and 96368  
Photometric Accuracy is traceable to certificate No 99925 and 100147  
Stray Light is traceable to certificate No 99365  
The above certificate are traceable to SI Unit through Stamp Scientific Ltd.  
(UKAS accredited calibration laboratory NO. 0659)

Calibrated by Mr.Kanchit Chundhep

Approved by

Mr.Kanchit Chundhep  
Technical Manager

The above results are valid exclusively for the calibrated item(s) as mention in this report / certificate.  
Advertising this 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 Co., Ltd.  
302 U Cha Trai Building Floor 7 Rama 4 Road  
Samsil Bangkok Bangkok 10500  
Tel: 02-6324302 Fax: 02-6377433-7  
www.barscientific.co.th



# Certificate of Calibration

Certificate No. BSCC-UV-173/22

Number of Page(s) 2 of 3

## Calibration Results:

### 1.Wavelength Accuracy

Certified Wavelength (nm)	UUC (nm)	Error (nm)	Uncertainty ( $\pm$ nm)
279.44	279.36	-0.08	0.18
418.53	418.16	-0.38	0.19
538.52	538.47	-0.05	0.13
684.50	684.50	0.00	0.18
879.41	879.24	-0.17	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
	0.6499	0.6490	-0.0010	0.0075
313	CNR	CNR	CNR	CNR
	CNR	CNR	CNR	CNR
350	0.0000	0.0000	0.0000	0.0075
	0.6306	0.6308	0.0002	0.0075

\*CNR = Customer not request

The above results are valid exclusively for the calibrated samples as mention in this report / certificate.  
Advertising the result / 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**  
Co., Ltd.

**Bara Scientific Co., Ltd.**

668/1 Chu Liang Building 1st floor, Bangkok Road  
Silom District Bangkok Thailand 10500  
Tel : 02-0324360 Fax : 02-5375196-7  
www.barascientific.com



# Certificate of Calibration

Certificate No.

QSCD-UV-173/22

Number of Page(s)

3 of 3

Calibration Results:

## 1. 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
	0.5473	0.5441	0.0009	0.0042
	0.7537	0.7620	-0.0011	0.0042
	1.0480	1.0484	0.0004	0.0042
440.0	0.0000	0.0000	0.0000	0.0042
	0.5371	0.5361	0.0010	0.0042
	0.7457	0.7450	-0.0008	0.0042
	1.0253	1.0243	0.0010	0.0042
455.0	CNR	CNR	CNR	CNR
	CNR	CNR	CNR	CNR
	CNR	CNR	CNR	CNR
	CNR	CNR	CNR	CNR
460.0	0.0000	0.0000	0.0000	0.0042
	0.5306	0.5312	-0.0005	0.0042
	0.6961	0.6948	-0.0015	0.0042
	0.9553	0.9558	-0.0005	0.0042
540.0	CNR	CNR	CNR	CNR
	CNR	CNR	CNR	CNR
	CNR	CNR	CNR	CNR
	CNR	CNR	CNR	CNR
635.0	0.0000	0.0000	0.0000	0.0042
	0.5137	0.5143	-0.0006	0.0042
	0.5807	0.5892	-0.0015	0.0042
	0.9533	0.9527	-0.0006	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 0640 11 nm	200.85	0.0120	2.3401

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-QNSC Accredited

The measurement uncertainty is based 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. 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.





## Certificate of Calibration

<b>Equipment:</b>	SPECTROPHOTOMETER	<b>Certificate No.:</b>	C06220266
<b>Model:</b>	DR6000	<b>Issued Date:</b>	09 June 2022
<b>Serial No. (or ID.):</b>	1693421 (EQL-197)	<b>Job No.:</b>	KSPR2206051
<b>Manufacturer:</b>	Hach	<b>Page:</b>	1 of 3
<b>Condition:</b>	In Condition		

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

**Environment Condition:**

Temperature	24.7	°C	±	0.2	°C
Humidity	54.5	%RH	±	2.2	%RH

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

**Calibration By:** Mr. Atachai Ngamchanat  
**Calibration Date:** 01 June 2022  
**The Method used:** In house method, SPCC-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 Stama Scientific Limited.

The standard for Wavelength Certificate No. 85283 and 85282  
The standard for Photometric Certificate No. 107642 and 85755  
The standard for Stray light Certificate No. 85760 and 85761  
The standard for Spectral resolution Certificate No. 85762

(Mr. Atachai Ngamchanat)  
Person in charge

**SERT**  
บริษัท เอสอาร์ที จำกัด  
SPC RT Co., Ltd.

(Mr. Thalemgkeat Pongngam)  
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 SPC RT Co., Ltd.



**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	418.9	-0.28	0.13
536.66	536.9	-0.24	0.13
637.98	638.0	-0.02	0.13
748.18	748.9	-0.42	0.13
807.03	807.6	-0.57	0.13

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.2878	0.289	-0.0012	0.0045
	0.5157	0.518	-0.0023	0.0045
	1.0258	1.029	-0.0032	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.2818	0.283	-0.0014	0.0045
	0.5059	0.508	-0.0021	0.0045
	1.0044	1.008	-0.0016	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.2467	0.249	-0.0023	0.0045
	0.4579	0.461	-0.0031	0.0045
	0.9301	0.932	-0.0018	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.2419	0.245	-0.0031	0.0045
	0.4646	0.466	-0.0014	0.0045
	0.9453	0.944	0.0013	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.2560	0.258	-0.0020	0.0045
	0.5036	0.504	-0.0004	0.0045
	1.0022	1.000	0.0022	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.2553	0.257	-0.0017	0.0045
	0.4971	0.497	0.0001	0.0045
	0.9717	0.970	0.0017	0.0045







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ใบรับรองการทดสอบ "เครื่องกลั่นในโตรเจน"

(Calibration Certificate of Distillation Unit VAPODEST

VAP20, VAP30s)



# Preventive Maintenance

วันที่ 22 เมษายน 2565 (ครั้งที่ 1/1)

บริษัท เทสท์ เทค จำกัด

ชนิดเครื่องมือ : Distillation Unit

รุ่น : VAPODEST 30

หมายเลขเครื่อง : GER003718

ผลิตจาก : Gerhardt



บริษัท เทสท์ เทค จำกัด

ฝ่ายบริการหลังการขาย

โทร 0-2185-4323 ต่อ 3994-3998 Fax 0-2153-1236, 0-2332-9158 E-mail: service.spc@spc-rt.com

ฝ่ายขายและการตลาด

โทร 0-2185-4323 ต่อ 2133-2134 Fax 0-2331-9809, 0-2332-6216 E-mail: marketing.spc@spc-rt.com

Website: www.spc-rt.com



## เงื่อนไขการให้บริการ Preventive Maintenance

บริษัทฯ จะส่งวิศวกรผู้ชำนาญ เพื่อให้บริการตามขอบข่ายของการบริการ ตามะ ในวันและเวลา ตามที่ ความประสงค์ที่จะใช้บริการขอหมายมือจากวัน เวลา ตามคำขอ (วันพฤหัสบดี .. อาทิตย์ หรือวันหยุด บังคับจัดศูนย์) บริษัทฯ จะคิดค่าบริการเพิ่มเติมตามอัตราที่กฎหมายแรงงานกำหนดไว้

### ขอบข่ายการบริการ

- ตรวจสอบสภาพการทำงานต่าง ๆ ของเครื่องมือ
- ตรวจสอบประสิทธิภาพการทำงานของเครื่องมือ
- ทำการซ่อมแซมหรือเปลี่ยนชิ้นส่วนที่ชำรุด

### หมายเหตุ

- ราคาไม่รวมสิ่งจำเป็นอื่น ๆ เช่น ค่าเดินทาง ค่าที่พัก ค่าอาหาร ค่าเช่ารถ หรือค่าเช่าเครื่องมือ
- ในกรณีที่ผู้รับบริการอยู่นอกเขตที่ให้บริการ บริษัทฯ จำเป็นต้องคิดค่าใช้จ้างเพิ่มเติม ได้แก่ ค่าเช่าที่พัก ค่าเช่ารถ ค่าเช่าเครื่องมือ



## ช่องทางการติดต่อ

### บริการหลังการขาย



ทีมเทคนิคประจำสำนักงานมีความชำนาญสูงสามารถแก้ไขปัญหาของเครื่อง  
โทรศัพท์ : 02-185-4333 จ.ละอองพระพรต 5004-5005 . งานติดตั้ง เบอร์ต่อ 3002-3004, 3005  
โทรสาร : 02-333-1236, 02-337-9158  
E-mail : service@ispca.com

### บริการลูกค้าด้วยหัวใจ



ระบบคอมพิวเตอร์เพิ่มเติมโปรแกรมบัญชี และ บริการ  
โทรศัพท์ : 02-185-4333 ต่อ 2133-2134  
โทรสาร : 02-333-8809, 02-332-2216  
E-mail : marketing.sp@ispca.com

### บริการรับเรื่องร้องเรียน (CSI-Center)



ลูกค้าสามารถร้องเรียน แนะนำ ข้อเสนอแนะเกี่ยวกับผลิตภัณฑ์ การบริการ หรือเรื่องอื่นใดของบริษัท  
โทรศัพท์ : 02-185-4333 ต่อ 2150, 6001  
E-mail : csi.sp@ispca.com

### สอบเทียบเครื่องมือ



ขอแนะนำข้อมูลเกี่ยวกับการบริการสอบเทียบ  
โทรศัพท์ : 02-185-4333 ต่อ 3301-3303  
โทรสาร : 02-185-4424  
E-mail : info.sp@spcal.com



## ข้อมูลพื้นฐานและชื่อ

ผลิตภัณฑ์ : เครื่องกั้นไนโตรเจน

ชื่อ : GERIARIT

รุ่น : VAPODEST 30

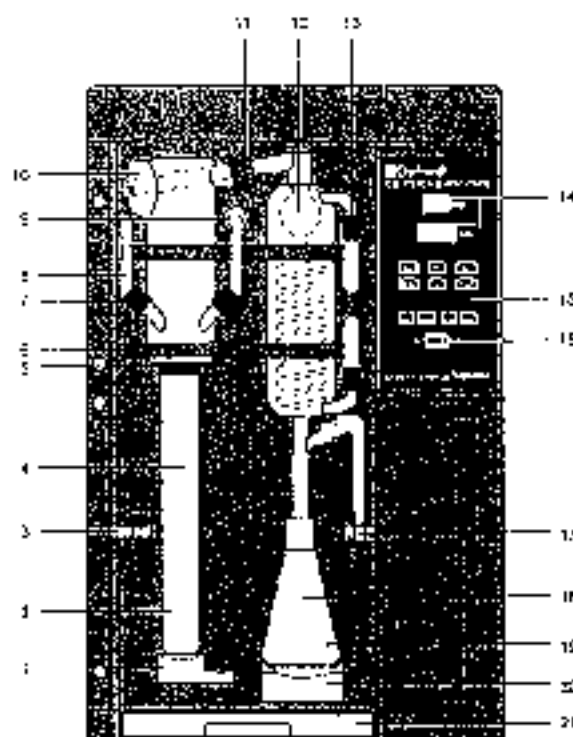
หมายเลขเครื่อง : GER00318



# Operational Qualification (OQ)

ตรวจสอบสภาพเครื่อง

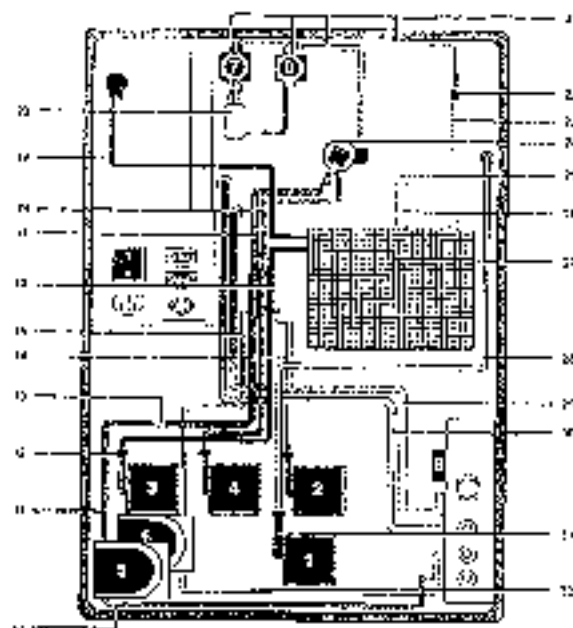
FRONT



	PASS	FAIL	N/A	REMARK
1. Quick clamping device with wedge	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
2. Kjeldachem 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. PTFE-inlet tubing, steam	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	.....
5. Vapor 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. PTFE-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. Platform	<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 $\text{H}_2\text{BO}_3$	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Vap 40 only
3. Diaphragm pump $\text{H}_2\text{O}$ for steam generator	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
4. Diaphragm pump $\text{H}_2\text{O}$ for sample	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Vap 36,40 only
5. Peristaltic pump for suction sample	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
6. Peristaltic pump for suction receiver	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Option
7. Pilot-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. Pilot-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 22.51x19x5 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 4x8 mm.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
17. Verprene-tubing 5x17 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. Neoprene tubing 4.8x8 mm	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	



		PASS	FAIL	N/A	REMARK
22.	Tubing, rubberized	<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 PTFE head	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
25.	SKT-valve (back 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"/>	

## รายละเอียดการตรวจสอบ

### ขั้นตอนการบริการ

#### ตรวจสอบระบบไฟฟ้า (Electrical Test)

- ☐ ตรวจสอบหาแนวทางไฟฟ้าของเครื่องกับกราวด์
- ☐ ตรวจสอบไฟฟ้าที่ใช้งาน

#### ตรวจสอบสภาพเครื่อง (Visual Test)

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

#### การทดสอบ Function การทำงาน (The Function Test)

- ☐ ระบบกลั่นและควบคุมความดันของ Steam
- ☐ ระบบการเดินน้ำเข้า Sample Tube
- ☐ ระบบการเดิน NaOH
- ☐ ระบบการ Suction ที่ Sample Tube Unit Receiver



## รายงานผลการให้ปฏิกรณ์

	PASS	FAIL	N/A	REMARK
<b>1. TECHNICAL DATA</b>				
Main Supply 220 volt $\pm$ 13% 50 Hz with ground	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Nominal current	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>1.1 COOLING WATER BATH</b>				
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"/>	
<b>1.2 OPTICAL TEST VAP 40</b>				
Screw cap CL14	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Screw cap CL18	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Screw cap CL22	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Distillation Condenser	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Vapor 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"/>	
<b>2. SYSTEM COOLING WATER INLET</b>				
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"/>	
<b>3. SYSTEM CONTROL</b>				
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 11,40 cm <sup>3</sup> /y
Adding NaOH	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Adding H <sub>2</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"/>	
<b>4. SYSTEM DISTILLATION</b>				
Boiler	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Level Sensor	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Neoprene-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"/>	



### 5. PUMP

Pump H<sub>2</sub>O Steam

☒
☐
☐

REMARK

- Non-Return Valve

☒
☐
☐

Pump H<sub>2</sub>O Sample

☒
☐
☐

- Non-Return Valve

☒
☐
☐

Pump NaOH

☒
☐
☐

- Non-Return Valve

☒
☐
☐

Pump section

☒
☐
☐

- Non-Return Valve

☒
☐
☐

### 6. The Following Program Run

Addition H<sub>2</sub>O 0-99 sec

☒
☐
☐

Addition NaOH 0-99 sec

☐
☐
☐

Addition H<sub>3</sub>BO<sub>3</sub> 0-99 sec

☒
☐
☒

Reaction Time 0-99 min

☒
☐
☐

Distillation Time 0-99

☒
☐
☐

Steam Capacity 50%-100%

☒
☐
☐

Suction Time 0-99 sec.

☒
☐
☐

The Instrument is in perfect technical shape

☒
☐
☐

Remark

Engineer : นายมงคล พงษ์นิลย์



## ทีมดูแลระบบทั่วไป (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 in 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 $H_2O$ )
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 steam-by is reached
<div> <div>Add soil. &gt; 1min</div> <div>Continue=Enter</div> </div>	Check programming Enter=continue of interrupted program Reset-Standby-mode
<div> <div>Program undefined</div> <div>→ </div> </div>	Check programming
<div> <div>Excess steam pressure</div> </div>	Switch the system off and call service
<div> <div>Sensor error</div> </div>	Switch the system off and call service