



Certificate of Calibration

Calibration Certification Information			
Cal. Date: May 31, 2022	Rootsmeter S/N: 438320	Ta: 295 °K	
Operator: Jim Tisch		Pa: 751.6 mm Hg	
Calibration Model #: TE-5025A	Calibrator S/N: 1089		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3930	3.2	2.00
2	3	4	1	0.9890	6.4	4.00
3	5	6	1	0.8850	8.0	5.00
4	7	8	1	0.8420	8.8	5.50
5	9	10	1	0.6950	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)
0.9947	0.7141	1.4135	0.9957	0.7148	0.8860
0.9905	1.0015	1.9990	0.9915	1.0025	1.2530
0.9884	1.1168	2.2349	0.9894	1.1179	1.4009
0.9873	1.1726	2.3440	0.9883	1.1737	1.4693
0.9820	1.4129	2.8270	0.9830	1.4143	1.7720
QSTD	m=	2.02336	QA	m=	1.26700
	b=	-0.02876		b=	-0.01803
	r=	0.99998		r=	0.99998

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

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



Environmental Solution Integrator Co., Ltd.

Web Site : www.esithailand.comE-mail : info@esithailand.com

PITOT TUBE CALIBRATION

Sampling System Equipment Information	
Console Model Number	XC-572-OV
Console Serial Number	1701014
DGM Model Number	SK25EX
DGM Serial Number	0002032
Pitot tube Number	-

Calibration Conditions			
Date	Time	08-Jun-22	9:00 AM
Calibration Reference No.	SE65AP009		
Barometric Pressure	759	mm Hg	
Pitot Tube Type	S		
size (OD)	3/8	inch	
Standard Pitot Tube ID Number	160-12		
C _p (std)	0.99		

Results				
"A" SIDE CALIBRATION				
RUN No.	Δp std	Δp (s)	C _p (s)	DEVIATION
	mm H ₂ O	mm H ₂ O		C _p (s)-C _p (A)
1	6.4	8.8	0.844	-0.003
2	16.4	22.4	0.847	0.000
3	30.8	41.8	0.850	0.003
	AVERAGE	C _p (SIDE A)	0.847	-0.002

Results				
"B" SIDE CALIBRATION				
RUN No.	Δp std	Δp (s)	C _p (s)	DEVIATION
	mm H ₂ O	mm H ₂ O		C _p (s)-C _p (B)
1	6.4	8.8	0.844	0.000
2	16.4	22.6	0.843	0.000
3	30.8	42.4	0.844	0.000
	AVERAGE	C _p (SIDE B)	0.844	0.000

$$[C_{pA}(\text{SIDE A}) - C_{p}(\text{SIDE B})] = 0.003$$

(must be ≤ 0.01)Note: Average deviation must be < 0.01 บริษัท เอ็นโวลูชันอินทิเกรตอร์ จำกัด
Environmental Solution Integrator Co., Ltd.Calibrated by : KiatkavinApproved by : Turadaj Sangthong



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THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information

Console Model Number	XC-572-OV
Console Serial Number	1701014
DGM Model Number	SK25EX
DGM Serial Number	0002032
Meter Box Model Number	JENGO 765
Meter Box Serial Number	JC04824

Calibration Conditions

Date	Time	06-Jun-22	10:00 AM
Calibration Reference No.	SE65AP009		
Reference Thermometer	FLUKE 714		
Serial Number	1812153		
Dry Box Calibrator	Pyros 650		
Serial Number	K38111		

Results

Console Thermocouple Simulator

Channel and test point	Meter Box Channel Temperature Reading (°C)										
	-18.0	25.0	38.0	93.0	149.0	260.0	371.0	482.0	593.0	816.0	1038.0
Stack	-17	25	38	94	151	259	368	482	593	815	1037
Aux	-17	24	38	94	151						
Probe	-17	24	38	94	151						
Oven	-17	24	38	95	151						
Filter	-17	24	38	95	151						
Exit	-17	24	38								

OUTLET DGM Thermocouple

Set Point	Reference Thermocouple	Probe Thermocouple	Difference
30	30.0	28	0.66
40	40.0	37	0.96
50	50.0	47	0.93

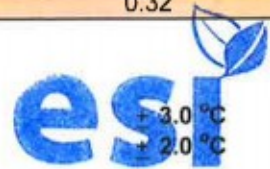
Probe Thermocouple 6ft

Set Point	Reference Thermocouple	Probe Thermocouple	Difference
100	100.0	98	0.54
250	250.0	248	0.38
300	300.0	298	0.35
350	350.0	348	0.32

Tolerance Range

Stack ± 1.50% Absolute
Probe ± 3.0 °C
Filter ± 3.0 °C

Meter
Exit



บริษัท เอ็นวIRONMENTAL SOLUTION INTEGRATOR จำกัด
Environmental Solution Integrator Co., Ltd

Calibrated by :

Kiatkasin

Approved by :

Toridin Sangthong



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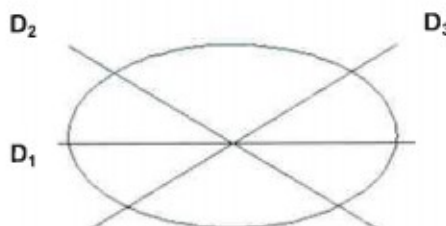
NOZZLE CALIBRATION

Sampling System Equipment Information		Calibration Conditions			
Console Model Number	XC-572-V	Date	Time	07-Jun-22	3:00 PM
Console Serial Number	1701014	Calibration Reference No.	SE61AP0002		
DGM Model Number	SK25EX	Barometric Pressure	756	mm Hg	
DGM Serial Number	00002883	Calibration	Vernier ,0-150mm	0.01 mm increments	
Nozzle Types	Glass	Method Reference	US.EPA Method		

Nozzle ID		Calibration Data			Results	
		Nozzle Diameter			Different	$(D_1 + D_2 + D_3) / 3$
Sizes		D ₁	D ₂	D ₃	ΔD	Davg
	mm	mm	mm	mm	mm	mm
4	3.2	3.02	3.03	3.03	0.006	3.027
6	4.8	4.75	4.79	4.63	0.083	4.723
8	6.4	6.61	6.59	6.59	0.012	6.597
10	7.9	7.92	7.95	7.91	0.021	7.927
12	9.5	9.49	9.50	9.50	0.006	9.497
14	11.1	11.15	11.10	11.10	0.029	11.117
16	12.7	12.82	12.82	12.85	0.017	12.830

Where :

D₁, D₂, D₃ = There difference nozzle diameters , mm ; diameter must be within 0.025 mm
 ΔD = Maximum difference between any two diameters, must be ≤ 0.100 mm
 Davg = $(D_1 + D_2 + D_3) / 3$



Calibrated by : Kiatkawin

Approved by : Terdang Sangthong



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NOZZLE CALIBRATION

Sampling System Equipment Information		Calibration Conditions			
Console Model Number	XC-572-OV	Date	Time	07-Jun-22	3:00 PM
Console Serial Number	1701014	Calibration Reference No.	SE85AP009		
DGM Model Number	SK25EX	Barometric Pressure	758	mm Hg	
DGM Serial Number	0002032	Calibration	Vernier ,0-150mm	0.01 mm increments	
Nozzle Types	Stainless	Method Reference	US EPA Method		

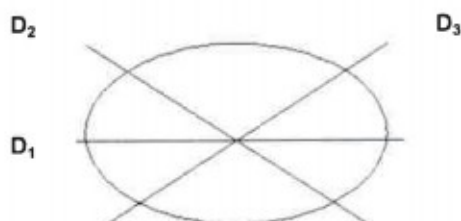
Calibration Data					Results	
Nozzle ID	Nozzle Diameter				Different	$(D_1 + D_2 + D_3) / 3$
Sizes		D ₁	D ₂	D ₃	ΔD	Davg
	mm	mm	mm	mm	mm	mm
4	3.2	3.19	3.16	3.17	0.015	3.173
6	4.8	4.50	4.53	4.55	0.025	4.527
8	6.4	6.07	6.07	6.07	0.000	6.070
10	8.0	7.75	7.74	7.77	0.015	7.753
12	9.5	9.49	9.49	9.47	0.012	9.483
14	11.1	11.10	11.07	11.07	0.017	11.080
16	12.7	12.69	12.69	12.72	0.017	12.700

Where :

D₁, D₂, D₃ = There difference nozzle diameters , mm ; diameter must be within 0.025 mm

ΔD = Maximum difference between any two diameters, must be ≤ 0.100 mm

Davg = $(D_1 + D_2 + D_3) / 3$



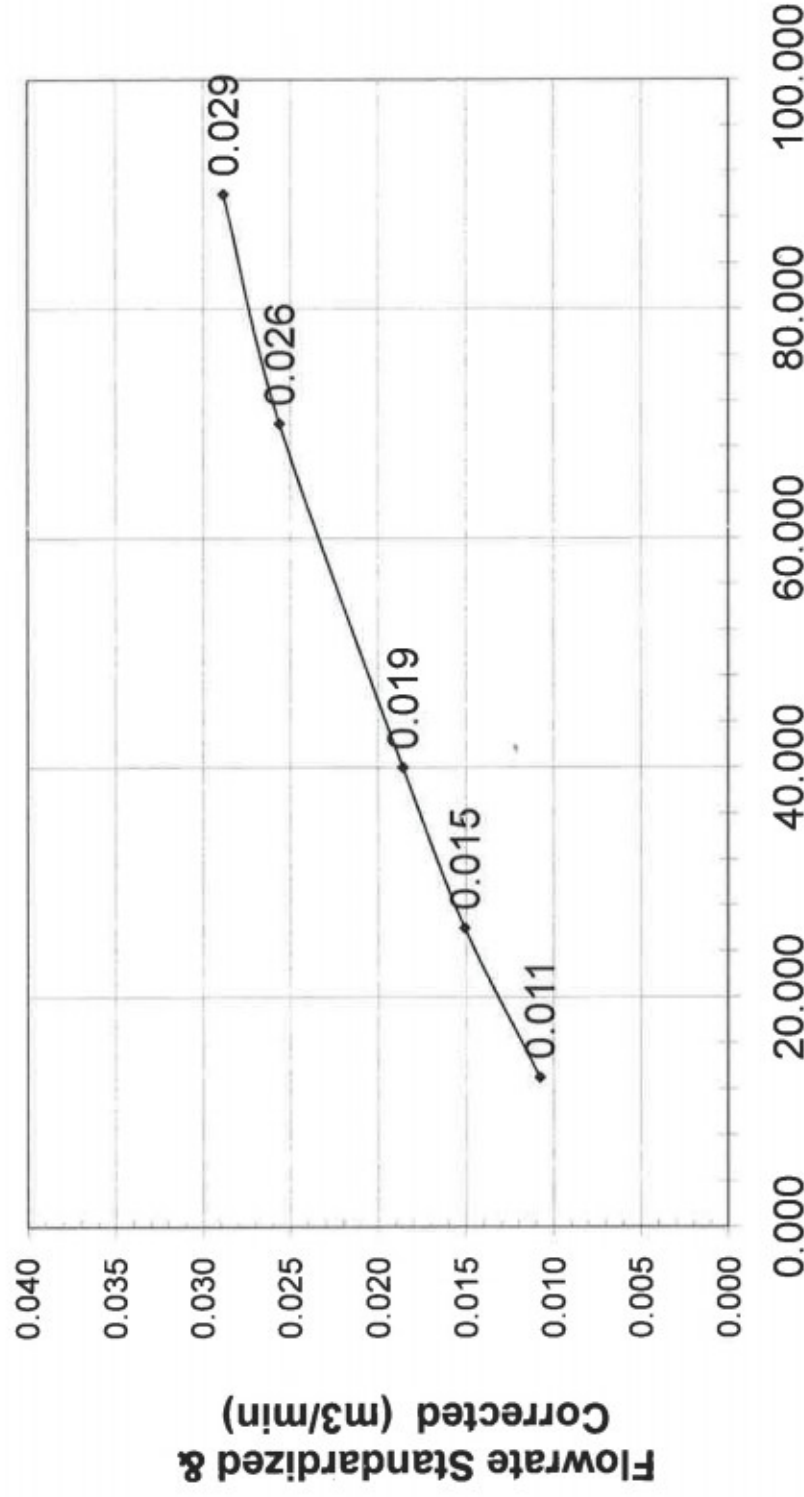
Calibrated by :

Kiatkavin

Approved by :

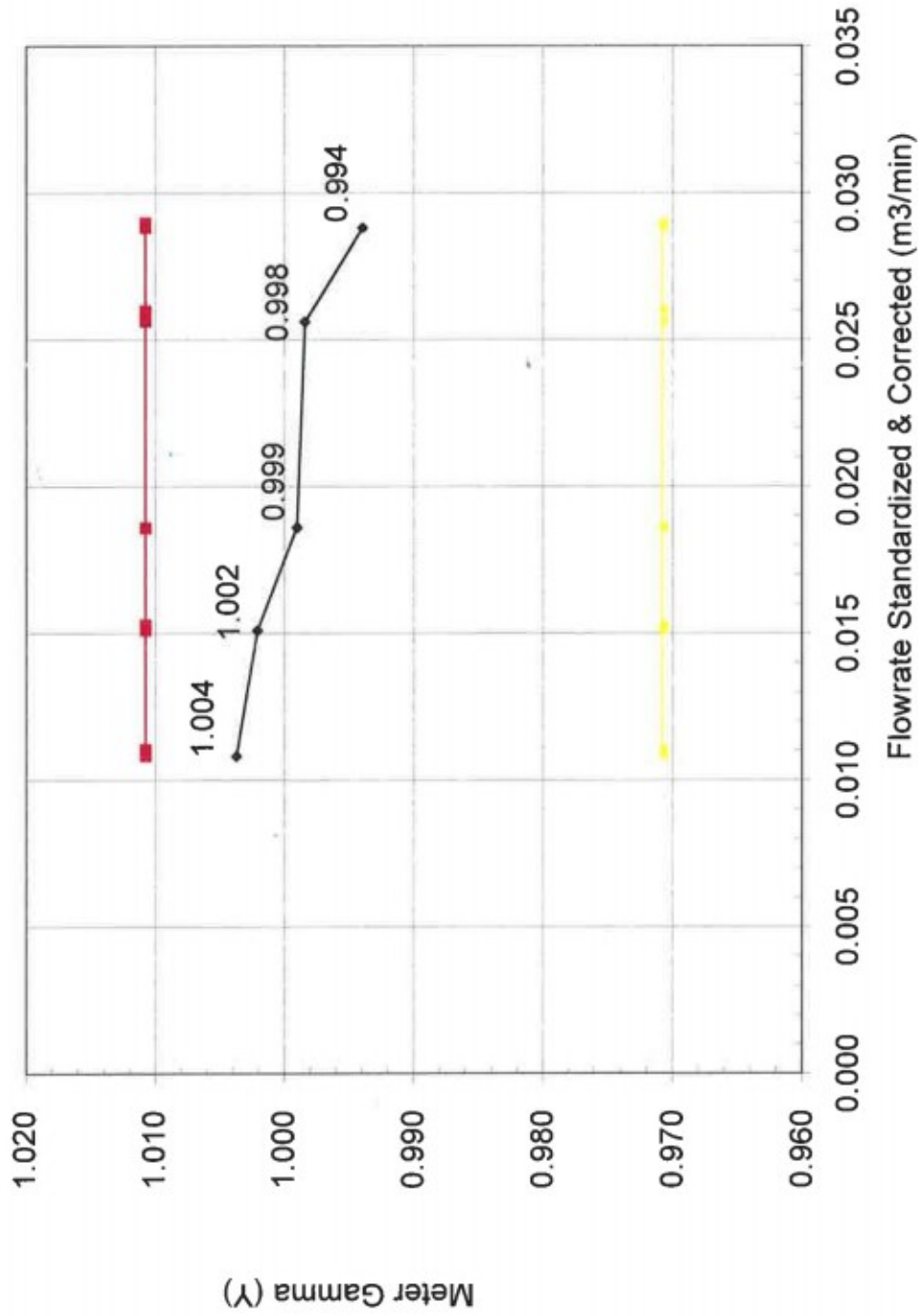
Panadon Samy Hong

Meter Pressure vs Flowrate



DGM Orifice ΔH (mm H₂O)

Meter Gamma vs Flowrate



Console Serial: 1701014

Console Model: XC-572-OV



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METHOD 5 CONSOLE CALIBRATION

USING REFERENCE WET TEST METER W-NK-2.5B No.545141

5-POINT METRIC UNIT

Calibration Data									
Results									
Standardized Data					Dry Gas Meter				
Dry Gas Meter		Calibration Meter			Calibration Factor		Flowrate		
(V _{std})	(Q _{std})	(V _{ref})	(Q _{ref})	(Q _W)	Value	(Y)	Std & Corr	(Q _{ref})	Variation
m ³	m ³ /min	m ³	m ³ /min	m ³ /min			(Q _{ref})	(ΔH@)	(ΔH@)
0.139	0.011	0.139	0.011	0.011	1.002	0.011	0.011	49.939	0.160
0.139	0.011	0.140	0.011	0.011	1.005	0.015	0.011	47.893	-1.887
0.140	0.015	0.139	0.015	0.015	0.999	0.008	0.015	51.416	1.636
0.140	0.015	0.139	0.015	0.015	0.999	0.008	0.015	50.096	0.317
0.279	0.019	0.279	0.019	0.019	0.998	0.007	0.019	52.201	2.421
0.279	0.019	0.277	0.019	0.019	0.990	-0.001	0.019	52.404	2.625
0.280	0.026	0.275	0.026	0.026	0.981	-0.010	0.026	48.483	-1.296
0.280	0.026	0.278	0.026	0.026	0.991	0.000	0.026	47.074	-2.706
0.281	0.030	0.273	0.029	0.029	0.972	-0.019	0.029	49.441	-0.338
0.281	0.030	0.272	0.029	0.029	0.971	-0.020	0.029	48.847	-0.932
					0.991	Y Average			
								49.779	ΔH@ Average



Environmental Solution Integrator Co., Ltd.

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ± 0.02 .
Note: For ΔH_G , orifice pressure differential that equals to 0.75cdm (0.0212m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 0.2 inches (5.1mm) H₂O.

Calibrated by: *Kulbassan*

Approved by: *Panday SangHong*

Date: 6-Jan-22



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METHOD 5 CONSOLE CALIBRATION
USING REFERENCE WET TEST METER W-NK-2.5B No.545141
5-POINT METRIC UNIT

Meter Console Information	
Console Model Number	XC-572-OV
Console Serial Number	1701014
DGM Model Number	SK25EX
DGM Serial Number	0002032

Calibration Conditions	
Date	6-Jun-22
Time	9:00 AM
Calibration Reference No.	SE85AP009
Barometric Pressure	758.00
Calibration Meter Gamma	1.0010

Factors/Conversions	
Std Temp	293
Std Press	760
K ₁	0.386
Console Leak Check	
PASS	

Calibration Data									
Metering Console					Calibration Meter				
Run Time	DGM Orifice ΔH (P _m)	Volume Initial (V _{m1})	Volume Final (V _{m2})	Outlet Temp Initial (t _{m1})	Outlet Temp Final (t _{m2})	Volume Initial (V _{w1})	Volume Final (V _{w2})	Outlet Temp Initial (t _{w1})	Outlet Temp Final (t _{w2})
Elapsed (Θ)	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C	°C
min									
12.90	13.0	621.6068	621.7468	20	20	479.004080	479.144420	22	21
12.68	13.0	621.7468	621.8868	20	21	479.144420	479.285200	21	21
9.23	26.0	621.9020	622.0420	21	22	479.302120	479.442180	21	21
9.12	26.0	622.0420	622.1820	22	22	479.442180	479.582280	21	21
14.98	40.0	622.1908	622.4708	23	23	479.590460	479.870620	21	21
14.90	40.0	622.4708	622.7508	23	24	479.870620	480.148680	21	21
10.73	70.0	622.7626	623.0426	24	25	480.159940	480.436220	21	21
10.68	70.0	623.0426	623.3226	25	26	480.436220	480.715300	21	21
9.47	90.0	623.3362	623.6162	27	27	480.721360	480.995500	21	21
9.40	90.0	623.6162	623.8962	28	28	480.995500	481.269360	21	21

PM-10 & TSP DUST MONITOR CALIBRATION REPORT

Date : 25 ตุลาคม 2564 Working Time : 14:30 - 16:00
 Location : สถานีฯ บริเวณวัดชัยบอน
 TSP ANALYZER : METONE MODEL : BAM1020 S/N : A12898
 PM-10 ANALYZER : METONE MODEL : BAM1020 S/N : A12902
 FLOW CALIBRATOR : BIOS MODEL : 510H S/N : 132877

FLOW RATE CALIBRATION SHEET

Dust Monitor	Before			After		
	Set-Point	Mea. Value	%Error	Set-Point	Mea. Value	%Error
	(LPM)			(LPM)		
TSP	16.67	16.60	-0.42	16.67	16.65	-0.12
PM-10	16.67	16.55	-0.72	16.67	16.67	0.00

Remark

- TSP : Percent Error per point must be less than +/- 5%
- PM-10 : Percent Error per point must be less than +/- 5%

SPAN FOIL CALIBRATION SHEET

Dust Monitor					
	COUNT (I _o)	COUNT (I)	Mass Conc.	ABS	%Error
TSP	947221	740069	0.848	0.846	0.24
PM-10	827690	646782	0.860	0.854	0.70

Remark : Percent Error must be less than +/- 5%

Reference from PCD Service Contact

Test Results : Pass

Test By : Chotree

Approved by : Aon

Remark : _____



MULTI POINT CALIBRATION REPORT

Station Name	สถานีตรวจวัดฯ บริเวณ วัดชัยบ่อน			Date	30 พฤศจิกายน 2564
Standard Gas Type	MIX GAS	Manufacturer	AIRGAS	Expired Date	Mar 12, 2023
Concentration	NO = 44.84 PPM	SO2 = 45.71 PPM		Cylinder NO.	EB0123716

Level/Parameter	NO (PPB)	NOX (PPB)	SO ₂ (PPB)
Zero	Actual	0.00	0.00
	Ideal	0.00	0.00
	Error	0.00	0.00
Level 1 (10%)	Actual	52.00	51.00
	Ideal	50.00	50.00
	Error	-4.00	2.00
Level 2 (40%)	Actual	201.00	203.00
	Ideal	200.00	200.00
	Error	-1.00	1.00
Level 3 (80%)	Actual	400.00	400.00
	Ideal	400.00	400.00
	Error	0.00	0.25

Remark: Percent Error per point must be less than +/- 5%
Reference from PCD Service Contact

TESTED BY : Chotree

APPROVED BY : ton

PM-10 & TSP DUST MONITOR CALIBRATION REPORT

Date : 25 ตุลาคม 2564 Working Time : 12:00 - 13:30
Location : สถานีฯ บริเวณบ้านไทรงาม
TSP ANALYZER : METONE MODEL : BAM1020 S/N : A13168
PM-10 ANALYZER : METONE MODEL : BAM1020 S/N : A12907
FLOW CALIBRATOR : BIOS MODEL : 510H S/N : 132877

FLOW RATE CALIBRATION SHEET

Dust Monitor	Before			After		
	Set-Point	Mea. Value	%Error	Set-Point	Mea. Value	%Error
	(LPM)			(LPM)		
TSP	16.67	16.76	0.54	16.67	16.66	-0.06
PM-10	16.67	16.79	0.72	16.67	16.67	0.00

Remark

- TSP : Percent Error per point must be less than +/- 5%
- PM-10 : Percent Error per point must be less than +/- 5%

SPAN FOIL CALIBRATION SHEET

Dust Monitor					
	COUNT (I _o)	COUNT (I)	Mass Conc.	ABS	%Error
TSP	754641	589929	0.862	0.866	-0.46
PM-10	1003053	787298	0.848	0.841	0.83

Remark : Percent Error must be less than +/- 5%

Reference from PCD Service Contact

Test Results : Pass

Test By : Chaiue

Approved by : Aor

Remark : _____



MULTI POINT CALIBRATION REPORT

Station Name	สถานีตรวจวัดฯ บริเวณ บ้านโพธิ์งาม			Date	29 พฤศจิกายน 2564
Standard Gas Type	MIX GAS	Manufacturer	AIRGAS	Expired Date	Mar 12, 2023
Concentration	NO = 44.83 PPM	SO2 = 45.69 PPM		Cylinder NO.	EB0123464

Level/Parameter	NO (PPB)	NOX (PPB)	SO ₂ (PPB)
Zero	Actual	0.00	0.00
	Ideal	0.00	0.00
	Error	0.00	0.00
Level 1 (10%)	Actual	49.00	51.00
	Ideal	50.00	50.00
	Error	-2.00	2.00
Level 2 (40%)	Actual	199.00	201.00
	Ideal	200.00	200.00
	Error	-0.50	0.50
Level 3 (80%)	Actual	400.00	400.00
	Ideal	400.00	400.00
	Error	0.00	0.00

Remark: Percent Error per point must be less than +/- 5%

Reference from PCD Service Contact

TESTED BY : *Chatree*

APPROVED BY : *Don*

PM-10 & TSP DUST MONITOR CALIBRATION REPORT

Date : 29 พฤศจิกายน 2564 Working Time : 09:30 - 10:30
Location : สถานีฯ บริเวณบ้านอ่างหิน
TSP ANALYZER : METONE MODEL : BAM1020 S/N : A12169
PM-10 ANALYZER : METONE MODEL : BAM1020 S/N : A12901
FLOW CALIBRATOR : BIOS MODEL : 510H S/N : 132877

FLOW RATE CALIBRATION SHEET

Dust Monitor	Before			After		
	Set-Point	Mea. Value	%Error	Set-Point	Mea. Value	%Error
	(LPM)			(LPM)		
TSP	16.67	16.75	0.48	16.67	16.66	-0.06
PM-10	16.67	16.77	0.60	16.67	16.65	-0.12

Remark

- TSP : Percent Error per point must be less than +/- 5%
- PM-10 : Percent Error per point must be less than +/- 5%

SPAN FOIL CALIBRATION SHEET

Dust Monitor					
	COUNT (I _o)	COUNT (I)	Mass Conc.	ABS	%Error
TSP	947039	744844	0.834	0.835	-0.12
PM-10	1052743	831300	0.821	0.821	0.00

Remark : Percent Error must be less than +/- 5%

Reference from PCD Service Contact

Test Results : Pass

Test By : Chatree

Approved by : AGN

Remark : _____



MULTI POINT CALIBRATION REPORT

Station Name	สถานีตรวจวัดฯ บริเวณ บ้านอ่างหิน			Date	29 พฤศจิกายน 2564
Standard Gas Type	MIX GAS	Manufacturer	AIRGAS	Expired Date	Mar 12, 2023
Concentration	NO = 44.88 PPM	SO2 = 45.68 PPM		Cylinder NO.	EB0123751

Level/Parameter		NO (PPB)	NOX (PPB)	SO ₂ (PPB)
Zero	Actual	0.00	1.00	0.00
	Ideal	0.00	0.00	0.00
	Error	0.00	1.00	0.00
Level 1 (100%)	Actual	52.00	53.00	51.00
	Ideal	50.00	50.00	50.00
	Error	-2.00	2.00	-4.00
Level 2 (400%)	Actual	201.00	203.00	202.00
	Ideal	200.00	200.00	200.00
	Error	-0.50	1.00	-1.00
Level 3 (800%)	Actual	400.00	401.00	400.00
	Ideal	400.00	400.00	400.00
	Error	0.00	0.25	-0.25

Remark: Percent Error per point must be less than +/- 5%
Reference from PCD Service Contact

TESTED BY : *Chatee*

APPROVED BY : *Aw*

PM-10 & TSP DUST MONITOR CALIBRATION REPORT

Date : 29 ตุลาคม 2564

Working Time : 11:30 - 14:00

Location : สถานีฯ บริเวณวัดหินลับ

TSP ANALYZER : METONE

MODEL : BAM1020

S/N : A12668

PM-10 ANALYZER : METONE

MODEL : BAM1020

S/N : A12905

FLOW CALIBRATOR : BIOS

MODEL : 510H

S/N : 132877

FLOW RATE CALIBRATION SHEET

Dust Monitor	Before			After		
	Set-Point	Mea. Value	%Error	Set-Point	Mea. Value	%Error
	(LPM)			(LPM)		
TSP	16.67	16.76	0.54	16.67	16.69	0.12
PM-10	16.67	16.70	0.18	16.67	16.67	0.00

Remark

- TSP : Percent Error per point must be less than +/- 5%
- PM-10 : Percent Error per point must be less than +/- 5%

SPAN FOIL CALIBRATION SHEET

Dust Monitor					
	COUNT (10)	COUNT (1)	Mass Conc.	ABS	%Error
TSP	963884	732943	0.816	0.821	-0.61
PM-10	1104232	953882	0.820	0.828	-0.97

Remark : Percent Error must be less than +/- 5%

Reference from PCD Service Contact

Test Results : Pass

Test By :

Chatra

Approved by :

Don

Remark :



MULTI POINT CALIBRATION REPORT

Station Name	สถานีตรวจวัดฯ บริเวณ วัดหินลับ		Date	26 พฤศจิกายน 2564
Standard Gas Type	MIX GAS	Manufacturer	Expired Date	Mar 12, 2023
Concentration	NO = 44.94 PPM	SO2 = 45.65 PPM	Cylinder NO.	EB0123786

Level/Parameter		NO (PPB)	NOX (PPB)	SO ₂ (PPB)
Zero	Actual	0.00	0.00	0.00
	Ideal	0.00	0.00	0.00
	Error	0.00	0.00	0.00
Level 1 (10%)	Actual	51.00	52.00	51.00
	Ideal	50.00	50.00	50.00
	Error	2.00	4.00	2.00
Level 2 (40%)	Actual	202.00	203.00	201.00
	Ideal	200.00	200.00	200.00
	Error	1.00	1.50	0.50
Level 3 (80%)	Actual	401.00	403.00	400.50
	Ideal	400.00	400.00	400.00
	Error	0.25	0.75	0.13

Remark: Percent Error per point must be less than +/- 5%

Reference from PCD Service Contact

TESTED BY : *Chattr*

APPROVED BY : *for*

PM-10 & TSP DUST MONITOR CALIBRATION REPORT

Date : 29 ตุลาคม 2564 Working Time : 09:30 - 12:00
Location : สถานีฯ บริเวณโรงเรียนชัยบ่อน
TSP ANALYZER : METONE MODEL : BAM1020 S/N : A12894
PM-10 ANALYZER : METONE MODEL : BAM1020 S/N : A12896
FLOW CALIBRATOR : BIOS MODEL : 510H S/N : 132877

FLOW RATE CALIBRATION SHEET

Dust Monitor	Before			After		
	Set-Point	Mea. Value	%Error	Set-Point	Mea. Value	%Error
	(LPM)			(LPM)		
TSP	16.67	16.54	-0.78	16.67	16.66	-0.06
PM-10	16.67	16.53	-0.84	16.67	16.65	-0.12

Remark

- TSP : Percent Error per point must be less than +/- 5%
- PM-10 : Percent Error per point must be less than +/- 5%

SPAN FOIL CALIBRATION SHEET

Dust Monitor					
	COUNT (lo)	COUNT (I)	Mass Conc.	ABS	%Error
TSP	955433	740995	0.853	0.850	0.35
PM-10	915443	724332	0.829	0.826	0.36

Remark : Percent Error must be less than +/- 5%

Reference from PCD Service Contact

Test Results : Pass

Test By : Chatrae

Approved by : Aon

Remark : _____



MULTI POINT CALIBRATION REPORT

Station Name	สถานีตรวจวัดฯ บริเวณ โรงเรียนชัยบ่อน			Date	26 พฤศจิกายน 2564
Standard Gas Type	MIX GAS	Manufacturer	AIRGAS	Expired Date	Mar 12, 2023
Concentration	NO = 44.90 PPM	SO2 = 45.66 PPM		Cylinder NO.	EB0123781

Level/Parameter		NO (PPB)	NOX (PPB)	SO ₂ (PPB)
Zero	Actual	0.00	1.00	1.00
	Ideal	0.00	0.00	0.00
	Error	1.00	1.00	1.00
Level 1 (10%)	Actual	52.00	53.00	49.00
	Ideal	50.00	50.00	50.00
	Error	2.00	6.00	2.00
Level 2 (40%)	Actual	202.00	203.00	199.00
	Ideal	200.00	200.00	200.00
	Error	0.50	1.50	1.50
Level 3 (80%)	Actual	400.50	402.50	399.00
	Ideal	400.00	400.00	400.00
	Error	0.25	0.75	0.00

Remark: Percent Error per point must be less than +/- 5%

Reference from PCD Service Contact

TESTED BY : *Chattr*

APPROVED BY : *Don*

CERTIFICATE OF CALIBRATION

Certificate No: FL-01012022

Page 1 of 1 pages

MEASUREMENT ITEM : Primary flow meter.
MANUFACTURER : Bios International Corp.
MODEL/TYPE : DryCal DC-Lite (DCL-ML)
SERIAL NUMBER : 109185
CUSTOMER : TPI Polene Public Company Limited.
Address No.229, Moo 5, Mittraphap Road Km.134, Tabkwang Sub-District, Saraburi 18260.

MEASUREMENT DATE : Jan 10, 2022.
ISSUED DATE : Jan 11, 2022.

ENVIRONMENTAL CONDITION:

The measurement was carried out in an ambient temperature of $(25\pm3)^{\circ}\text{C}$, relative humidity of $(50\pm15)\%$, and atmospheric pressure of $(1006.8\pm1)\text{hPa}$.

MEASUREMENT METHOD:

The primary flow calibrator, Unit Under Calibration (UUC) was calibrated by volumetric primary flow standard. The flow rate reading of UUC ($\text{UUC}_{\text{Reading}}$) were compared to the flow rate reading of standard ($\text{STD}_{\text{Reading}}$) to determine the errors. The uncertainty was evaluated for average reading of each calibration point.

TRACEABILITY:

This calibration documents the traceability to national standard, Which realize the unit of measurements according to the national system of units (SI) through Certificate number: AD2103-364-0002 Due date: March 27, 2022, Certificate number: AD2103-364-0001 Due date: March 29, 2022,

MEASUREMENT RESULTS:

The results of calibration and associated measurement uncertainties are reported in the table below.

Calibration point mL/min.	$\text{STD}_{\text{Reading}}$ mL/min	$\text{UUC}_{\text{Reading}}$ mL/min	Error mL/min	Expanded Uncertainty ($\pm\text{mL/min}$)
50	53.174	50.00	-3.17	0.95
500	503.29	500.6	-2.7	2.6
1000	1010.3	1007	-4	3.9
1500	1490.9	1477	-14	5.6
2000	2045.2	2021	-24	6.9

UUC*: Unit Under Calibration.

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

Calibrated by

☒ Mr. Sorawit Thachalad



Approved Signatory:.....

25/01/22

Mr. Parinya Booncharoen
Calibration Department Manager



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0650

MTC No. EEL. BP. 80/0664

CALIBRATION CERTIFICATE



Submitted by : TPI POLENE PUBLIC COMPANY LIMITED

Address : 26/56, Chan Tat Mai Rd., Thingmahamek, Sathorn, Bangkok 10120.

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

Instrument Calibrated :

Ambient Environment

Description : Integrating Sound Level Meter

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

Manufacturer : Rion

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

Model : NL-04

Ambient Pressure : $(101.325 \pm 1.5) \text{ kPa}$

Serial No. : 11064577

Microphone : UC-52 No.50207

Preamplifier : NH-21 No.65042

Standards used :

1. Band Pass Filter Wavetek 752A S/N 90010494.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2633526.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 18 Jun. 2021

Date of Calibration : 1-2 Jul. 2021

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0650

MTC No. EEL. BP. 80/0664

9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2006). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the 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.

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%.

Date of Calibration : 1-2 Jul. 2021

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Signature

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Unit Under Test				Tolerance Limit Class 2 (±dB)
	Measured Value (dB)		Deviation (dB)	Uncertainty (±dB)	
	Before adjust	After adjust			
113.90	114.0	113.9	0.0	0.30	1.4

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 94.3 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (+dB)
22.5	0.10

2.2 The microphone of the sound level meter was replaced by electrical signal input device

Frequency Weighting	Measured Value (dB)	Uncertainty (+dB)
A-Weighting	21.0	0.10
C-Weighting	22.9	0.10
Flat	27.4	0.10

Date of Calibration : 1-2 Jul. 2021

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0650

MTC No. EEL. BP. 80/0664

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
125	0.4	0.3	0.2	0.40	2.0
1 000	-0.2	-0.2	-0.2	0.40	1.4
4 000	-0.7	-0.6	-0.7	0.40	3.6

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from response curve			Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
	A-weighting (dB)	C-weighting (dB)	Flat (dB)		
63	0.3	0.0	0.0	0.20	2.5
125	0.2	0.1	0.0	0.20	2.0
250	0.2	0.0	0.0	0.20	1.9
500	0.1	0.0	0.0	0.20	1.9
1 000	0.0	0.0	0.0	0.20	1.4
2 000	0.0	0.1	0.1	0.20	2.6
4 000	-0.1	0.0	0.1	0.20	3.6
8 000	-0.1	0.1	0.2	0.20	5.6

Date of Calibration : 1-2 Jul. 2021

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0650

MTC No. EEL. BP. 80/0664

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
A-weighting	94.0	0.0	0.20	0.4
C-weighting	94.0	0.0	0.20	0.4
Flat	94.0	0.0	0.20	0.4

5.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
Fast	94.0	0.0	0.20	0.3
Slow	94.0	0.0	0.20	0.3
Leq	94.0	0.0	0.20	0.3

6. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
108	108.0	0.0	0.30	1.4
107	107.1	0.1	0.30	1.4
106	106.0	0.0	0.30	1.4
105	105.0	0.0	0.30	1.4
104	104.0	0.0	0.30	1.4
103	103.0	0.0	0.30	1.4
102	102.0	0.0	0.30	1.4

Date of Calibration : 1-2 Jul. 2021

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Request No. 21-64/0650

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6. Level linearity on the reference level range (continue)

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (\pm dB)	Tolerance Limits Class 2 (\pm dB)
101	101.0	0.0	0.30	1.4
100	100.0	0.0	0.30	1.4
99	99.0	0.0	0.30	1.4
94	94.0	0.0	0.30	1.4
89	89.0	0.0	0.30	1.4
84	84.1	0.1	0.30	1.4
79	79.0	0.0	0.30	1.4
74	74.1	0.1	0.30	1.4
69	69.1	0.1	0.30	1.4
64	64.2	0.2	0.30	1.4
59	59.1	0.1	0.30	1.4
54	54.0	0.0	0.30	1.4
49	49.1	0.1	0.30	1.4
44	44.2	0.2	0.30	1.4
43	43.1	0.1	0.30	1.4
42	42.6	0.6	0.30	1.4
41	41.1	0.1	0.30	1.4
40	40.1	0.1	0.30	1.4

Date of Calibration : 1-2 Jul. 2021

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7. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (+dB)
70-130	125	125.0	0.0	0.30	1.4
60-120	115	115.1	0.1	0.30	1.4
50-110	105	105.1	0.1	0.30	1.4
40-100	95	95.0	0.0	0.30	1.4
30-90	85	85.0	0.0	0.30	1.4
20-80	75	75.0	0.0	0.30	1.4

8. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured Value (dB)	Deviated Value (dB)	Uncertainty (+dB)	Tolerance Limits Class 2 (dB)
Fast	200	96.0	0.0	0.20	± 1.3
	2	79.7	0.7	0.20	+1.3; -2.8
Slow	200	89.7	0.1	0.20	± 1.3
SEL	200	89.7	-0.3	0.20	± 1.3
	2	70.0	0.0	0.20	+1.3; -2.8

Date of Calibration : 1-2 Jul. 2021

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Request No. 21-64/0650

MTC No. EEL. BP. 80/0664

9. Overload indication

Measured value (dB)		Deviated value (dB)	Uncertainty (±dB)	Tolerance Limits Class 2 (±dB)
Positive one-half cycle	Negative one-half cycle			
146.6	146.6	0.0	0.30	1.8

Calibrated by :

Panya Phasingsri

(Mr. Panya Phasingsri)

Approved by :

Prawate Kluyapa

(Mr. Prawate Kluyapa)

Acting Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Ref : 2011264061802650001

Date of Calibration : 1-2 Jul. 2021

Date of Issue : 9 Jul. 2021

End of Certificate

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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0151	4-Mar-22	2-Sep-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0975	26-Jan-22	27-Jul-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0163	17-Mar-22	15-Sep-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0159	31-Mar-21	29-Sep-22	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0974	26-Jan-22	27-Jul-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0910	6-May-21	4-Nov-22	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0919	30-Aug-21	28-Feb-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0917	1-Nov-21	2-May-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0159	31-Mar-21	29-Sep-22	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0974	26-Jan-22	27-Jul-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0917	1-Nov-21	2-May-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0919	30-Aug-21	28-Feb-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0910	6-May-21	4-Nov-22	18
Ambient	Hydrogen Chloride	Field Rotameter	BKK_FS1024	1-Apr-22	1-Jul-22	3
Ambient	Hydrogen Chloride	Ion Chromatography	BKK_EN0069	12-Jan-22	12-Jan-23	12
Ambient	Cadmium	High Volume	BKK_FS0360	-	-	On site Calibration
Ambient	Cadmium	High Volume	BKK_FS0362	-	-	On site Calibration
Ambient	Cadmium	High Volume	BKK_FS0365	-	-	On site Calibration
Ambient	Cadmium	High Volume	BKK_FS0366	-	-	On site Calibration
Ambient	Cadmium	High Volume	BKK_FS0364	-	-	On site Calibration
Ambient	Cadmium	High Volume	BKK_FS1059	-	-	On site Calibration
Ambient	Cadmium	High Volume	BKK_FS1057	-	-	On site Calibration
Ambient	Cadmium	High Volume	BKK_FS0371	-	-	On site Calibration
Ambient	Cadmium	High Volume	BKK_FS0371	-	-	On site Calibration
Ambient	Cadmium	High Volume	BKK_FS1057	-	-	On site Calibration
Ambient	Cadmium	High Volume	BKK_FS0360	-	-	On site Calibration
Ambient	Cadmium	High Volume	BKK_FS0362	-	-	On site Calibration
Ambient	Cadmium	High Volume	BKK_FS0366	-	-	On site Calibration
Ambient	Cadmium	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Ambient	Lead	High Volume	BKK_FS0360	-	-	On site Calibration
Ambient	Lead	High Volume	BKK_FS0362	-	-	On site Calibration
Ambient	Lead	High Volume	BKK_FS0365	-	-	On site Calibration
Ambient	Lead	High Volume	BKK_FS0366	-	-	On site Calibration
Ambient	Lead	High Volume	BKK_FS0364	-	-	On site Calibration
Ambient	Lead	High Volume	BKK_FS1059	-	-	On site Calibration
Ambient	Lead	High Volume	BKK_FS1057	-	-	On site Calibration
Ambient	Lead	High Volume	BKK_FS0371	-	-	On site Calibration
Ambient	Lead	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Ambient	Mercury	High Volume	BKK_FS0360	-	-	On site Calibration
Ambient	Mercury	High Volume	BKK_FS0362	-	-	On site Calibration
Ambient	Mercury	High Volume	BKK_FS0365	-	-	On site Calibration
Ambient	Mercury	High Volume	BKK_FS0366	-	-	On site Calibration
Ambient	Mercury	High Volume	BKK_FS0364	-	-	On site Calibration
Ambient	Mercury	High Volume	BKK_FS1059	-	-	On site Calibration
Ambient	Mercury	High Volume	BKK_FS1057	-	-	On site Calibration
Ambient	Mercury	High Volume	BKK_FS0371	-	-	On site Calibration
Ambient	Mercury	CVAFS	BKK_EL0011	7-Jun-21	7-Jun-22	12

CERTIFICATE OF CALIBRATION

Certificate No. WS-01032022
Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger
Manufacturer : Data logger, Lul buzer
Model/Type : Cup anemometer, Lul buzer
Serial Number : Data logger: 16050287
ID No : Cup anemometer: B01412369
Customer : Data logger: BWA P80151
Cup anemometer

Customer : A13 Laboratory Group (Thailand) Co., Ltd.
104 Phetchaburi 40, Phetchaburi Rd, Phetchaburi, Sam Lung, Muang Sam Lung, Bangkok 10260 Thailand

Test Conditions : Wind tunnel cross test section area : 900 m²
Anemometer frontal area : 150 cm²
Diameter of measuring pipe : 60 mm
Blockage ratio of test object : 0.217
Test Conditions : Air temperature : 24.7 ±0.8 °C
Air pressure : 1010.9 ±0.4 mPa
Relative air humidity : 60.0 ±3.5 %RH

Calibration Procedure : Calibration was carried out using the:
ISO 6140-12.1, IEC 61220 Power Performance Measurements of Electricity Producing Wind Turbines.
MEASNET Anemometer Calibration Procedure - Version 2, 2009.

Traceability : This calibration documents the traceability to national standards, which reside the unit of measurements according to the international system of units (SI) through National Institute of Metrology (Thailand NIMT).

Measurement Date : 10 MAR 04, 2022
Issued Date : 10 MAR 11, 2022

Calibrated by :
☒ Mr. Surach Thichchai
☐ Mrs. Chitra Wachulaya

Approved Signature :
Mr. Parinya Eonchaisri
Calibration Department Manager



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Certification of Certificate of Calibration Number

Certificate No. WS-01032022
Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment
Calibration in the range of 1 - 10 m/s at a calibration interval of 1 m/s.
The results of calibration and associated measurement uncertainties are reported in the table below.

V _{meas} Reading m/s	V _{corr} Reading m/s	Error m/s	Uncertainty m/s
2.085	2.07	0.02	2.2
4.125	3.99	-0.14	3.3
5.68	5.99	0.02	1.9
7.88	7.99	0.02	0.66
10.02	10.21	0.18	1.1
12.00	12.20	0.20	0.43
14.03	14.49	0.47	0.37
16.00	16.66	0.66	0.86
18.02	18.66	0.66	0.72
20.00	20.66	0.66	0.40
22.02	22.66	0.66	0.46
24.00	24.66	0.66	0.58
26.02	26.66	0.66	0.76
28.00	28.66	0.66	0.86
30.02	30.66	0.66	3.4
32.00	32.66	0.66	4.3

LMC* Unit Under Calibration

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

Appendix 1: Indemnifications

No	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Flow rate	VECTO MP	00332145	Aug 07, 2021	MS-0034-21	0 - 30 m/s
2	Pressure Differential Pressure Meter	Zepha	DPN2500	Aug 07, 2021	MS-0034-21	0 - 30 m/s
3	Air velocity (inductor flow rate)	TS MP	8455-12	Aug 08, 2021	MS-0034-21	0 - 5 m/s
4	Temperature	Zepha	009114	Mar 20, 2021	CL-0274-21	0 - 70 °C
5	Relative humidity	Zepha	009114	Mar 20, 2021	RH-0303-2021	0 - 100 %RH
6	Atmospheric pressure	Zepha	009114	Mar 20, 2021	BP-0103-2021	800 - 1100 mPa
7	Wind speed	CECOP	MP3301	-	-	0 - 50 m/s

End of certificate of calibration



CERTIFICATE OF CALIBRATION

Certificate No: WD-Q1032022
Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger
Manufacturer : Data logger: Lei Lashen
: Wind direction sensor: Lei Lashen
Model/Type : Data logger: EI O105
: Wind direction sensor: DINA212
Serial Number : Data logger: 16050287
: Wind direction sensor: BR1412238
ID No : Data logger: 8KH.F50151
: Wind direction sensor: -
Customer : ALS laboratory group (Thailand) co., Ltd.
: 104 Puchanank 40, Puchanank Rd, Khwaeng Suan Luang, Huet Suan Luang, Bangkok 10250 Thailand.

Environmental Condition

The measurement was carried out in an ambient temperature of (23±2) °C, and relative humidity of (40±10) %.

Measurement Method

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and the laser is used for axis control. The measurement were taken at 45° intervals in clockwise and counter-clockwise directions.

Note: The UMC was warned up for 1 hour prior to the calibration being performed

Traceability

The measurement results are traceable to the international system of units (SI) through Certificate No: Q21086014, Certificate No: RV954/0025.

Measurement Date : MAR 04, 2022
Issued Date : MAR 11, 2022

Performed by

☒ Mr. Sraeth Thachasat
☐ Miss Orathai Wathakulaya



Approved Signatory:

[Signature]
Mr. Panyas Boonchurorn
Calibration Department Manager

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Continuation of Certificate of Calibration Number

Certificate No: WD-Q1032022
Page 2 of 2 pages

Result of calibration: ☒ Without adjustment ☐ With adjustment.
Calibration in the range of 0 - 360 ° at a calibration interval of 45°.
The results of calibration and associated measurement uncertainties are reported in table below.

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty u(°)
1	Clockwise	0/360	0	0	0	3.0
2		45	45	47	2	3.0
3		90	90	93	3	3.0
4		135	135	137	2	3.0
5		180	180	181	1	3.0
6		225	225	225	0	3.0
7		270	270	269	-1	3.0
8		315	315	314	-1	3.0
9	Counter Clockwise	0/360	0	0	0	3.0
10		45	45	47	2	3.0
11		90	90	93	3	3.0
12		135	135	137	2	3.0
13		180	180	181	1	3.0
14		225	225	225	0	3.0
15		270	270	269	-1	3.0
16		315	315	314	-1	3.0

UUC*: Unit Under Calibration. The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%.

End of Certificate of Calibration



CALIBRATION REPORT

Calibration No. : RB-01032022
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Data logger: Lei laiden
Relative humidity sensor: Lei laiden
Model/Type : Data logger: DLO105
Relative humidity sensor: DHA672-1
Serial Number : Data logger: 16056287
Relative humidity sensor: AW1412830
ID No : BKK F50151

Customer : AIS laboratory group (Thailand) Co., Ltd.
104 Phudhannan 40, Phudhannan Rd, Khwaeng San Luang, Khut San Luang, Bangkok 10250
Thailand

Environmental Condition:

The measurement was carried out in an ambient temperature of (25±3)°C, and relative humidity of (50±15)%.

Measurement Method:

The Relative humidity with data logger, Unit Under Calibration (UUC) was calibrated by comparison method with the equilibrium of standard salt solution CH₃COOK Pelletium Acetate, MgSO₄ Magnesium Sulfate, KCl Pelletium Chloride to determine the error.

Measurement Date : MAR 06, 2022
Issued Date : MAR 11, 2022

Measurement Results:

The results of calibration are reported in table below

Standard salt solutions	Standard (RH%)	UUC(RH%)	Error
CH ₃ COOK Pelletium Acetate	22.51	22.0	-0.5
MgSO ₄ Magnesium Sulfate	57.89	57.0	-0.9
KCl Pelletium Chloride	84.34	82.5	-1.8

Performed by
☒ Mr. Srirach Thachalad
☐ Miss Oranai Wathakanya



Approved Signatory :
Mr. Panyee Booncharoen
Calibration Department Manager

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CALIBRATION REPORT

Calibration Number : RB-01032022
Page 1 of 2 Pages

Measurement Item : Rain gauge with data logger
Manufacturer : Data logger: Lei laiden
Rain gauge: Lei laiden
Model/Type : Data logger: DLO105
Rain gauge: DGA170.1
Serial Number : Data logger: 16056287
Rain gauge: P1412534
ID NO : BKK F50151

Customer : AIS laboratory group (Thailand) Co., Ltd.
104 Phudhannan 40, Phudhannan Rd, Khwaeng San Luang, Khut San Luang, Bangkok 10250, Thailand

Environmental Condition:

The measurement was carried out in an ambient temperature of (25±3)°C, and relative humidity of (50±15)%.

Measurement Method:

The Rain gauge, Unit Under Calibration (UUC) was calibrated by Precision reference bottle with flow adjuster at the rate 0.6 mm per minute or 1 tipping every 20 seconds. The tipping number was determined by procedures below.

- Obtain rain gauge test area
Rain gauge precise diameter in cm = Diameter/2 = R (radius)
Rain gauge area = πR^2 3.14 6.34 cm diameter = 20.3 cm, UUC radius = 10.15 cm
Rain gauge area = 323.6 cm²
- Obtain theoretical correct rain gauge answer: number of tipping using 323.6 cm² test area and 0.6 L of rain.
a) 10,000 cm³ / 323.6 cm² test area = 30.90 rain gauge area = 1700.00 of square meter
b) 30.90 * 0.6 L volume = 18.54 mm (mm of rain over 1 m² surface) 500 ml of rain volume on the rain gauge area = 16.45 mm of rain.
c) Number of tipping = 16.45 / 0.2 mm = 77 tipping.

Note: Rain gauge is fully cleaned and leveling prior the calibration performed

Measurement Date : MAR 10, 2022
Issued Date : MAR 11, 2022

Performed by
☒ Mr. Srirach Thachalad
☐ Miss Oranai Wathakanya



Approved Signatory :
Mr. Panyee Booncharoen
Calibration Department Manager

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Walthapa, Bangkok, Bangkok 10600 Thailand.
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jnatec.com

J
NAC

Calibration Co., Ltd.

Continuation of Calibration of Calibration Number

Calibration Number: RB-01032022
Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment.
The results of calibration are reported in table below.

Quantity of H ₂ O ml	Determined Tipping	Tipping count	Acceptable Tipping count
500	77	77	75 - 79
500	77	76	75 - 79
500	77	76	75 - 79
500	77	76	75 - 79

Remark: The procedure is made to verify the correct reading of the Unit under Calibration rain gauge when a precise volume of water falls into its cone. We suggest that the number of tipping should be within $\pm 2\%$ different from the 60° tipping (accepted range: 61-64 tipping) it means that the rain gauge meets the manufacturer acceptable limit.

End of calibration report



CERTIFICATE OF CALIBRATION

Certificate No.: CL-038-65
Page 1 of 2

Equipment Name: Data Logger with Temperature

Manufacturer: ISI Iestem
Model: EL0105
Serial No.: 1605G287
ID No.: BKK_FS0151

Customer

Name: ALS laboratory group (Thailand) Co., Ltd.
Address: 104 Phetthani 40, Phetthani
Rd., Khwaeng Suan Luang, Khet Suan Luang, Bangkok
10250 Thailand.

Received date: 09 FEB 2022
Calibration date: 07 MAR 2022
Issue date: 11 MAR 2022

Reference Used During Calibration

1. Standard Temperature Probe Model: STS-100 AS00.
Serial No.: 667662-06, Due date: 25 Mar 2022
2. Digital Temperature Indicator Model: D11-1000 A MK
II, Serial No.: 671407-00591, Due date: 04 June 2022

Calibration Condition

Temperature: (23 \pm 3) °C
Relative Humidity: (65 \pm 15)%

Calibration Procedure

The temperature calibration was done by In-House
calibration method as WI CL 001 according to
comparison method with standard digital temperature
indicator and standard temperature probe. The
temperature scale use was based on ITS-90.

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: IT-0036-21. Certificate number: ER-0032-
21

Calibrated by

☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwattaya

Approved Signatory:

Mr. Panyia Bhancharoen
Calibration Department Manager



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Result of Calibration: ☒ Without Adjustment ☐ With Adjustment
Calibration Range: 20 - 40 °C

Functions: This equipment was connected with temperature sensor Model : DMA672.1 S/N : AW1412830
Dimension : Diameter 15mm, Length 140 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
120	20.054	18.83	1.22	0.082
120	25.044	23.64	1.41	0.081
120	30.035	28.35	1.68	0.081
120	35.029	33.20	1.83	0.081
120	40.025	37.91	2.12	0.081

UUC*: Unit Under Calibration

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

* End of Certificate *



CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : LSI system
MODEL/TYPE : DGA240.1
SERIAL NUMBER : R1412996
ID NUMBER : BNC_F50151
CONDITION AS RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) co., Ltd.
104 Phatthanasak 40, Phatthanasak Rd,
Khaeng Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand.

Calibration procedure:
The pressure calibration was done by in-house calibration method as WP-CL-003 according to comparison method with Digital pressure calibrator based on DKD R 6-1

Traceability:
The measurement results are traceable to the international system of units (SI) through MENSOR which complies with the requirements of ISO/IEC 17025:2017, ANSI/NCSL 2540-1 via Certificate number: 201479

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

RECEIVED DATE : 9 Feb 2022
MEASUREMENT DATE : 11 Mar 2022
ISSUE DATE : 11 Mar 2022

CONDITION OF THIS RESULT OF CALIBRATION:

- Reference Standard Instrument:
Instrument: Absolute Pressure Transducer CPG2500 4100181.1
Model: Social No. 4100181.1
Serial No. 201479
- Calibration effort for calibration sequence A
- The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level.
- Calibration conditions:
Pressure transmitting medium : Air
 ρ (20°C, 1 bar) : 1.19 kg/m³
 μ (20°C) : (55±15) %
 T_{ref} : (23±3) °C
 P_{ref} : (1010±10) mbar
- The certificate is valid only to the item calibrated on date and place of calibration.

Calibrated by:
☒ Mr. Sorawat Thachulad
☐ Miss Orathai Wiwetwittaya



Approved signature:
Mr. Porluya Booncharoen
Calibration Department Manager

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STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty(k=2) (mbar)
950.05	949.4	-0.6	0.77
969.94	969.3	-0.6	0.74
989.91	989.3	-0.7	0.78
1009.88	1009.2	-0.7	0.86
1029.92	1029.3	-0.6	0.78
1049.92	1049.3	-0.7	0.79

Note : UUC* Unit Under Calibration

: To convert the result in report unit to Pa should be multiply by 100

End of certificate



CERTIFICATE OF CALIBRATION

Certificate No. WS-00012022
Page 1 of 2 pages

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Wallhapra, Bangkhuyai,Bangkok 10600 Thailand.
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jranetec.com

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novakys

Cup anemometer: Novakys

Model/Type : Data logger: 110 WS-250L D

Cup anemometer: WS102P

Serial Number : Data logger: A6443

Cup anemometer: WS10002

ID No : Data logger: 1006 F33975

Cup anemometer: -

Customer : A/S laboratory group (thailand) co., ltd.

: 104 Prachinpraphan 40, Prachinpraphan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Test Conditions : Wind tunnel cross test section area

900 cm²

Anemometer tube area

100 cm²

Diameter of mounting pipe

mm

Recessed ratio of test object

0.111 [-]

Test Conditions

Air temperature

24.1 ±0.8 °C

Air pressure

1010.9 ±0.4 kPa

Relative air humidity

52.4 ±3.5 %RH

Calibration Procedure

Calibration was carried out based on:

ISO 61400-12-1, ISO 11: 2008 Power Performance Measurements of Electricity Producing Wind Turbines;

MEASNET Anemometer Calibration Procedure - Version 2 2009.

Traceability

This calibration documents the traceable to national standards, which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).

Measurement Date

: JAN 26, 2022

Issued Date

: JAN 31, 2022

Calibrated by

☒ Mr. Somchai Thapaeat

☐ Miss Grabe Wudhaya



Approved Signature:

Mr. Panyat Boonchomson
Calibration Department Manager

63/14-15, 67/35-36, Soi Petchkasem 7/71, Petchkasem Rd,
Walthapra, Bangkokyai, Bangkok 10600 Thailand.
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jirantee.com

Certificate of Calibration Number

Certificate No. WD-03012022
Page 2 of 2 Pages

Result of calibration: ☒ without adjustment ☐ with adjustment
Calibration in the range of 1 - 16 m/s at a calibration interval of 1 m/s.
The results of calibration and associated measurement uncertainties are reported in the table below.

Wind Speed m/s	Wind Speed m/s	Error m/s	Uncertainty (k=1)
2.018	1.9	0.2	2.5
4.195	4.0	0.1	1.2
6.371	6.0	0.0	0.85
8.547	8.0	0.0	0.84
10.722	10.0	0.1	0.87
12.898	12.0	0.2	2.4
15.073	14.0	0.1	0.53
17.248	16.0	0.2	0.47
19.423	18.0	0.2	1.2
21.598	20.0	0.0	0.77
23.773	22.0	0.1	0.68
25.948	24.0	0.1	0.87
28.123	26.0	0.0	1.2
30.298	28.0	0.0	0.96
32.473	30.0	0.0	1.6
34.648	32.0	0.2	4.8

WIND-1000-010000

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

Appendix 1: Intercomparison

NO.	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	WIND-1000	TECHNOLOG	TECHNOLOG	Aug 07, 2021	WV 003421	5 - 40 m/s
2	WIND-1000	TECHNOLOG	TECHNOLOG	Aug 07, 2021	WV 003421	5 - 40 m/s
3	WIND-1000	TECHNOLOG	TECHNOLOG	Aug 07, 2021	WV 003421	5 - 40 m/s
4	WIND-1000	TECHNOLOG	TECHNOLOG	Aug 07, 2021	WV 003421	5 - 40 m/s
5	WIND-1000	TECHNOLOG	TECHNOLOG	Aug 07, 2021	WV 003421	5 - 40 m/s
6	WIND-1000	TECHNOLOG	TECHNOLOG	Aug 07, 2021	WV 003421	5 - 40 m/s
7	WIND-1000	TECHNOLOG	TECHNOLOG	Aug 07, 2021	WV 003421	5 - 40 m/s

End of certificate of calibration



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CERTIFICATE OF CALIBRATION

Certificate No. WD-03012022
Page 1 of 2 pages

Measurement Item	Wind direction sensor with data logger
Manufacturer	Data logger: HANSON Wind direction sensor: HANSON
Model/Type	Data logger: HANSON-2500-01 Wind direction sensor: W5-02P
Serial Number	Data logger: A5443 Wind direction sensor: W5C-032
ID No	Data logger: HANSON-2500-01 Wind direction sensor: W5C-032
Customer	ALS laboratory group (The Wind Co., Ltd.) 104 Phayathai Road, Pathumwan, Bangkok 10330, Thailand

Environmental Condition

The measurement was carried out in an ambient temperature of (23±3) °C, and relative humidity of (40±10) %.

Measurement Method

The wind direction sensor calibration according to comparison method with reference angle measurement electronic module and the sensor is used for angle control. The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

Note: The UUC was waited up for 1 hour prior to the calibration being performed

Traceability

The measurement results are traceable to the international system of units (SI) through Certificate No: Q21086014, Certificate No: 80754-0726.

Measurement Date: 1 JAN 28, 2022
Issued Date: 1 JAN 31, 2022

Performed by

☒ Mr. Gornth Thachakul
☐ Mrs. Orathai Wathanya



Approved Signature

Mr. Panya Boonchuan
Calibration Department Manager

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Continuation of Certificate of Calibration Number

Certificate No: WD-35012022
Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.
Calibration in the range of 0 - 360 ° at a calibration interval of 45°.
The results of calibration and associated measurement uncertainties are reported in table below.

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	0	0	0	3.0
2		45	45	42	-3	3.0
3		90	90	88	-2	3.0
4		135	135	133	-2	3.0
5	Counter Clockwise	180	180	180	0	3.0
6		225	225	227	2	3.0
7		270	270	272	2	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	0	0	0	3.0
10		45	45	42	-3	3.0
11		90	90	88	-2	3.0
12		135	135	133	-2	3.0
13		180	180	180	0	3.0
14		225	225	227	2	3.0
15		270	270	272	2	3.0
16		315	315	318	3	3.0

UUC* Unit Under Calibration The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%.

End of Certificate of Calibration



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CALIBRATION REPORT

Calibration No.: RH-03012022
Page: 1 of 1 Pages

Measurement Item : Relative humidity with data logger.
Manufacturer : Data logger: NovaSys
: Relative humidity sensor: NovaSys.
Model/Type : Data logger: 110-WB-250L-D
: Relative humidity sensor: HMP50.
Serial Number : Data logger: A5443
: Relative humidity sensor: R 131111
ID No : Data logger: BWS 950975
: Relative humidity sensor: :

Customer : ALS laboratory group (Thailand) Co.,Ltd
: 104 Phatthanawan 40, Phatthanawan Rajkhaseng San Luang, Khet San Luang, Bangkok 10250
Thailand

Environmental Condition:
The measurement was carried out in an ambient temperature of (25±3)°C, and relative humidity of (50±15)%.

Measurement Method:
The Relative humidity with data logger, Unit Under Calibration (UUC) was calibrated by comparison method with the equilibrium of standard salt solution CH₃COOK, Potassium Acetate, Mg(NO₃)₂ Magnesium Nitrate, KCl, Potassium Chloride to determine the errors.

Measurement Date : JAN 24, 2022
Issued Date : JAN 25, 2022

Measurement Results:

The results of calibration are reported in table below.

Standard salt solution	Standard (RH%)	UUC _{Reading}	Error
CH ₃ COOK: Potassium Acetate	22.61	22.1	-0.4
Mg(NO ₃) ₂ Magnesium Nitrate	52.89	52.5	-0.4
KCl: Potassium Chloride	84.34	84.2	-0.1

Performed by
☐ Mr. Soravit Thongchai
☒ Miss Oranai Wongsakulchai



Approved Signatory

[Signature]

Mr. Pinita Booncharoen
Calibration Department Manager

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CALIBRATION REPORT

Calibration Number: - RB-03012022
Page 1 of 2 Pages

Measurement Item	Rain gauge with data logger
Manufacturer	Data logger: Revolvec Rain gauge: Hoanapex
Model/Type	Data logger: J1019S-250.01 Rain gauge: J1019S-250.01
Serial Number	Data logger: A5443 Rain gauge: RB-000
ID NO	998 879675
End-user	Ats Laboratory, 998/101 and 102, 101 104 Petchkasem Rd, Petchkasem Rd, Bangkok 10600, Thailand Bangkok 10600, Thailand

Environmental Conditions

The measurement was carried out in an ambient temperature of 27.5°C/81°F, and relative humidity of 60% RH.

Measurement Method

The rain gauge (see Under Calibration) was calibrated by Precision reference balls with mass adjusted at low rate (0.5 mm per weight) for 1 tipping every 20 mm. Two tipping weights was determined by manufacturer's manual.

1. Check rain gauge test area
Rain gauge precise diameter in cm = Diameter2 - R (radial)
Rain gauge area: $APPA = 14.1882 \text{ (Area)} - 20.3 \text{ cm (RAD)} = 10.16 \text{ cm}$
Rain gauge area: 23.6 cm^2
2. Check theoretical correct rain gauge area = Number of tipping using 323.6 mm² test area and 0.5 l of rain.
a) $10,000 \text{ cm}^2 / 323.6 \text{ mm}^2 \text{ test area} = 30,900 \text{ Rain gauge area} = 1,920.0 \text{ of square meter}$
b) $30,900 \times 0.5 \text{ l, correct} = 15,450 \text{ test area of rain over } 1 \text{ m}^2 \text{ turned, 690 cm of rain volume on the rain gauge}$
area = 15.45 mm of rain
c) Number of tipping = $15.45 / 0.25 \text{ mm} = 62 \text{ tipping}$

Note: Rain gauge is fully cleaned and leveling prior the calibration performed.

Measurement Date: 1 JAN 2022
Issued Date: 1 JAN 21, 2022

Performed by
☒ Mr. Jorak Thachad
☐ Mrs. Orana Wathachai



Approved Signature

Mr. Jorak Thachad
Calibration Department Manager

[Signature]



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Continuation of Calibration of Calibration Number

Calibration Number: RB-03012022
Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment.
The results of calibration are recorded in table below.

Quantity of H ₂ O (ml)	Determined Tipping	Tipping count	Acceptable Tipping count
500	62	60	60 - 64
500	62	61	60 - 64
500	62	61	60 - 64
500	62	62	60 - 64
500	62	61	60 - 64

Remark: The procedure is made to verify the correct reading of the test under calibration rain gauge when a precise volume of water falls into its cone. We suggest that the number of tipping should be within ±2% offset from the 62 tipping tolerance range. If the 62 tipping it means that the rain gauge meets the manufacturer's acceptable limit.

End of Calibration Report





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CERTIFICATE OF CALIBRATION

Certificate No.: CL-003.65
Page 1 of 2

Equipment Name: Data logger with Temperature

Sensor

Manufacturer: Novallux

Model: 110 WS-250L D

Serial No.: A5443

ID No.: BKK_F50975

Customer

Name: ALS Laboratory group (Thailand) Co., Ltd.

Address: 104 Prathitnanon 40, Prathitnanon

Rd. Khwaeng Suan Luang, Khet Suan Luang, Bangkok

10250 Thailand.

Received date: 17 JAN 2022

Calibration date: 24 JAN 2022

Issue date: 25 JAN 2022

Reference Used During Calibration

1. Standard Temperature Probe Model: STS-100 A5000,

Serial No.: 667952 DG, Due date: 25 Mar 2022

2. Digital Temperature Indicator Model: DTI 1000 A MA

II, Serial No.: 671457 J06591 Due date: 04 June 2022

Calibration Condition

Temperature: (23.13) °C

Relative Humidity: 65% (5%)

Calibration Procedure

The temperature calibration was done by in house
calibration method as WI CL 001, according to
comparison method with standard digital temperature
indicator and standard temperature probe. The
temperature scale was based on ITS 90

Traceability

The measurement results are traceable to the
international system of units (SI) through National
Institute of Metrology Thailand (NIMT) Certificate
number: IT 0036 21. Certificate number: EN-0032
21

Calibrated by

☐ Mr. Soravit Thechaval

☒ Miss Orlbua Wuthattaya



Approved Signatory

Mr. Panya Booncharoen

Calibration Department Manager

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Certificate No.: CL-003.65
Page 2 of 2

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment

Calibration Range: 20 - 40 °C

Function:

This equipment was connected with temperature sensor Model: HMP60 S/N: R1131111

Dimension: Diameter 12mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.053	19.8	-0.3	0.099
60	25.001	24.6	-0.4	0.099
60	29.991	29.7	-0.3	0.099
60	34.980	34.5	-0.5	0.099
60	39.960	39.5	-0.5	0.099

UUC* Unit Under Calibration

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

* End of Certificate *





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CERTIFICATE OF CALIBRATION

Certificate No: WD-03032022
Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger

Manufacturer : Data logger: Novatek

Model/Type : Wind direction sensor: Novatek

Serial Number : Data logger: 200305-25-B

Wind direction sensor: WS-02P

Serial Number : Data logger: A4917

Wind direction sensor: -

ID No : Data logger: BMS-F501-63

Wind direction sensor: -

Customer : A/S Laboratory Group (Thailand) Co., Ltd

104 Phrasimwan 41, Phrasimwan Rd, Klongkum, Klongkum, Bangkok 10260
Thailand

Environmental Condition

The measurement was carried out in an ambient temperature of (23±3) °C, and relative humidity of (40±10) %

Measurement Method

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and the laser is used for axis control. The measurement was given at 45° intervals in clockwise and counter-clockwise directions

Note: The UIC was carried up for 1 hour prior to the calibration being performed

Traceability

The measurement results are traceable to the International system of units (SI) through Certificate No: Q21086014, Certificate No: P99264/2025

Measurement Date : MAR 17, 2022

Issued Date : MAR 21, 2022

Calibrated by

☒ Mr. Somchai Thongdee

☐ Miss Chitra Watanadaya



Signature:

Mr. Pinyia Booncharoen
Calibration Department Manager

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Continuation of Certificate of Calibration Number

Certificate No: WD-03032022
Pages: 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment

Calibration in the range of 0 - 360° at a calibration interval of 45°

The results of calibration and associated measurement uncertainties are reported in table below

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UIC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	43	-2	3.0
3		90	90	87	-3	3.0
4		135	135	132	-3	3.0
5		180	180	180	0	3.0
6		225	225	229	4	3.0
7		270	270	275	5	3.0
8		315	315	320	5	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	43	-2	3.0
11		90	90	87	-3	3.0
12		135	135	132	-3	3.0
13		180	180	180	0	3.0
14		225	225	229	4	3.0
15		270	270	275	5	3.0
16		315	315	320	5	3.0

UIC*: Unit Under Calibration. The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No: WD-02042021
Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Novatek.
Wind direction sensor: Novatek.

Model/Type : Data logger: 200-WB-25LB.
Wind direction sensor: WS-02P.

Serial Number : Data logger: A4903.
Wind direction sensor: -

Customer : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthana 40, Phatthana 40, Khwaeng Suan Luang, Wattana Luang, Bangkok 10260
Thailand

Environmental Condition:

The measurement was carried out in an ambient temperature of (23±3)°C, and relative humidity of (40±10)%.

Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and line laser is used for axis control. The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

Note: The UUC was warmed up for 1 hour prior to the calibration being performed

Traceability:

The measurement results are traceable to the International system of units (SI) through Certificate No: CS563-07-0045, Certificate No: RW563/0044.

Measurement Date : Mar 31, 2021.
Issued Date : Apr 01, 2021.

Performed by

☐ Mr. Sorwit Thachaiad
☒ Mr. Bongsath Maithong

Approved Signatory:

Mr. Panyee Booncharoen,
Technical Support
and Calibration Manager



Continuation of Certificate of Calibration Number

Certificate No: WD-02042021
Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.
Calibration in the range of 0 - 360 ° at a calibration interval of 45°.
The results of calibration and associated measurement uncertainties are reported in table below.

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1		0/360	0/360	0	0	3.0
2		45	45	43	-2	3.0
3		90	90	88	-2	3.0
4	Clockwise	135	135	133	-2	3.0
5		180	180	180	0	3.0
6		225	225	227	2	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9		0/360	0/360	0	0	3.0
10		45	45	43	-2	3.0
11		90	90	88	-2	3.0
12		135	135	133	-2	3.0
13	Counter Clockwise	180	180	180	0	3.0
14		225	225	227	2	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

UUC*: Unit Under Calibration The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%.

End of Certificate of Calibration



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CERTIFICATE OF CALIBRATION

Certificate No. NS-02042021
 Page 1 of 2 pages

Measurement Item

Manufacturer

Model/Type

Serial Number

Calibrator

Test Conditions

Test Conditions

Calibration Procedure

Traceability

Measurement Date

Issued Date

Calibrated by
☒ Mr. Sereen Thachasud
☐ Mr. Hongkoo Muthong



Approved Signature

Mr. Panya Boonchanee
 Technical Support
 and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No.: NS-02042021
 Page 2 of 2 Pages

Result of calibration: ☒ without adjustment ☐ with adjustment
 Calibration in the range of 1 - 16 m/s at a calibration interval of 1 %
 The results of calibration and associated measurement uncertainties are reported in the table below.

V _{ref} Reading m/s	V _{ref} Reading m/s	Error (m/s)	Uncertainty (%)
2.069	1.9	-0.2	2.5
4.100	4.0	-0.1	1.2
6.02	6.0	0.0	0.99
7.96	8.1	0.1	0.78
10.03	10.2	0.2	0.72
12.02	12.2	0.2	0.66
14.00	14.6	0.6	0.69
15.99	16.6	0.6	1.14
18.01	18.6	0.6	0.94
13.02	13.3	0.3	0.61
11.03	11.2	0.2	0.75
9.07	9.1	0.1	0.70
8.99	7.0	0.0	1.1
5.166	5.1	-0.1	0.9
3.018	3.0	0.0	1.7
1.038	0.8	-0.2	6.0

LMC[®] Unit Under Calibration

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

Appendix 1: Instrumental data

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Number	Range
1	Pressure	TESSIO INC.	ES352145	July 16, 2020	NAV-0035-20	5 - 30 m/s
2	Pressure Differential Pressure Meter	Ziglab	DPN05600	July 16, 2020	NAV-0035-20	5 - 30 m/s
3	Air velocity transducer (hot wire)	TEI INC.	8455 12	July 20, 2020	NAV-0035-20	0 - 5 m/s
4	Temperature	Ziglab	DS3 3pin	March 3, 2020	H2500003C1001	-30 - 70°C
5	Relative humidity	Ziglab	DS3 3pin	March 30, 2020	H2500003C1001	0 - 100 %RH
6	Atmospheric pressure	Ziglab	DS3 3pin	March 30, 2020	H2500003C1001	500 - 1100 hPa
7	WIND TUNNEL	EPSON	SPD300			0 - 80 m/s

End of certificate of calibration



CERTIFICATE OF CALIBRATION

Certificate No: WS-02012022
Page 1 of 2 pages

Measurement Item: Cup anemometer with data logger

Manufacturer: Data logger: Kongsin
Cup anemometer: Kongsin

Model/Type: Data logger: 110-015 250L-D
Cup anemometer: WS-0202

Serial Number: Data logger: A5439
Cup anemometer: WS01001

ID No: Data logger: 896, 93974
Cup anemometer: -

Customer: ALE Laboratory Group (Thailand) Co., Ltd.
104 Phrasarang 40, Prachinburi Rd, Krasang, Sam Lukang, Phet Sam Lukang, Bangkok 10340 Thailand

Test Conditions: Wind tunnel: cross test section area: 900 cm²
Anemometer: probe area: 100 cm²
Blower: of mounting pipe: - cm
Blockage ratio of test object: 0.111 ±

Test Conditions: Air temperature: 23.6 ±0.8 °C
Air pressure: 1010.9 ±0.4 hPa
Relative air humidity: 56.3 ±3.5 %RH

Calibration Procedure: Calibration was carried out using:
ISO 51450:2011, 5.1.1: 2000-Power Performance Measurements of Electricity Producing Wind Turbines.
MAGNET Anemometer Calibration Procedure - Version 2, 2009.

Traceability: This calibration documents the traceability to national standard, which require the unit of measurements according to the international system of units (SI) through National Institute of Metrology, Thailand (NIMT).

Measurement Date: 1 JAN 26, 2022
Issued Date: 1 JAN 31, 2022

Calibrated by: ☒ Mr. Sornrat Theerapad
☐ Miss Sirinrat Wuthitadaya

Approved Signatory: 
Mr. Pinyak Boonwong
Calibration Department Manager



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Continuation of Certificate of Calibration Number:

Certificate No: WS-02012022
Page 2 of 2 Pages

Result of calibration: ☒ without adjustment ☐ with adjustment
Correction in the range of 1 - 10 m/s at a calibration interval of 1 m/s.
The results of calibration and associated measurement uncertainties are reported in the table below.

V _{ref} Heading m/s	V _{ref} Reading m/s	Error m/s	Uncertainty m/s
2.080	2.0	-0.1	0.4
4.142	4.1	0.0	1.1
6.02	6.0	0.0	0.89
7.97	8.0	0.0	0.84
10.01	10.1	0.1	0.82
12.03	12.1	0.1	0.72
14.03	14.2	0.2	0.65
16.00	16.3	0.3	0.68
18.00	18.2	0.2	0.77
19.01	19.2	0.2	0.65
11.02	11.1	0.1	0.62
9.04	9.1	0.1	0.85
2.68	2.0	0.0	0.82
6.134	6.2	0.1	0.96
2.998	3.1	0.1	1.6
1.003	0.9	-0.1	4.6

UNC⁹⁵ Unit Under Calibration
The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%.

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pressure	TECO INC	0335145	Aug 07 2021	WS-0204-21	5 - 30 m/s
2	Precision Differential Pressure Meter	Zepco	DP42200	Aug 07 2021	WS-0204-21	5 - 30 m/s
3	Air velocity transducer (hot wire)	TSI INC	8445-12	Aug 08 2021	WS-0206-21	0 - 5 m/s
4	Temperature	Zepco	0305100	March 30 2021	01-027-64	-30 - 70 °C
5	Relative humidity	Zepco	0305100	March 30 2021	WS-0203-21	0 - 100 %RH
6	Atmospheric pressure	Zepco	0305100	March 30 2021	WS-0203-21	500 - 1100 m/s
7	Wind tunnel	QSCOR	QSCOR			0 - 50 m/s

Kind of certificate of calibration





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CERTIFICATE OF CALIBRATION

Certificate No: WD-02012022
Page: 1 of 2 pages

Measurement Item : Wind direction sensor with data logger
Manufacturer : Data logger: Nivaxys
Model/Type : Wind direction sensor: Nivaxys
Serial Number : Data logger: 1 (0406-2678-7)
Wind direction sensor: WD-DSP
ID No : Data logger: A5439
Wind direction sensor: WDC-301
Wind direction sensor: WDC-301

Customer : M/S Jiranatee Group (Public) Co., Ltd.
104 Phatthanasri 40, Phatthanasri Rd, Suvarnabhumi, Bangkok 10760
Thailand

Environmental Condition:
The measurement was carried out in an ambient temperature of (23±3) °C, and relative humidity of (40±10) %.

Measurement Method:
The wind direction sensor calibration according to comparison method with reference angle measurement electronic frequency and
the laser is used for axis correct, the measurement were taken at 45° intervals in clockwise and counter-clockwise
direction.

Note: The UUC was carried up for 1 hour prior to the calibration being performed.

Traceability:
The measurement results are traceable to the International system of units (SI) through Certificate No: Q21086014, Certificate No:
K025540006.

Measurement Date : 30/11/25, 2022
Issued Date : 30/11/25, 2022

Performed by
☒ Mr. Jiranatee Thakorn
☐ Mrs. Chiraporn Wathapra



Approved Signatory
Mr. Jiranatee Thakorn
Calibration Department Manager

This certificate was issued after the measurement was carried out in accordance with the requirements of the ISO 9001:2015 standard.



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Continuation of Certificate of Calibration Number

Certificate No: WD-02012022
Page: 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.
Calibration in the range of 0 - 360° at a calibration interval of 45°.
The results of calibration and associated measurement uncertainties are reported in table below.

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1		0/360	0	0	0	3.0
2		45	45	42	-3	3.0
3		90	90	86	-4	3.0
4		135	135	132	-3	3.0
5		180	180	179	-1	3.0
6		225	225	227	2	3.0
7		270	270	275	5	3.0
8		315	315	318	3	3.0
9		0/360	0	0	0	3.0
10		45	45	42	-3	3.0
11		90	90	86	-4	3.0
12		135	135	132	-3	3.0
13	Counter Clockwise	180	180	179	-1	3.0
14		225	225	227	2	3.0
15		270	270	275	5	3.0
16		315	315	318	3	3.0

UUC*: Unit Under Calibration The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%.

End of Certificate of Calibration



CALIBRATION REPORT

Calibration No.: PH-02012022
Page: 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Data logger: Novatek
: Relative humidity sensor: Novatek
Model/Type : Data logger: 110VW-25CL-D
: Relative humidity sensor: HAP566
Serial Number : Data logger: A5439
: Relative humidity sensor: R1311110
ID No : Data logger: BKK_F50574
: Relative humidity sensor: -

Customer : A/S laboratory group (Thailand) Co., Ltd.
: 104 Puthrasaban Rd, Puthrasaban Rd, Kwang San Luang, Khut San Luang, Bangkok 10260
: Thailand

Environmental Condition
The measurement was carried out in an ambient temperature of (25±3)°C, and relative humidity of (55±15)%.

Measurement Method
The Relative humidity with data logger, Unit Under Calibration (UUC) was calibrated by comparison method with the equilibrium of standard salt solution CH_3COOK , Potassium Acetate, Magnesium Chloride, Magnesium Chloride to determine the errors.

Measurement Date : JAN 24, 2022
Issued Date : JAN 26, 2022

Measurement Results
The results of calibration are reported in table below.

Standard salt solution	Standard (RH)	UUC(measured)	Error
CH_3COOK , Potassium Acetate	22.61	22.1	-0.4
$\text{Mg}(\text{NO}_3)_2$ Magnesium Nitrate	62.69	62.7	-0.2
MgCl_2 Potassium Chloride	84.34	84.5	0.2

Performed by
☐ Mr. Soravit Thachwad
☒ Miss Orathai Wudhethaya



Signature

Approved Signatory
Mr. Panyia Booncharoen,
Calibration Department Manager

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CALIBRATION REPORT

Calibration Number: PH-02012022
Page: 1 of 2 Pages

Measurement Item : Rain gauge with data logger
Manufacturer : Data logger: Novatek
: Rain gauge: Novatek
Model/Type : Data logger: 110VW-25CL-D
: Rain gauge: 110VW-24503
Serial Number : Data logger: A5439
: Rain gauge: R14001
ID NO : BKK_F50574

Customer : A/S laboratory group (Thailand) Co., Ltd.
: 104 Puthrasaban Rd, Puthrasaban Rd, Kwang San Luang, Khut San Luang, Bangkok 10260, Thailand

Environmental Condition
The measurement was carried out in an ambient temperature of (25±3)°C, and relative humidity of (60±15)%.

Measurement Method
The Rain gauge, Unit Under Calibration (UUC) was calibrated by Precision reference bottle with flow adjuster at low rate 0.6 mm per minute or 1 typing every 20 seconds. The typing number was determined by procedures below.

1. Obtain rain gauge inlet area
Rain gauge precise diameter in cm = Diameter/2 = R (radius)
Rain gauge area = $\text{PI} \times R^2$ (3.14 (0.003 diameter=0.003 cm, UUC radius=0.15 cm)
Rain gauge area = 323.6 cm^2
2. Obtain theoretical constant rain gauge answer number of typing using 323.6 cm^2 inlet area and 0.5 L of rain.
a) $10,000 \text{ mm} / 323.6 \text{ cm}^2$ inlet area = 30.93 rain gauge area = 1/30.93 of square meter
b) $30.93 \times 0.5 \text{ L volume} = 15.465 \text{ mm liter of rain over } 1 \text{ m}^2$ surface 500 ml of rain volume on the rain gauge
area = 15.45 mm of rain.
c) Number of typing = $15.45 / 0.25 \text{ mm} = 62$ typing.

Note: Rain gauge is fully cleaned and leveling prior the calibration performed

Measurement Date : JAN 26, 2022
Issued Date : JAN 31, 2022

Performed by
☒ Mr. Soravit Thachwad
☐ Miss Orathai Wudhethaya



Signature

Approved Signatory
Mr. Panyia Booncharoen,
Calibration Department Manager

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Continuation of Calibration of Calibration Number

Calibration Number: R0-02012/22
Page 2 of 2 Pages

Result of Calibration: ☒ Without Adjustment ☐ With Adjustment
The number of calibration are recorded in this table.

Quantity of H ₂ O (kg)	Delivered Tipping	Tipping count	Acceptable Tipping count
50.0	62	60	60 - 64
50.0	62	61	60 - 64
50.0	62	60	60 - 64
50.0	62	61	60 - 64
50.0	62	61	60 - 64

Remark: The procedure is made to verify the correct reading of the unit under calibration sign gauge when a precise volume of water falls into its cone. We suggest that the number of tipping should be within $\pm 2\%$ of the nominal range.

Card of calibration report



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J-NAC Associates Co., Ltd.
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Petchkasem 7/1, Rd.
Bangkok 10600 (Thailand)
Tel: +668080812
Mobile: +6680959555
E-mail: jnac.calibration@jnasee.com
Web site: www.jnasee.com

CERTIFICATE OF CALIBRATION

Certificate No. : CL 003-65

Page 1 of 2 Pages

MEASUREMENT ITEM : Digital barometer
MANUFACTURER : Nealyms
MODEL/TYPE : 110-W5-25B
SERIAL NUMBER : A5439
ID NUMBER : BNC-150974
CUSTOMER : ALS laboratory group (Thailand) co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd,
Khuasong Suan Luang, Khet Suan Luang,
Bangkok 10250 Thailand

RECEIVED DATE : 12 Jan 2022
MEASUREMENT DATE : 29 Jan 2022
ISSUE DATE : 31 Jan 2022

CONDITION OF THIS RESULT OF CALIBRATION:

1. Reference Standard Instrument.

Instrument : Absolute Pressure Transducer
Model : CPG2500
Serial No. : 410018.1
Certificate No. : 201479
Due Date : 13 Sep 2022

2. The UUC* was installed in vertical orientation above reference standard instrument and center of UUC* was used as the reference level.

3. Calibration conditions:
Pressure transmitting medium : Air
Pn(20°C, 1 bar) : 1.19 kg/m²
dh : -0.080 m
Tamb : (23±2) °C
Pamb : 1009.5 mbar

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

Calibrated by:
☒ Mr. Serawat Thachulad
☐ Miss Oranai Witsawatwong



Approved signature:
Mr. Pong Booncharoen
Calibration Department Manager

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MEASUREMENT RESULTS : ☒ Without adjustment ☐ With adjustment
 CALIBRATION IN THE RANGE OF : 950 - 1050 mbar

The results of calibration and associated measurement uncertainties are reported in the table below

STD (mbar)	UUC* (mbar)	Error (mbar)	Uncertainty(k=2) (mbar)
950.28	950.847	0.562	1.2
970.01	970.761	0.747	1.1
989.95	990.576	0.622	0.78
1009.96	1010.759	0.295	0.46
1029.87	1029.888	0.020	0.19
1049.87	1049.594	-0.180	0.30

Note: UUC* Unit Under Calibration

End of certificate



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CERTIFICATE OF CALIBRATION

Certificate No.: CL-002-85
 Page 1 of 2

Equipment Name: Delta Logger with Temperature

Manufacturer: Novatymx
 Model: 110 WS 250L D
 Serial No.: A5439
 ID No.: BKA_F507994

Received date: 12 JAN 2022
 Calibration date: 24 JAN 2022
 Issue date: 25 JAN 2022

Customer:
 Name: ALS laboratory group (Thailand) Co. Ltd.
 Address: 104 Phrahitthaisan 40, Phrahitthaisan
 Rd., Khwaeng Suan Luang, Nhet Suan Luang, Bangkok
 10250 Thailand.

Calibration Condition
 Temperature: (23±3) °C
 Relative Humidity: (55±15)%

Reference Used During Calibration
 1. Standard Temperature Probe Model: STS-100 A500,
 Serial No.: 667682-09, Due date: 25 Mar 2022
 2. Digital Temperature Indicator Model: D11-1000 A MK
 II, Serial No.: 671407 00591 Due date: 04 June 2022

Traceability

The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT 6036-21, Certificate number: ER 0032-21

Calibration Procedure

The temperature calibration was done by In-House calibration method as WI.C.001, according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale use was based on ITS-90.

Approved Signatory:
 Mr. Parinya Bhojcharoen
 Calibration Department Manager



Calibrated by
☐ Mr. Sorawit Thachakul
☒ Miss Orathai Wiatwittaya

Result of calibration: ☒ without adjustment ☐ with adjustment
Calibration is in the range of 1 - 16 m/s at a calibration interval of 1 m/s.

The results of calibration and associated measurement uncertainty are reported in the table below.

Vane Reading m/s	Vane Reading m/s	Error m/s	Uncertainty (k=1)
2.000	1.7	0.3	2.6
4.000	3.9	-0.1	1.2
6.00	6.0	0.0	0.99
7.99	8.0	0.0	0.76
10.00	10.2	0.2	0.67
12.00	12.3	0.3	0.60
14.04	14.4	0.4	0.57
15.07	16.6	0.6	0.65
14.98	16.3	0.3	0.60
12.99	13.3	-0.3	0.61
11.00	11.1	0.1	0.60
9.00	9.1	0.1	0.78
6.99	7.0	0.0	1.0
5.00	5.0	-0.1	1.2
2.99	2.8	-0.2	2.2
1.00	0.7	-0.4	6.9

UNC* Limit Under Calibration

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

Appendix 1: Instrumentation

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pressure static	TECUM INC.	05352145	July 16, 2020	M/00365-20	5 - 30 m/s
2	Pressure Differential Pressure Meter	Zepeda	DPV2500	July 16, 2020	M/00365-20	5 - 30 m/s
3	Atmospheric pressure	TECUM	8455-12	July 20, 2020	M/00365-20	0 - 5 m/s
4	Temperature	Zepeda	DSH 510P	March 30, 2021	Q-02744	-30 - 70°C
5	Relative humidity	Zepeda	DSH 510P	March 30, 2021	Q-02744	0 - 100 %RH
6	Atmospheric pressure	Zepeda	DSH 510P	March 30, 2021	Q-02744	900 - 1100 hPa
7	Wind speed	CECUM	UP3300		Q-02744	0 - 60 m/s

End of certificate of calibration



CERTIFICATE OF CALIBRATION

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Honeywell
Wind direction sensor: Honeywell

Model/Type : Data logger: 200-WB-201B
Wind direction sensor: WS-02F.

Serial Number : Data logger: A5263,
Wind direction sensor :

ID No : Data logger: 896, JS0910,
Data logger:

Customer : ALS laboratory group (thailand) Co., Ltd.
164 Puthachon 40, Puthachon Rd, Kwang, Khut San, Bangkok 10250
Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of 23±3°C, and relative humidity of 40±10%.

Measurement Method:

The wind direction sensor calibration according to comparison method with reference angle measurement electronic theodolite and five laser is used for axis control. The measurement were taken at 45° intervals in clockwise and counterclockwise directions.

Note: The UVC was warmed up for 1 hour prior to the calibration being performed

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No. 05663-07-0045, Certificate No. RW903/0044.

Measurement Date : May 11, 2021
Issued Date : May 12, 2021.

Performed by
☐ Mr. Soravit Thakwatt
☒ Mr. Bongvach Mulhong



Approved Signatory:

Mr. Panyia Booncharoen
Technical Support
and Calibration Manager



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Certification of Calibration Number

Certificate No WD-01052021

Page 2 of 2 pages

Result of calibration: ☐ without adjustment ☒ with adjustment.
Calibration in the range of 0 - 360 ° at a calibration interval of 45°
The results of calibration and associated measurement uncertainties are reported in table below.

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUT ² Reading (°)	Error (°)	Uncertainty u(1°)
1		0/260	360	359	-1	3.0
2		45	45	41	-4	3.0
3		90	90	87	-3	3.0
4		135	135	134	-1	3.0
5		180	180	180	0	3.0
6		225	225	227	2	3.0
7		270	270	272	2	3.0
8		315	315	319	4	3.0
9		0/260	360	359	-1	3.0
10		45	45	41	-4	3.0
11		90	90	87	-3	3.0
12		135	135	134	-1	3.0
13		180	180	180	0	3.0
14		225	225	227	2	3.0
15		270	270	272	2	3.0
16		315	315	319	4	3.0

UUT² Use Under Calibration The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%

End of Certificate of Calibration



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CERTIFICATE OF CALIBRATION

Certificate No. : CL 0028-64
Page 1 of 2

Equipment Name : Data Logger with Temperature

Manufacturer : Novatynx

Model : 200 WS-25LB

Serial No. : A5263

ID No. : BKK_FS0910

Customer

Name : ALS laboratory group (thailand) Co.,Ltd

Address : 104 Phatthanakon 40, Phatthanakon Rd.,

Khaoeng Suan Luang, Nuea Suan Luang,

Bangkok 10250 Thailand.

Received date : 30 Apr 2021

Calibration date : 07 May 2021

Issue date : 11 May 2021

Reference Used During Calibration

1. Standard Temperature Probe Model : STS 100 A500.

Serial No. : 667652.09, Due date : 25 Mar 2022

2. Digital Temperature Indicator Model : DTI-1000A MK

II, Serial No. : 611401-005991 Due date : 20 May 2021

Calibration Condition

Temperature : (23±3) °C

Relative Humidity : (65±15)%

Calibration Procedure

The temperature calibration was done by in-house calibration method as WtCL001 according to comparison method with standard digital temperature indicator and standard temperature probe. The temperature scale was based on ITS-90.

Traceability

The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number : TI-0036-21, Certificate number : ER 0071-20

Calibrated by

☐ Mr. Sorawat Thachalad

☒ Mr. Bongkroch Maitthong

Approved Signatory:

Mr. Pannya Booncharoen

Technical Support

And Calibration Manager

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Result of Calibration: ☒ Without Adjustment ☐ With Adjustment
Calibration Range: 20 °C - 40 °C

Function:

This equipment was connected with temperature sensor Model : HMP60 S/N : N033078C

Dimension : Diameter 12mm, Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.045	19.6	-0.4	0.19
60	25.041	24.6	-0.4	0.19
60	30.035	29.5	-0.5	0.19
60	35.027	34.5	-0.5	0.19
60	40.020	39.4	-0.6	0.19

UUC* : Unit Under Calibration

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

★ End of Certificate ★



CALIBRATION REPORT

Calibration No. : P14-01020221
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger.
Manufacturer : Data logger: Novolyne,
Relative humidity sensor: Novolyne.
Model/Type : Data logger: 200-MS-254.B.
Relative humidity sensor: HUP40.
Serial Number : Data logger: A5263.
Relative humidity sensor: M0330786.
ID No : Data logger: B94, P100910.
Relative humidity sensor: .
Customer : A/S laboratory group (Thailand) co., Ltd.
104 Phrommanon 40, Phrommanon Rd, Khwaeng Suan Luang, Phet Suan Luang, Bangkok 10250
Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of (25±3)°C, and relative humidity of (50±10)%.

Measurement Method:

The relative humidity with data logger (Unit Under Calibration (UUC)) was calibrated by comparison method with the equivalent of standard salt solution (CH₃COOK, Potassium Acetate, Mg(NO₃)₂ Magnesium Nitrate, KCl, Potassium Chloride) to determine the error.

Measurement Date : May 07, 2021
Issued Date : May 11, 2021

Measurement Result:

The results of calibration are reported in table below.

Standard salt solution,	Standard (B7H)	UUC (Measured)	Error
CH ₃ COOK, Potassium Acetate	29.51	29.5	0.0
Mg(NO ₃) ₂ Magnesium Nitrate	52.89	51.3	-1.5
KCl, Potassium Chloride	84.34	81.8	-2.5

Performed by

☐ Mr. Sorasil Thairatad
☒ Mr. Bongkosh Meethong

Approved Signatory:

Mr. Panyee Booncharoen,
Technical Support
and Calibration Manager



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CERTIFICATE OF CALIBRATION

Certificate No. WS 00082021
Page 1 of 2 pages

Measurement Item: Cup anemometer with data logger.
Manufacturer: Data logger: NAC
Cup anemometer: NAC
Model/Type: Data logger: 200-VIS 2500
Cup anemometer: WS 020
Serial Number: Data logger: A3379
Cup anemometer:
ID No: Data logger: R96.F50010
Cup anemometer:
Customer: (A/S) SECURITY GROUP (THAILAND) CO., LTD.
106 Prachinwong 43, Prachinwong Rd, Kwang San Luang, Khet San Luang, Bangkok 10160
Thailand
Test Conditions: Wind tunnel: cross section area: 900 cm²
Air temperature: 22.7 ±0.8 °C
Air pressure: 1038.3 ±0.4 hPa
Relative humidity: 45.5 ±1.5 %RH
Calibration Period: 12 months
Traceability: This calibration conforms to the standards to national standards which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology (Thailand) Ltd.

Measurement Date:
Issue Date:

Calibrated by:
☒ Mr. Jiraporn Jiranatee
☐ Mr. Jiraporn Jiranatee



Approved Signature

Jiraporn
Mr. Jiraporn Jiranatee
Technical Support
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Continuation of Certificate of Calibration Number

Certificate No. WS 00082021
Page 2 of 2 Pages

Result of calibration: ☒ without adjustment; ☐ with adjustment.
Calibration in the range of 1 - 16 m/s at a calibration interval of 1 m/s.
The results of calibration and associated measurement uncertainties are reported in the table below.

V_{ref} Reading m/s	V_{ref} Reading m/s	Error (m/s)	Uncertainty (m/s)
2.022	2.0	0.1	2.7
4.064	4.1	0.0	1.3
5.99	6.0	0.0	0.98
8.03	8.0	0.0	0.74
10.01	10.2	0.2	0.65
11.98	12.3	0.3	0.45
14.03	14.4	0.4	0.47
15.98	16.6	0.6	0.39
16.00	16.4	0.4	0.51
12.98	13.4	0.4	0.66
10.99	11.2	0.2	0.53
8.97	9.0	0.0	0.65
6.97	7.0	0.0	0.84
5.062	5.1	0.0	0.62
2.972	3.1	0.1	1.6
1.021	3.9	0.1	6.3

UUC* Unit Under Calibration

The reported expanded uncertainty is based on observed variability multiplied by a coverage factor $k=2$ providing a level of confidence of approximately 95%.

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pressure	TECOT	TECOT 140	Aug 07, 2021	MA 0013421	5 - 30 m/s
2	Pressure	TECOT	TECOT 140	Aug 07, 2021	MA 0013421	5 - 30 m/s
3	Pressure	TECOT	TECOT 140	Aug 07, 2021	MA 0013421	5 - 30 m/s
4	Pressure	TECOT	TECOT 140	Aug 07, 2021	MA 0013421	5 - 30 m/s
5	Pressure	TECOT	TECOT 140	Aug 07, 2021	MA 0013421	5 - 30 m/s
6	Pressure	TECOT	TECOT 140	Aug 07, 2021	MA 0013421	5 - 30 m/s
7	Wind Speed	TECOT	TECOT 140	Aug 07, 2021	MA 0013421	5 - 30 m/s

End of certificate of calibration





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CERTIFICATE OF CALIBRATION

Certificate No: WD-08/08/2021

Page 1 of 2 page

Measurement Item : Wind direction sensor with data logger.

Manufacturer : Data logger: Norlynx.

Model/Type : Wind direction sensor: Norlynx.

Serial Number : Data logger: 20049-2018.

ID No : Wind direction sensor: WS-02F.

Delivery : Data logger: A5370.

Environmental Condition : Wind direction sensor: .

Measurement Method : Data logger: BvK-F90219.

The measurement was carried out in an ambient temperature of (23.3)°C and relative humidity of (60±10)%,

Under the UUC was warmed up for 1 hour prior to the calibration being performed

Traceability: The measurement results are traceable to the international system of units (SI) through Certificate No. 05563-07-0046.

Certificate No. W0563/0044.

Measurement Date : Aug 30, 2021.

Issued Date : Aug 31, 2021.

Performed by : Mr. Sornchai Tachakul

Mr. Orathai Wathaiyaya

Mr. Panyai Banchayasin

Technical Support

and Calibration Manager

Signature

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Continuation of Certificate of Calibration Number

Certificate No: WD-08/08/2021

Page 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

Calibration in the range of 0 - 360 ° at a calibration interval of 45°.

The results of calibration and associated measurement uncertainties are reported in table below.

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1		0/360	360	359	-1	3.0
2		45	45	41	-4	3.0
3		90	90	86	-4	3.0
4	Clockwise	135	135	133	-2	3.0
5		180	180	178	-2	3.0
6		225	225	227	2	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9		0/360	360	359	-1	3.0
10		45	45	41	-4	3.0
11		90	90	86	-4	3.0
12	Counter Clockwise	135	135	133	-2	3.0
13		180	180	178	-2	3.0
14		225	225	227	2	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

UUC*: Unit Under Calibration The reported expanded uncertainty is based on standard uncertainty multiplied by a coverage factor k=2 providing a level of confidence of approximately 95%.

End of Certificate of Calibration



THIS CERTIFICATE REPORT MAY NOT BE REPRODUCED EXCEPT IN FULL. UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY.

CERTIFICATE OF CALIBRATION

Certificate No.: WD-01112021
Page 1 of 2 pages

Page 1 of 2 pages

Measurement Item	Wind direction sensor with data logger
1. Wind direction sensor with data logger	

Manufacturer	Data logger: Biosynex	Wired deflection sensor: Biosynex
...

Model/Type	Model/Type
<ul style="list-style-type: none"> • Data logger 200-ws-2516 • Wind direction sensor WS-07F 	

Serial Number : Data logger A6377
 - loaded at 09:08:00 on 2009-07-20

$$= \frac{\log_{10}(\text{fold change})}{\sqrt{\frac{1}{n} + \frac{1}{m}}}$$

Customer: A/S. Laboratory group, Thailand Co., Ltd.
104 Pothayuan Rd, Pothayuan Sub. Loc., Kae I-ang, Bangkok 10260
Thailand

Environmental Condition

The reaction mechanism with regard to the C_2H_2 and C_2H_4 concentrations is given by eqs. (1) and (2).

Stress-Induced Abortion

The anti-detonation sensor calibration according to compression control with reference angle measurement (stationary, idle and 1400 rpm) is done for all sensors. The measurement are taken at 40° crankshaft in clockwise and counter-clockwise

data. The IIIrd was warmer on 10/1 than on 10/2, but the radiation being performed

Trenchard 1787

The measurement results are traceable to the SI through Certificate No. 62/096014. Certificate No. 62/096014 is available at <http://www.bipm.org>.

Measurement Date	Nov 01, 2021
Measured Data	Nov 01, 2021

Performed by:

☒ **Yes (Contact Trained)**

Signature: 2kmpm Mr. Parinya Booncharoen
Education Department Manager

1995, 1996) and a 10% increase in the number of people who are employed in the service sector (1995, 1996). The number of people employed in the service sector has increased from 1.5 million in 1995 to 1.6 million in 1996. The number of people employed in the service sector has increased from 1.5 million in 1995 to 1.6 million in 1996.

Continuation of Certificate of Calibration Number

Certificate No: WD-21112021
Page 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment

The results of calibration and associated measurement uncertainties are reported in table below.

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	LUZ® Reading (°)	Error (°)	Uncertainty s(°)
1		0/360	360	359	1	3.0
2		45	45	41	-4	3.0
3		90	90	87	-3	3.0
4		135	135	135	0	3.0
5		180	180	183	3	3.0
6		225	225	229	4	3.0
7		270	270	274	4	3.0
8		315	315	320	5	3.0
9		0/360	360	359	-1	3.0
10		45	45	41	-4	3.0
11		90	90	87	-3	3.0
12		135	135	135	0	3.0
13		180	180	183	3	3.0
14		225	225	229	4	3.0
15		270	270	274	4	3.0
16		315	315	320	5	3.0

0.005, the Linear Combination Test reported accurately is based on standard uncertainty multiplied by a coverage factor $k=2$ (corresponding to a level of confidence of approximately 95%).

End of Certificate of Calibration



63/14-15, 67/35-36, Soi Petchkasem 7/71, Petchkasem Rd,
Walthapa, Bangkokyisi, Bangkok 10600 Thailand.
Tel: (66) 02-8680812#13 Fax: (66) 02-8680860 www.jiranalee.com

CERTIFICATE OF CALIBRATION

Certificate No: W55-Q112021
Page 1 of 2 pages

Page 1 of 2 pages

— Cup anemometer with data logger.

Data Indices: Neurological.

Cup monomer: Novolac.

Florida International University

Das heißt: es ist nicht alles
das ankommen ist alles

Phone: 603-888-3800

UNION REGISTER, AUGUST 17

Data logger: BNA_F50017

Customer: ALS laboratory group (Finland) AS, Ltd.

104 Pratharak 43, Phatthanasri Rd. Khwaeng San Luang, Wattana Bangkoc 10160
Thailand

It has been found

What I read often had nothing to do

Anomalous frontal area

Diameter of mounting hole

Block:924 ratio of leaf content

Air Transportation 263

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100																																																																																																																																																																																								
Population	10.0	10.1	10.2	10.3	10.4	10.5	10.6	10.7	10.8	10.9	11.0	11.1	11.2	11.3	11.4	11.5	11.6	11.7	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.1	13.2	13.3	13.4	13.5	13.6	13.7	13.8	13.9	14.0	14.1	14.2	14.3	14.4	14.5	14.6	14.7	14.8	14.9	15.0	15.1	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9	16.0	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9	17.0	17.1	17.2	17.3	17.4	17.5	17.6	17.7	17.8	17.9	18.0	18.1	18.2	18.3	18.4	18.5	18.6	18.7	18.8	18.9	19.0	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9	20.0	20.1	20.2	20.3	20.4	20.5	20.6	20.7	20.8	20.9	21.0	21.1	21.2	21.3	21.4	21.5	21.6	21.7	21.8	21.9	22.0	22.1	22.2	22.3	22.4	22.5	22.6	22.7	22.8	22.9	23.0	23.1	23.2	23.3	23.4	23.5	23.6	23.7	23.8	23.9	24.0	24.1	24.2	24.3	24.4	24.5	24.6	24.7	24.8	24.9	25.0	25.1	25.2	25.3	25.4	25.5	25.6	25.7	25.8	25.9	26.0	26.1	26.2	26.3	26.4	26.5	26.6	26.7	26.8	26.9	27.0	27.1	27.2	27.3	27.4	27.5	27.6	27.7	27.8	27.9	28.0	28.1	28.2	28.3	28.4	28.5	28.6	28.7	28.8	28.9	29.0	29.1	29.2	29.3	29.4	29.5	29.6	29.7	29.8	29.9	30.0	30.1	30.2	30.3	30.4	30.5	30.6	30.7	30.8	30.9	31.0	31.1	31.2	31.3	31.4	31.5	31.6	31.7	31.8	31.9	32.0	32.1	32.2	32.3	32.4	32.5	32.6	32.7	32.8	32.9	33.0	33.1	33.2	33.3	33.4	33.5	33.6	33.7	33.8	33.9	34.0	34.1	34.2	34.3	34.4	34.5	34.6	34.7	34.8	34.9	35.0	35.1	35.2	35.3	35.4	35.5	35.6	35.7	35.8	35.9	36.0	36.1	36.2	36.3	36.4	36.5	36.6	36.7	36.8	36.9	37.0	37.1	37.2	37.3	37.4	37.5	37.6	37.7	37.8	37.9	38.0	38.1	38.2	38.3	38.4	38.5	38.6	38.7	38.8	38.9	39.0	39.1	39.2	39.3	39.4

Relative to Native 470 -3.5 98264

the following water management issues:

IEC 61400-12-1 (IEC-2005) Power Performance Measurements of Electrically Producing Wind Turbines

Figure 4. Longitudinal

MEMBNET Response Calibration Procedure - Version 2, 2009

This celebration documents the transition to national standards. When raised the unit of measurement according to the international system of units (SI) through national institute of standards (NIST).

New 01 2001

Nov 01 2021

Calibrated by
☒ Mr. Steven Tagwood
☐ Miss Patricia Winters

Approved Signatory: [Signature]
 Lt. Piyush Bhandarkar
 Calibration Department Manager

THIS CERTIFICATE MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY

J
NAC

63/14-15,67/35-36, Soi Petchkasem 7/1, Petchkasem Rd.
 Watthapra, Bangkokkhai,Bangkok 10600 Thailand.
 Tel: (66) 02-868081/2#13 Fax: (66) 02-8680800 www.jiranates.com

Continuation of Certificate of Calibration Number

Certificate No: W3-01112021
Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

The results of calibration and associated measurement uncertainties are reported in the table below.

V_{bias} , biasing mV	M_{iso} , Biasing mV	Error (mV)	Uncertainty (%)
1.594	1.9	<1	2.5
* 4.002	4.0	0.0	1.2
6.00	6.0	0.0	0.95
8.02	8.0	0.0	0.73
10.01	10.1	0.1	0.63
12.00	12.1	0.1	0.74
13.69	14.1	0.1	0.76
16.01	16.3	0.3	0.80
18.01	18.3	0.3	0.64
19.00	19.1	0.1	0.45
11.01	13.1	0.1	0.67
0.02	9.1	0.0	0.64
7.02	7.1	0.0	0.98
4.992	5.0	0.0	1.2
2.840	2.9	0.1	1.5
0.996	0.9	0.1	4.5

ULUC® Unit Under Cabinet

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

Appendix 1: Instrumentation

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	PM2.5	TECOT PAC	Q505P2145	Aug 07, 2023	MW/00034-21	5 - 300 µg/m³
2	Precision Differential Pressure Meter	Zigzag	3PM25600	Aug 07, 2023	MW/00034-21	0 - 300 Pa
3	Air velocity Differential pressure meter	Tsu PAC	64552-12	Aug 02, 2023	MW/00035-21	0 - 8 m/s
4	Temperature	Zigzag	Q505T2145	March 30, 2023	BU/027-64	30 - 70°C
5	Relative Humidity	Zigzag	Q505H2145	March 30, 2023	BU/028302023	10 - 100 %RH
6	Atmospheric pressure	Zigzag	Q505P2145	March 30, 2023	BU/0332023	960 - 1100 hPa
7	Wind Speed	Zigzag	Q505W2145	March 30, 2023	BU/0342023	0 - 40 m/s

^{***}End of certificate of certification etc.

**J
NAC**
HIRAWATE ASSOCIATES CO., LTD.



ROTA METER CALIBRATION RESULT APRIL 2022

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R ²)
BKK_FS0577	01 Apr 22	$Y = 1.0202x + 0.1976$	1.0000
BKK_FS0579	01 Apr 22	$Y = 1.0078x + 0.4789$	0.9998
BKK_FS0583	01 Apr 22	$Y = 1.016x + 0.3922$	1.0000
BKK_FS0584	01 Apr 22	$Y = 1.0036x + 2.2262$	0.9997
BKK_FS0585	01 Apr 22	$Y = 1.0189x - 5.6476$	0.9997
BKK_FS0586	01 Apr 22	$Y = 1.0095x - 1.1524$	0.9995
BKK_FS0587	01 Apr 22	$Y = 1.013x - 3.6619$	0.9996
BKK_FS0588	01 Apr 22	$Y = 1.0154x + 4.8357$	0.9999
BKK_FS0589	01 Apr 22	$Y = 0.9918x + 4.8069$	0.9999
BKK_FS0590	01 Apr 22	$Y = 1.0038x - 0.4857$	0.9996
BKK_FS0591	01 Apr 22	$Y = 0.9705x - 52.174$	0.9986
BKK_FS0592	01 Apr 22	$Y = 0.9646x - 37.642$	0.9985
BKK_FS0593	01 Apr 22	$Y = 0.9767x - 58.445$	0.9988
BKK_FS0594	01 Apr 22	$Y = 0.9902x - 62.87$	0.9999
BKK_FS0595	01 Apr 22	$Y = 1.0249x - 98.162$	0.9999
BKK_FS0596	01 Apr 22	$Y = 0.9843x - 26.806$	0.9991
BKK_FS0597	01 Apr 22	$Y = 0.9802x - 61.653$	0.9978
BKK_FS1004	01 Apr 22	$Y = 0.9696x + 17.69$	0.9990
BKK_FS1005	01 Apr 22	$Y = 1.0065x + 5.6786$	0.9997
BKK_FS1006	01 Apr 22	$Y = 1.2142x - 7.1037$	0.9993
BKK_FS1007	01 Apr 22	$Y = 0.9917x + 1.8592$	1.0000
BKK_FS1008	01 Apr 22	$Y = 1.0132x + 0.7207$	1.0000
BKK_FS1009	01 Apr 22	$Y = 1.0132x + 1.1633$	0.9960
BKK_FS1010	01 Apr 22	$Y = 1.0033x + 0.5758$	0.9999
BKK_FS1011	01 Apr 22	$Y = 1.0234x + 0.1759$	0.9996
BKK_FS1012	01 Apr 22	$Y = 1.0106x - 2.0048$	0.9997
BKK_FS1013	01 Apr 22	$Y = 0.9677x - 35.851$	0.9997
BKK_FS1014	01 Apr 22	$Y = 1.0021x + 0.3148$	0.9998
BKK_FS1015	01 Apr 22	$Y = 0.9994x + 1.785$	1.0000
BKK_FS1016	01 Apr 22	$Y = 1.0105x - 80.256$	0.9998
BKK_FS1017	01 Apr 22	$Y = 0.9995x + 0.649$	1.0000
BKK_FS1018	01 Apr 22	$Y = 1.0011x + 1.1786$	1.0000
BKK_FS1019	01 Apr 22	$Y = 1.0023x - 68.424$	0.9996
BKK_FS1020	01 Apr 22	$Y = 1.0547x - 0.666$	0.9998
BKK_FS1021	01 Apr 22	$Y = 1.018x - 3.3286$	0.9998
BKK_FS1022	01 Apr 22	$Y = 0.9932x - 57.035$	0.9986
BKK_FS1023	01 Apr 22	$Y = 1.0094x + 0.0717$	0.9999
BKK_FS1024	01 Apr 22	$Y = 1.0042x + 0.4086$	0.9997



ROTA METER CALIBRATION RESULT APRIL 2022

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R ²)
BKK_FS1025	01 Apr 22	$Y = 1.0132x - 88.507$	0.9996
BKK_FS1026	01 Apr 22	$Y = 1.0018x + 1.0776$	0.9997
BKK_FS1027	01 Apr 22	$Y = 1.0053x + 0.231$	0.9995
BKK_FS1028	01 Apr 22	$Y = 0.9792x - 60.312$	0.9992
BKK_FS1029	01 Apr 22	$Y = 0.9935x + 0.8234$	1.0000
BKK_FS1030	01 Apr 22	$Y = 1.0038x + 0.515$	0.9999
BKK_FS1031	01 Apr 22	$Y = 1.009x - 79.295$	0.9998
BKK_FS1039	01 Apr 22	$Y = 0.9868x + 7.8119$	0.9993
BKK_FS1040	01 Apr 22	$Y = 1.0096x - 7.2905$	0.9990
BKK_FS1041	01 Apr 22	$Y = 1.076x - 2.0503$	0.9999
BKK_FS1042	01 Apr 22	$Y = 1.0054x + 1.6095$	0.9995
BKK_FS1043	01 Apr 22	$Y = 1.0108x - 11.048$	0.9999
BKK_FS1044	01 Apr 22	$Y = 1.0468x - 0.9391$	0.9997
BKK_FS1161	01 Apr 22	$Y = 1.0126x + 0.7738$	0.9999
BKK_FS1162	01 Apr 22	$Y = 0.9994x + 2.6357$	0.9995
BKK_FS1163	01 Apr 22	$Y = 0.977x - 55.03$	0.9987
BKK_FS1164	01 Apr 22	$Y = 0.9914x + 0.8427$	0.9997
BKK_FS1165	01 Apr 22	$Y = 0.9893x + 6.5919$	0.9998
BKK_FS1166	01 Apr 22	$Y = 1.0031x - 77.881$	0.9996
RYG_FS0197	01 Apr 22	$Y = 1.0055x + 1.1914$	0.9998
RYG_FS0198	01 Apr 22	$Y = 0.996x + 23.788$	0.9996
RYG_FS0199	01 Apr 22	$Y = 1.1166x - 3.3942$	0.9998

Review By :

(Mr. Wichan Choocharat)

Enviro Field Services Manager

Approved By :

(Mr. Sarayuth Jitranont)

Assistant General Manager

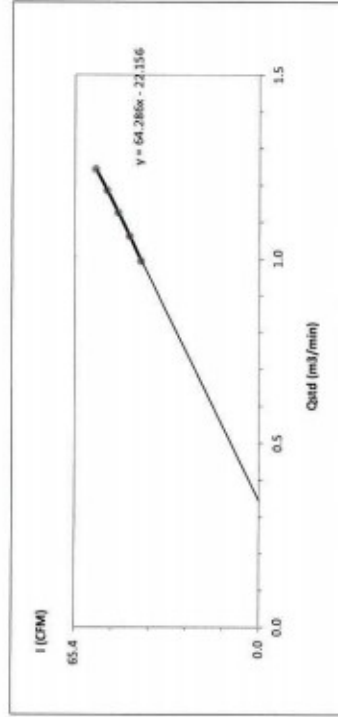


High Volume Air Sampler Calibration Worksheet

Project Site: TPI Polene Power Public Co., Ltd.
Calibrate Location: ต.บ้านดง อ.บ้านดง จ.บุรีรัมย์
Calibrate Date: 12-May-22
Calibrationsheet No.: C-120522-BKK-F50360
Calibrator ID: RYG-F50415
Calibrator Model: TE-5028A
Calibrator S/N: 3494

Barometric Pressure (mm Hg): 730
Temperature (°C): 32
High Volume ID: BKK-F50360
High Volume Model: G1051
High Volume S/N: 1331
Calibrator Slope: 1.65177
Calibrator Intercept: -0.01312

Test No.	Delta H ₂ O (inch)	Q _{ad} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.8	0.9945	42	Slope: 64.2862 Intercept: -22.1565 Correlation Coefficient: 0.9994
2	3.2	1.0623	46	
3	3.6	1.1259	50	
4	4.0	1.1861	54	
5	4.4	1.2434	58	



Calibrated by: A.H.T.A.

Approved by: [Signature]

(Mr. Autit Aoonasim)
Field Scientist(2)

(Mr. Noppong Juntarapan)
Enviro Field Coordinator Scientist (3)

REVIEW BY: Audhawan S.
APPROVED BY: [Signature]
NEXT CAL DATE: 12/Jan/23



Certificate of Calibration ICS-2100: Anion (ID#659)

This certificate is to verify that instrument below are calibrated
by Archemica Lab Co., Ltd.

ICS-2100 S/N: 15010977

AS-HV S/N: 5450A36659

For

ALS Laboratory Group (Thailand) Co., Ltd.



Operator Signature: [Signature]

Date: Jan 12, 2022

(Mr. Thitipong Piromkriput)

Applications Chemist



High Volume Air Sampler Calibration Worksheet

Project Site: TPI Polene Power Public Co., Ltd. Barometric Pressure (mm Hg): 730

Calibrate Location: จันทบุรี (จันทบุรี) S) Temperature (°C): 32

Calibrate Date: 12-May-22 High Volume ID: BKK-FS0362

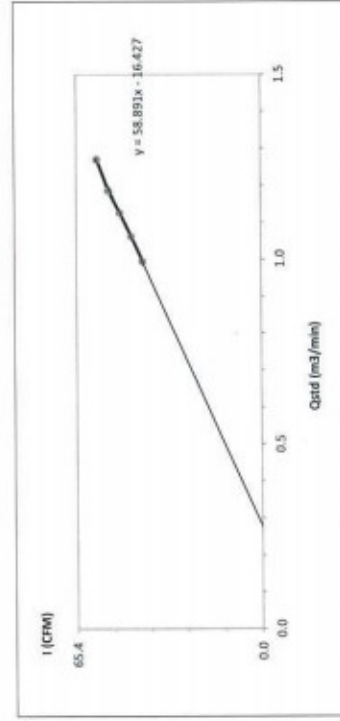
Calibration Sheet No.: C-120522-BKK-FS0362 High Volume Model: G1051

Calibrator ID: RYG-FS0415 High Volume S/N: 1452

Calibrator Model: TE-5028A Calibrator Slope: 1.65177

Calibrator S/N: 3494 Calibrator Intercept: -0.01312

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	1: Chart (CFM)	Linear Regression
1	2.8	0.9945	42	Slope: 58.8914
2	3.2	1.0623	46	Intercept: -16.4269
3	3.6	1.1259	50	Correlation Coefficient: 0.9982
4	4.0	1.1861	54	
5	4.6	1.2710	58	



Calibrated by: A. A. Approved by: (Mr. Noppong Jantarapan) Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site: TPI Polene Power Public Co., Ltd. Barometric Pressure (mm Hg): 730

Calibrate Location: จันทบุรี (จันทบุรี) S) Temperature (°C): 32

Calibrate Date: 12-May-22 High Volume ID: BKK-FS0365

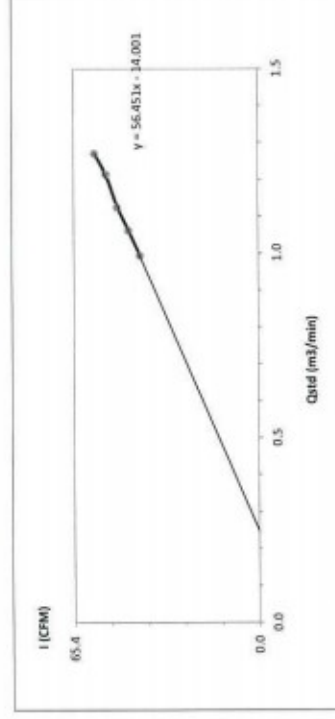
Calibration Sheet No.: C-120522-BKK-FS0365 High Volume Model: TE-5009X

Calibrator ID: RYG-FS0415 High Volume S/N: 4164

Calibrator Model: TE-5028A Calibrator Slope: 1.65177

Calibrator S/N: 3494 Calibrator Intercept: -0.01312

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	1: Chart (CFM)	Linear Regression
1	2.8	0.9945	42	Slope: 56.4512
2	3.2	1.0623	46	Intercept: -14.0014
3	3.6	1.1259	50	Correlation Coefficient: 0.9980
4	4.2	1.2151	54	
5	4.6	1.2710	58	



Calibrated by: A. A. Approved by: (Mr. Noppong Jantarapan) Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site: TPI Polene Power Public Co., Ltd. Barometric Pressure (mm Hg): 730

Calibrate Location: ดุจวิทยุ 6 Temperature (°C): 32

Calibrate Date: 12-May-22 High Volume ID: BKK_F50366

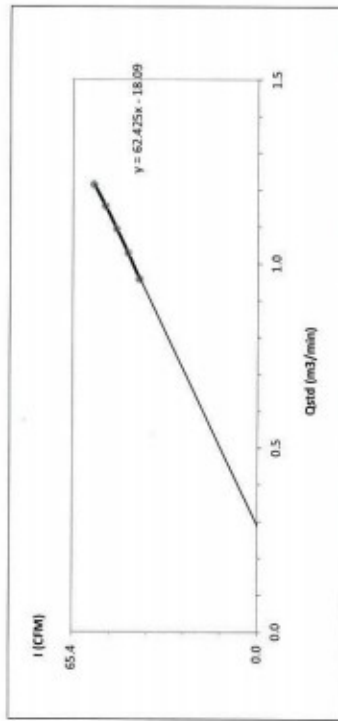
Calibration Sheet No.: C-120522-BKK_F50366 High Volume Model: TE-5009X

Calibrator ID: RYG_F50415 High Volume S/N: 4156

Calibrator Model: TE-5020A Calibrator Slope: 1.65177

Calibrator S/N: 3494 Calibrator Intercept: -0.01312

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.6	0.9588	42	Slope: 62.4251 Intercept: -18.0905 Correlation Coefficient: 0.9994
2	3.0	1.0289	46	
3	3.4	1.0946	50	
4	3.8	1.1564	54	
5	4.2	1.2151	58	



Calibrated by: Auth A.

Approved by: Signature

(Mr. Noppong Juntarapan)
Enviro Field Coordinator Scientist (3)

(Mr. Autit Aoonim)
Field Scientist(2)



High Volume Air Sampler Calibration Worksheet

Project Site: TPI Polene Power Public Co., Ltd. Barometric Pressure (mm Hg): 730

Calibrate Location: ดุจวิทยุ Temperature (°C): 32

Calibrate Date: 12-May-22 High Volume ID: BKK_F50364

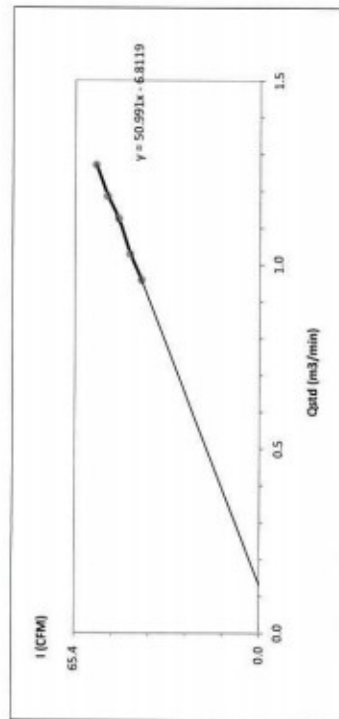
Calibration Sheet No.: C-120522-BKK_F50364 High Volume Model: TE-5009X

Calibrator ID: RYG_F50415 High Volume S/N: 4154

Calibrator Model: TE-5020A Calibrator Slope: 1.65177

Calibrator S/N: 3494 Calibrator Intercept: -0.01312

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.6	0.9588	42	Slope: 50.9912 Intercept: -6.8119 Correlation Coefficient: 0.9981
2	3.0	1.0209	46	
3	3.6	1.1259	50	
4	4.0	1.1861	54	
5	4.6	1.2710	58	



Calibrated by: Auth A.

Approved by: Signature

(Mr. Noppong Juntarapan)
Enviro Field Coordinator Scientist (3)

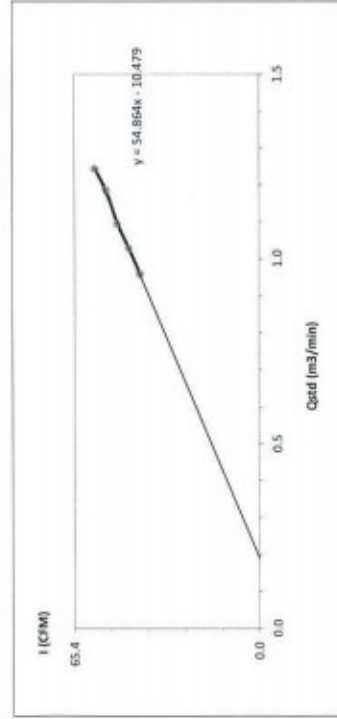
(Mr. Autit Aoonim)
Field Scientist(2)



High Volume Air Sampler Calibration Worksheet

Project Site: TPI Polene Power Public Co., Ltd. Barometric Pressure (mm Hg): 730
Calibrate Location: 2006 Jirachwong Temperature (°C): 32
Calibrate Date: 12-May-22 High Volume ID: BKK FS1059
Calibration Sheet No.: C-120522-BKK FS1059 High Volume Model: TE-5009X
Calibrator ID: RYG FS0415 High Volume S/N: 5693
Calibrator Model: TE-5028A High Volume Slope: 1.65177
Calibrator S/N: 3494 Calibrator Intercept: -0.01312

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	1: Chart (CFM)	Linear Regression
1	2.6	0.9588	42	Slope: 54.8639
2	3.0	1.0289	46	Intercept: -10.4793
3	3.4	1.0946	50	Correlation Coefficient: 0.9981
4	4.0	1.1861	54	
5	4.4	1.2434	58	



Calibrated by: Aht A.

Approved by: [Signature]

(Mr. Anut Anonim)
Field Scientist(2)

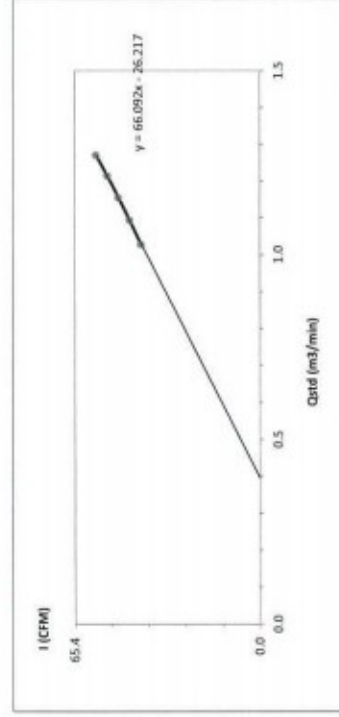
(Mr. Noppong Juntarugan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site: TPI Polene Power Public Co., Ltd. Barometric Pressure (mm Hg): 730
Calibrate Location: 2006 Jirachwong Temperature (°C): 32
Calibrate Date: 12-May-22 High Volume ID: BKK FS1057
Calibration Sheet No.: C-120522-BKK FS1057 High Volume Model: TE-5009X
Calibrator ID: RYG FS0415 High Volume S/N: 5500
Calibrator Model: TE-5028A High Volume Slope: 1.65177
Calibrator S/N: 3494 Calibrator Intercept: -0.01312

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	1: Chart (CFM)	Linear Regression
1	3.0	1.0289	42	Slope: 66.0923
2	3.4	1.0946	46	Intercept: -26.2173
3	3.8	1.1564	50	Correlation Coefficient: 0.9995
4	4.2	1.2151	54	
5	4.6	1.2710	58	



Calibrated by: Aht A.

Approved by: [Signature]

(Mr. Anut Anonim)
Field Scientist(2)

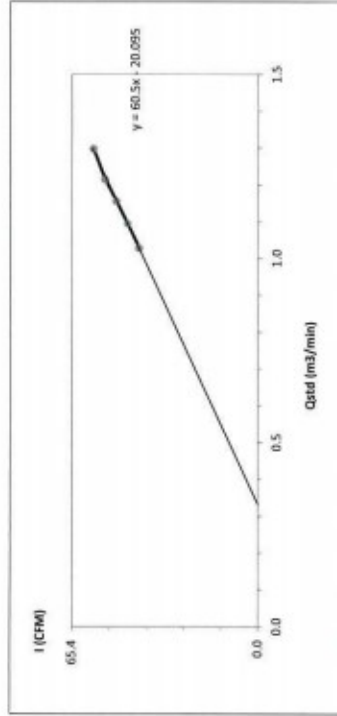
(Mr. Noppong Juntarugan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site: TPI Polene Power Public Co., Ltd. Barometric Pressure (mm Hg): 730
Calibrate Location: Office W533 A Temperature (°C): 32
Calibrate Date: 12-May-22 High Volume ID: BKK FS0371
Calibration Sheet No.: C-120522-BKK FS0371 High Volume Model: G1051
Calibrator ID: RYG FS0415 High Volume S/N: 1324
Calibrator Model: TE-5028A Calibrator Slope: 1.65177
Calibrator S/N: 3494 Calibrator Intercept: -0.01312

Test No.	Delta H ₂ O (inch)	Q _{ad} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	3.0	1.0289	42	Slope: 60.4999
2	3.4	1.0946	46	Intercept: -20.0955
3	3.8	1.1564	50	Correlation Coefficient: 0.9982
4	4.2	1.2151	54	
5	4.8	1.2981	58	



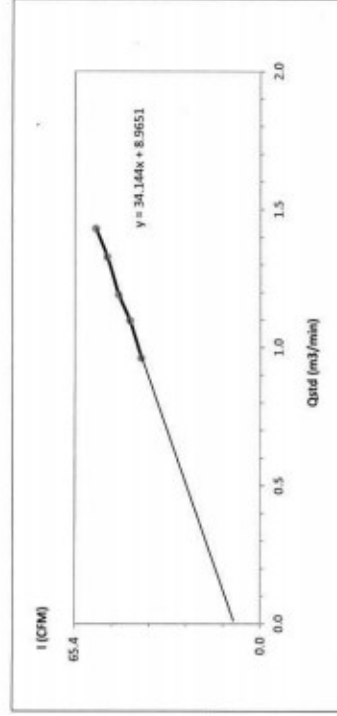
Calibrated by: Aht A. Approved by: Di P.
(Mr. Aht Aonsum) (Mr. Noppong Jantarapan)
Field Scientist(2) Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site: TPI Polene Power Public Co., Ltd. Barometric Pressure (mm Hg): 730
Calibrate Location: Dorm 3 Temperature (°C): 30
Calibrate Date: 20-May-22 High Volume ID: BKK FS0371
Calibration Sheet No.: C-200522-BKK FS0371 High Volume Model: G1051
Calibrator ID: RYG FS0415 High Volume S/N: 1324
Calibrator Model: TE-5028A Calibrator Slope: 1.65177
Calibrator S/N: 3494 Calibrator Intercept: -0.01312

Test No.	Delta H ₂ O (inch)	Q _{ad} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.6	0.9619	42	Slope: 34.1439
2	3.4	1.0981	46	Intercept: 8.9651
3	4.0	1.1900	50	Correlation Coefficient: 0.9982
4	5.0	1.3289	54	
5	5.8	1.4302	58	



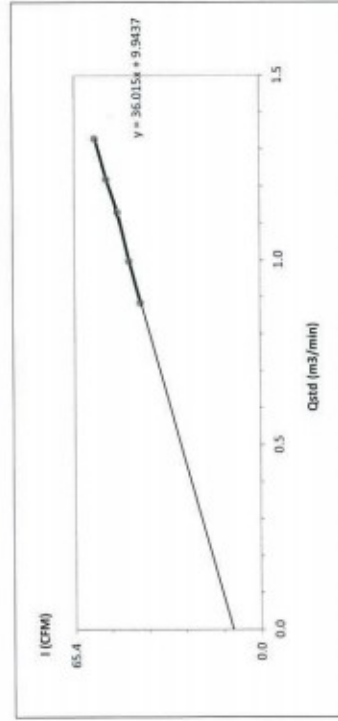
Calibrated by: Thanesun Approved by: Di P.
(Mr. Thanesun Srivastav) (Mr. Noppong Jantarapan)
Field Technician Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site: TPI Polene Power Public Co., Ltd. Barometric Pressure (mm Hg): 730
Calibrate Location: กรุงเทพมหานคร Temperature (°C): 30
Calibrate Date: 20-May-22 High Volume ID: BKK-FS1057
Calibration Sheet No.: C-200522-BKK-FS1057 High Volume Model: TE-5004X
Calibrator ID: RYG-FS0415 High Volume S/N: 5500
Calibrator Model: TE-5028A High Volume S/N: 1.65177
Calibrator S/N: 3494 Calibrator Intercept: -0.01312

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	2.2	0.8859	42	Slope: 36.0147 Intercept: 9.9437 Correlation Coefficient: 0.9985
2	2.8	0.9977	46	
3	3.6	1.1296	50	
4	4.2	1.2190	54	
5	5.0	1.3289	58	



Calibrated by

Thanesuan

(Mr. Thanesuan Sriwasut)
Field Technician

Approved by:

Thanesuan

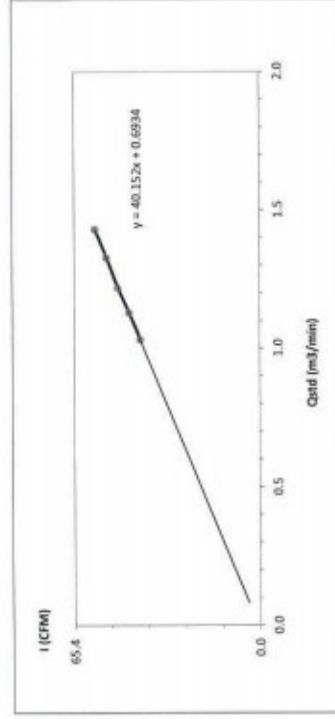
(Mr. Noppong Juntarapan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site: TPI Polene Power Public Co., Ltd. Barometric Pressure (mm Hg): 730
Calibrate Location: กรุงเทพมหานคร Temperature (°C): 30
Calibrate Date: 20-May-22 High Volume ID: BKK-FS0360
Calibration Sheet No.: C-200522-BKK-FS0360 High Volume Model: G1051
Calibrator ID: RYG-FS0415 High Volume S/N: 1331
Calibrator Model: TE-5028A High Volume S/N: 1.65177
Calibrator S/N: 3494 Calibrator Intercept: -0.01312

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	3.0	1.0323	42	Slope: 40.1520 Intercept: 0.6934 Correlation Coefficient: 0.9995
2	3.6	1.1296	46	
3	4.2	1.2190	50	
4	5.0	1.3289	54	
5	5.8	1.4302	58	



Calibrated by

Thanesuan

(Mr. Thanesuan Sriwasut)
Field Technician

Approved by:

Thanesuan

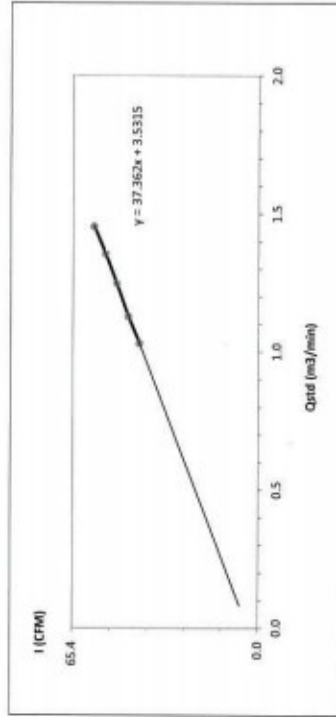
(Mr. Noppong Juntarapan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site : TPI Polene Power Public Co., Ltd. Barometric Pressure (mm Hg) : 730
Calibrate Location : 17060197 Temperature (°C) : 30
Calibrate Date : 20-May-22 High Volume ID : BKK_F50362
Calibrationsheet No.: C-200522-BKK_F50362 High Volume Model : G1051
Calibrator ID: RYG_F50415 High Volume S/N: 1452
Calibrator Model : TE-5028A Calibrator Slope : 1.65177
Calibrator S/N : 3494 Calibrator Intercept : -0.01312

Test No.	Delta H ₂ O (inch)	Q _{ad} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	3.0	1.0323	42	Slope : 37.3622
2	3.6	1.1296	46	Intercept : 3.5315
3	4.4	1.2474	50	Correlation Coefficient : 0.9996
4	5.2	1.3549	54	
5	6.0	1.4545	58	



Calibrated by : Thaneeuan

(Mr. Thaneeuan Srivastu)
Field Technician

Approved by :

Signature

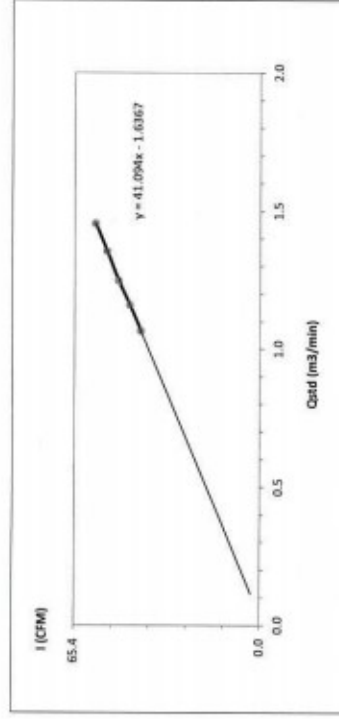
(Mr. Noppong Juntarapan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site : TPI Polene Power Public Co., Ltd. Barometric Pressure (mm Hg) : 730
Calibrate Location : 17060197 Temperature (°C) : 30
Calibrate Date : 20-May-22 High Volume ID : BKK_F50366
Calibrationsheet No.: C-200522-BKK_F50366 High Volume Model : TE-5009X
Calibrator ID: RYG_F50415 High Volume S/N: 4156
Calibrator Model : TE-5028A Calibrator Slope : 1.65177
Calibrator S/N : 3494 Calibrator Intercept : -0.01312

Test No.	Delta H ₂ O (inch)	Q _{ad} (m ³ /min)	I: Chart (CFM)	Linear Regression
1	3.2	1.0657	42	Slope : 41.0045
2	3.8	1.1602	46	Intercept : -1.6367
3	4.4	1.2474	50	Correlation Coefficient : 0.9994
4	5.2	1.3549	54	
5	6.0	1.4545	58	



Calibrated by : Thaneeuan

(Mr. Thaneeuan Srivastu)
Field Technician

Approved by :

Signature

(Mr. Noppong Juntarapan)
Enviro Field Coordinator Scientist (3)

Certificate of System Qualification

ES-OQ

System ID: MY16010005
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Phatthanakan 40 Phatthanakan Rd., Bangkok 10250

Date: September 13, 2021 5:48:11 PM

EQP Name: Agilent Recommended

EQP Revision: ES.02.50

Overall Qualification Status: Pass

Preparation

Pass

Instrument Tests

Pass

Autosampler Operation

Pass

REVIEW BY *Thitiya B.*

APPROVED BY *Savitree N.*

NEXT CAL DATE *12 Mar 23*

Instrument Details

Purpose

This section describes the as found system configuration.

Details

Spectrometer 1

Manufacturer

Name

Model Number

Sample Introduction

Serial Number

Firmware Revision

Agilent Technologies

5100 SVDV

G8010A

Double pass glass cyclonic spraychamber and nebulizer

MY16010005

5385

Chiller 1

Manufacturer

Name

Other Unspecified Name

Model Number

Other Unspecified Model Number

Serial Number

Agilent Technologies

Other Unspecified

Chiller

Other Unspecified

G3292-80201

2008-00159

Autosampler 1

Manufacturer

Name

Model Number

Serial Number

Agilent Technologies

SPS4

G8410A

AU15440784

Switching Valve Accessory 1

Manufacturer

Name

Model Number

Serial Number

Agilent Technologies

SVS 2+

G8485A

AU16040115

Electronic Signature

Purpose

This signature page was created and published because the ACE sign-off action was executed, which is valid for the entire document, including attachments. The ACE sign-off is an electronic signature that requires two distinct identification components: unique username and personal password. The Agilent representative who has delivered this service understands the meaning and legal status of an electronic signature. As a trained official operator, the Agilent representative has a unique password and login to access ACE and electronically sign this document. (Other e-signatures can be applied to this document using a Document Content Management or other suitable method defined in your data access and control procedures.)

Details

Full Name of Signer: Kanyakorn Sukosilrajarn
Logged On User Name: phimpapra.pearaphong@ugilent.com
Signature Creation Date: September 13, 2021
Reason for Signature: Executed protocol and published his o

Regulatory Disclaimer

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

Warranty

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User Name: phmgraphia.jensaphong
Hostname: ASDKOWX328
Print Date: September 13, 2021 5:45:12 PM
System ID: MY16016005

Time	Transaction Date	Activity Performed	Type of Transaction	Optional Information
	September 8, 2021 8:40:59 AM	Session Closed	Session	None
	September 8, 2021 8:45:29 AM	Configuration	Session	None
	September 8, 2021 8:45:29 AM	Enrollment	Licensing	User is Field Engineer and does not reside at vehicle code
	September 8, 2021 9:07:09 AM	Eng. loaded	Session	EGP details for primary technician [21] - File path: [ProtocolPath]\Data\Config\enr02.0003.02.10.enp, EGP File Name: [E02.M.enp], EGP Name: [AgentName]unmanned
	September 8, 2021 9:07:11 AM	Configuration	Session	None
	September 8, 2021 9:07:15 AM	Qualification	Session	OQ
	September 8, 2021 9:07:15 AM	Execution	Preparation: 5:00 SVDW; Qualification Test - No segments associated	None
	September 8, 2021 9:34:25 AM	Execution	Preparation: 5:10 SVDW; Qualification Test - No segments associated	Run Count: 1
	September 8, 2021 9:34:29 AM	Execution	Instrument Tests: 5:00 SVDW; Qualification Test - No segments associated	None
	September 8, 2021 9:51:27 AM	Execution	Instrument Tests: 5:10 SVDW; Qualification Test - No segments associated	Run Count: 1

User Name: phetprapha.jersphong
 Hostname: ASD0000228
 QCLW 3109 EPORES ALS 0004021 Transaction Log :

System ID: MY16010005
 Print Date: September 13, 2021 5:48:12 PM

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 8, 2021 9:51:39 AM	Start	Execution	Autosampler Operation : Autosampler 1 - SP54; Qualitative Test - No subpoints included	None
September 8, 2021 9:51:39 AM	End	Execution	Autosampler Operation : Autosampler 1 - SP54; Qualitative Test - No subpoints included	Run Count : 1
September 8, 2021 9:51:39 AM	End	Qualification	Session	OO
September 8, 2021 9:51:39 AM	Start	Reporting	Session	None
September 8, 2021 10:25:49 AM	Auto	Acquisition	Session	None
September 13, 2021 9:01:26 PM	Auto	Acquisition	Session	None
September 13, 2021 9:01:26 PM	Auto	Session/Reloaded	Session	None
September 13, 2021 9:01:26 PM	Start	Qualification	Session	OO
September 13, 2021 9:01:26 PM	Auto	Reporting	Session	Report Generated : Certificate



Agilent CrossLab Compliance Services

Agilent
 CrossLab
 From Insight to Outcome

EQUIPMENT QUALIFICATION REPORT (EQR)

Agilent CrossLab Compliance

Qualification Type: ES-OQ

System ID: MY16010005

EQP Name: AgilentRecommended

EQP Details: Agilent Technologies System

EQP Revision: ES.02.50

EQP Release Date: March 2020

Date: September 13, 2021 5:50:41 PM

Report Type: Report

Org. Name: ALS Laboratory Group (Thailand) Co., Ltd.

Org. Location: 104 Phatthanakan 40 Phatthanakan Rd., Bangkok 10250

Table of Contents

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Instrument Tests : \$100 SVDV	10
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Test Summary

Purpose

This section includes a status for each scheduled test and the overall qualification. For each test that is run, (1) the status is automatically determined based on pre-defined limits, and (2) the total number of times the test was run is displayed. For detailed results and specifications for a test, refer to the test results in this EQR.

Details	Status	Runs
Test		
Preparation : \$100 SVDV	Pass	1
Instrument Tests : \$100 SVDV	Pass	1
Autosampler Operation : Autosampler 1 - SPS4	Pass	1

Overall Qualification Status

Pass

Service Details

Purpose

This section includes local contact and delivery details for this service.

General Details

Service Order No./Request: 6004823273
EQP Name: Agilent/Recommended
EQP Revision: ES.02.50
Report Type: Report

Organization Details

Name: ALS Laboratory Group (Thailand) Co., Ltd.
Location: 104 Phatthanakan 40 Phatthanakan Rd., Bangkok 10260

Local Contact Details

Name: Khun Thidma Boonpeng
Job Title: Scientist 2, Life Sciences
Qualification Location: ICP Room

Operator Details

Name: Kanyakorn sukpaibrajarn
Job Title: Field Service Engineer

Data Acquisition Details

Acquisition Software Name: ICP Expert
Acquisition Software Revision: 7.5.3.11953

Customer Data System (CDS)

Es: ICP Expert

Instrument Details

Purpose

This section describes the as found system configuration.

Details

Spectrometer 1

Manufacturer: Agilent Technologies
Name: 5100 SVDV
Model Number: G8010A
Sample Introduction: Double pass glass cyclonic spraychamber and seaspray nebulizer
Serial Number: MY16010005
Firmware Revision: 5395

Chiller 1

Manufacturer: Agilent Technologies
Name: Other Unspecified
Other Unspecified Name: Chiller
Model Number: Other Unspecified
Other Unspecified Model Number: G3292-80201
Serial Number: 2008-00159

Autosampler 1

Manufacturer: Agilent Technologies
Name: SPS4
Model Number: G8410A
Serial Number: AU15440764

Switching Valve Accessory 1

Manufacturer: Agilent Technologies
Name: SVS 2+
Model Number: G8485A
Serial Number: AU16040115

Protocol Details

Purpose

This section lists the revisions for all test units used in this report. For complete test-specific and high-level change details, refer to the Revision History document.

Test Revision	Test
ES.02.50	Autosampler Operation
ES.02.50	Instrument Tests
ES.02.50	Preparation

Preparation

Purpose

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

Configuration Details

Model/Serial No.:

GB010A

MY16010005

Results

Criteria

Does the plasma ignite successfully in the first three attempts?

☐

Was the detector calibration performed and completed successfully?

Was the instrument calibration performed and completed successfully?

Observed Result

Yes

Yes

Yes

Expected Result

Yes

Yes

Yes

Status

Pass

Pass

Pass

Was the instrument calibration performed and completed successfully?

Image Details:
Date and Time: September 8, 2021 9:33:30 AM
Host Name: ASBKXWX328

Overall Test Status

Pass

Runs: 1

Test	Result	Pass/Fail	Message
1. Instrument Calibration	Pass	Pass	Instrument calibration completed successfully.
2. Instrument Performance	Pass	Pass	Instrument performance is within specifications.
3. Instrument Accuracy	Pass	Pass	Instrument accuracy is within specifications.
4. Instrument Precision	Pass	Pass	Instrument precision is within specifications.
5. Instrument Linearity	Pass	Pass	Instrument linearity is within specifications.
6. Instrument Range	Pass	Pass	Instrument range is within specifications.
7. Instrument Resolution	Pass	Pass	Instrument resolution is within specifications.
8. Instrument Sensitivity	Pass	Pass	Instrument sensitivity is within specifications.
9. Instrument Stability	Pass	Pass	Instrument stability is within specifications.
10. Instrument Reliability	Pass	Pass	Instrument reliability is within specifications.
11. Instrument Safety	Pass	Pass	Instrument safety is within specifications.
12. Instrument Maintenance	Pass	Pass	Instrument maintenance is within specifications.
13. Instrument Documentation	Pass	Pass	Instrument documentation is within specifications.
14. Instrument Training	Pass	Pass	Instrument training is within specifications.
15. Instrument Compliance	Pass	Pass	Instrument compliance is within specifications.

Test Evidence
Was the detector calibration performed and completed successfully?

Image Details:
Date and Time: September 8, 2021 9:07:42 AM
Host Name: ASBKXWX328

Overall Test Status

Pass

Runs: 1

Test	Result	Pass/Fail	Message
1. Instrument Calibration	Pass	Pass	Instrument calibration completed successfully.
2. Instrument Performance	Pass	Pass	Instrument performance is within specifications.
3. Instrument Accuracy	Pass	Pass	Instrument accuracy is within specifications.
4. Instrument Precision	Pass	Pass	Instrument precision is within specifications.
5. Instrument Linearity	Pass	Pass	Instrument linearity is within specifications.
6. Instrument Range	Pass	Pass	Instrument range is within specifications.
7. Instrument Resolution	Pass	Pass	Instrument resolution is within specifications.
8. Instrument Sensitivity	Pass	Pass	Instrument sensitivity is within specifications.
9. Instrument Stability	Pass	Pass	Instrument stability is within specifications.
10. Instrument Reliability	Pass	Pass	Instrument reliability is within specifications.
11. Instrument Safety	Pass	Pass	Instrument safety is within specifications.
12. Instrument Maintenance	Pass	Pass	Instrument maintenance is within specifications.
13. Instrument Documentation	Pass	Pass	Instrument documentation is within specifications.
14. Instrument Training	Pass	Pass	Instrument training is within specifications.
15. Instrument Compliance	Pass	Pass	Instrument compliance is within specifications.

Instrument Tests

Purpose

This test records a status for each of the automated tests within the Agilent ICP-OES CDS. For detailed test criteria, refer to the attached report.

Configuration Details

Model/Serial No.:

GB010A

MY16010005

Results

Observed Result Expected Result Status

Are the Functional Tests results within acceptance criteria?

Subsystem Communications

Air Flow

Yes

Yes

Pass

Water Flow

Yes

Yes

Pass

Gas Flows

Yes

Yes

Pass

RF Generator

Yes

Yes

Pass

Camera

Yes

Yes

Pass

Optics

Yes

Yes

Pass

Are the Instrument Performance Tests results within acceptance criteria?

Resolution

Yes

Yes

Pass

Sensitivity

Yes

Yes

Pass

Precision

Yes

Yes

Pass

Overall Test Status

Pass

Runs: 1

Autosampler Operation

Purpose

This test verifies that the autosampler operates properly.

Configuration Details

Model/Serial No.:

GB410A

AU15460764

Results

Criteria

Observed Result Expected Result Status

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

Yes

Yes

Pass

Overall Test Status

Pass

Runs: 1

Declaration of Change Control

This document is under change control. Revision history is maintained and printed on each document. Access to the master documents is limited to process owners. Documents receive periodic review and cannot be assigned an evergreen status. The qualification performed according to this document refers only to the hardware/software configuration in place at the time of the qualification. Agilent Technologies recommends that instrument configuration change management procedures be in place in order to maintain the validation process. Any changes to the analytical or computer hardware or software must be clearly specified. A change management system provides a means for determining the degree of requalification required according to the extent of the changes made. All details of the changes must be thoroughly recorded and documented, together with details of completed tests and their results. Note: Hardware/software configuration management is the customer's responsibility.

Attachments

Location	Category	Document Name	Page
EQR	General	Certificate of Qualification for ACE	1
EQR	General	Certificate of Qualification for ACE	1
EQR	General	Operator's training certificate and qualifications	1
EQR	Material	Certificate of Analysis Wavelength calibration solution	4
EQR	Comments	General	1
EQR	General	Instrument's Test Report	5
EQR	General	Instrument's Test Report	4

Document Name:

Certificate of Qualification for ACE



Agilent Technologies

Agilent Compliance Engine Self Qualification

Date: September 8, 2021 10:10:13 AM
Drive Serial #: 6VFD6572 Platform Revision: A.03.01

Individual self-qualification reports for each specific technique installed are also available upon request. They provide additional details on the general report from the overview summary and are structured by the actual algorithms challenged during the process. There is not a one-size-fits-all relationship between algorithms and OQ program tests because some algorithms are used by several tests and across multiple similar hardware components of the qualified systems.

Technique Type	Tests Completed	Result
UV-Vis Spectrophotometer	13	Confirms
Atomic Absorption	7	Confirms
Capillary Electrophoresis	10	Confirms
Software	6	Confirms
Envision Spectroscopy	3	Confirms
Infrared Spectroscopy	7	Confirms

Overall Qualification Status

Confirms

Date: September 13, 2021 5:50:41 PM
System ID: MY16010005

Page 14 / 34

Document Name:

Certificate of Qualification for ACE



Agilent Technologies

Certificate of Completion

Learner Name: Kanyakorn Sudeethajirern

Title Of Course: AN/CE-SS-II-609-A: ACE 3.X User Update Training

Completion Date: June 25, 2020

Certified By Company: Learning at Agilent

All Service and Support training certificates have the following specific limitations.

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Date: September 13, 2021 5:50:41 PM
System ID: MY16010005

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CERTIFICATE OF ANALYSIS

Agilent Product Name: Wavelength Calibration Solution for RP-QES & MP-AES, 5 mg/L, 500mL
Agilent Part No: 819630100
Lot No: 807503843

[illegible]

Master: 016 100110

Intended Use: This solution is intended for use as a certified reference material or calibration standard for laboratory-based plasma optical emission spectrometry (PO-OES), inductively coupled plasma mass spectrometry (ICP-MS), atomic absorption spectrometry (AAS), inductively coupled plasma atomic emission spectrometry (ICP-AES), and electrothermal atomic absorption spectrometry (ETAAS), and other techniques for elemental analysis.

[illegible][illegible]

with direct exposure to moisture or high humidity.



Certificate of Completion

Course Name:	Kern County Support Services
Title of Course:	ANV-CE-CFOES-2-608-A: Agilent 5100 ICP-OES Support Neophyte Training
Completion Date:	November 4, 2017
Certified By Company:	Learning at Agilent

institutions and countries have the following specific limitations.

[illegible]



Period of Validity: Agent reserves the accuracy of this solution until the expiration date shown below, provided the instructions for use are followed. During the period of validity, the purchaser will be notified if this product is recalled due to any significant changes in the stability of the solution.

Example 1: *but, approximately*

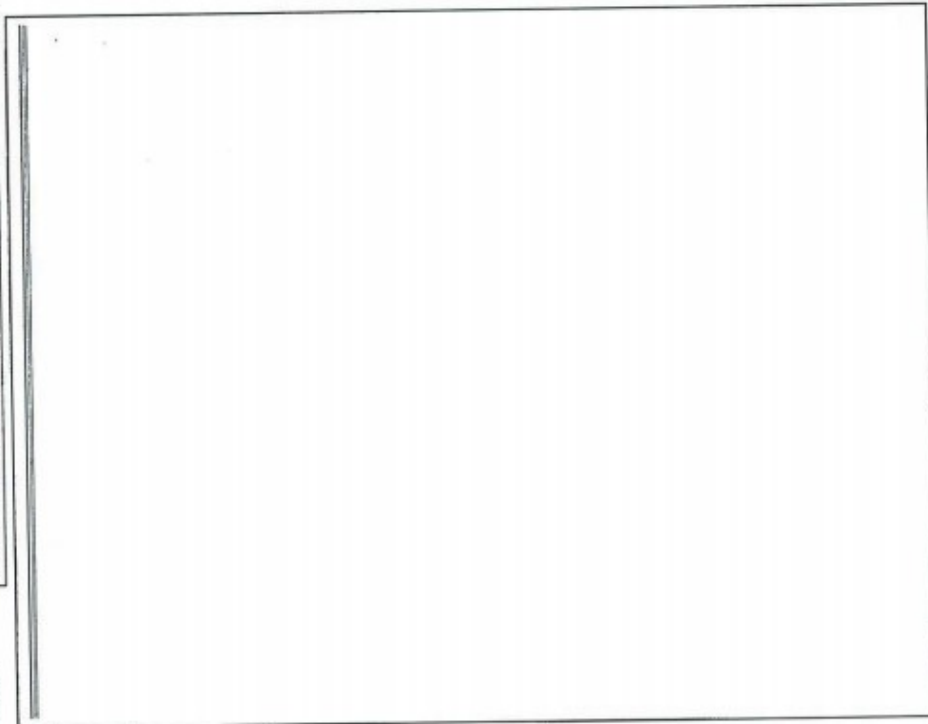
Date of release: 8 April 2023
Date of expiration: 8 October 2023

David S. Anderson
David S. Anderson, Certified Public Accountant

[illegible]

Document Name:

Certificate of Analysis Wavelength calibration solution



Comments

Date/Time:

Test:

Comment:

September 13, 2021 5:27:56 PM

General

Start OQ on 03 Sep 21 and found water flow fail, So repair job complete for 13 Sep 21 and OQ continue to complete.

Document Name:

Instrument's Test Report

Report Summary
Instrument Model: Agilent 5100/5116 SYDV RPT-QES
Instrument ID: 0015AGS014A
Instrument Serial Number: MY16010005
Software Version: 7.3.3.11663
Firmware Version: 5355
Tested By: Knapkorn S.
Test started at: 9/2/2021 5:51:21 AM
Test Completed On: 9/2/2021 5:58:39 AM

Result Summary

Subsystem Communications Test	Pass
Air Flow Test	Shipped
Water Flow Test	Shipped
Gas Flow Test	Shipped
RF Generator Test	Shipped
Camera Test	Shipped
Optics Test	Pass
Advanced Valve System Test	Shipped
Resolution Test	Pass
Sensitivity Test	Pass
Precision Test	Pass

Subsystem Communications Test

Optics Test	Pass
Intensity	3082176
Wavelength	737.212
Resolution	3416288
Sensitivity	737.212
Precision	737.212

Document Name:

Instrument's Test Report

Resolution Test

Element Wavelength	Specification	Width
Ni (174.213 nm)	± 9.40	7.54
Ar (188.869 nm)	± 8.20	8.43
C (185.027 nm)	± 11.50	8.89
Mn (202.032 nm)	± 8.20	8.60
Cr (200.158 nm)	± 13.40	11.05
Zn (213.857 nm)	± 8.70	7.27
Pb (220.353 nm)	± 9.50	7.52
Co (228.615 nm)	± 17.20	12.85
Ba (228.424 nm)	± 9.40	7.80
Mn (237.470 nm)	± 13.30	9.69
Mn (260.568 nm)	± 26.30	16.83
Cr (267.718 nm)	± 11.02	8.53
Co (264.354 nm)	± 26.00	19.14
Ca (397.396 nm)	± 14.20	11.75
Sr (338.071 nm)	± 33.50	25.94
Ba (455.403 nm)	± 44.00	33.57
Sr (460.783 nm)	± 38.00	22.38
Ba (482.408 nm)	± 38.00	26.66
Ba (514.171 nm)	± 42.00	29.49
Ar (575.283 nm)	± 74.00	50.58
K (766.491 nm)	± 80.00	66.42

Document Name: Instrument's Test Report

Document Name: Instrument's Test Report

Sensitivity Test		Pass		Fail	
Radial					
Exposure Wavelength	Specification	Matched	Results	Standard	Block
Ar (405.002 nm)	≥ 46.0	SPHR	81.8	900.1	94.9
He (468.276 nm)	≥ 41.0	SPHR	55.8	705.4	713.8
Ne (478.2 nm)	≥ 46.0	SPHR	2905.3	2967.4	197.9
Pb (225.353 nm)	≥ 46.0	SPHR	100.5	1302.6	152.2
Mn (257.610 nm)	≥ 35.0±0.6	SPHR	1644.7	172413.8	565.9
Al (265.152 nm)	≥ 3.4	SPHR	6.3	24257.9	5081.8
Na (448.403 nm)	≥ 34.0	SPHR	65.1	105546.7	10954.7
K (766.481 nm)	≥ 1.8	SPHR	4.4	87043.9	15321.8

Element	Wavelength	Specification	Method	Ratio	Standard	Blank
As	189 (980 nm)	≥ 200.0	SFBR	292.4	5116.1	372.0
Se	196 (626 nm)	≥ 150.0	SFBR	198.9	3403.2	271.0
Zn	200 (626 nm)	≥ 243.0	SFBR	703.6	14029.9	257.0
Zn	213.3 (527 nm)	≥ 1743.0	SFBR	402.4	150653.8	696.4
Co	214 (439 nm)	≥ 4227.0	SFBR	493.6	67092.4	375.1
Pb	220 (321 nm)	≥ 323.0	SFBR	527.3	7633.1	485.3
Ni	237 (619 nm)	≥ 90818.0	SFBR	1903.6	632481.9	1164.7
Cr	247 (716 nm)	≥ 1546.0	SFBR	4115.3	173896.6	1791.8
Co	234 (754 nm)	≥ 19.0	SBR	46.6	18350.3	3960.0
Al	396 (192 nm)	≥ 6.0	SBR	76.7	16460.2	847.5
Ba	454 (456 nm)	≥ 2.0	SBR	16.0	437403.7	31797.2
Co	706 (491 nm)	≥ 60.0	SBR	94.8	25037.2	36594.9

Precipitation Test	Pass
Residual	
Element VaneStrength	Measured Value % RSD
As (100,800 nnt)	± 2.00 1.58
Se (100,026 nnt)	± 2.00 1.38
Zn (233,857 nnt)	± 1.50 0.62
Pb (230,353 nnt)	± 2.00 0.72
Mn (257,210 nnt)	± 1.50 0.44

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Model	Element Wavelength	Specification	Measured Value % RSD
	As (188.102 nm)	≤ 1.50	0.64
	Sr (467.833 nm)	≤ 1.50	0.58
	Zn (213.857 nm)	≤ 1.50	0.39
	Cd (226.503 nm)	≤ 1.50	0.30
	Cu (242.716 nm)	≤ 1.50	0.47
	Mn (257.610 nm)	≤ 1.50	0.18
	Co (287.716 nm)	≤ 1.50	0.30
	Cu (324.754 nm)	≤ 1.50	0.45
	As (208.152 nm)	≤ 1.50	0.35
	Ba (455.403 nm)	≤ 1.50	0.50
	K (766.491 nm)	≤ 1.50	0.48

Report Detail:Tests Run - Operator: Kanyakom S.

Subsystem Communications Test- Started

SubSystem StatusMain Power Module - Passed

RF Generator - Passed

Optical Camera Control Module - Passed

Subsystem Communications Test Complete

Optics Test-Started

[Test View Mode](#) [InformaBites Status](#)

LED off • Failed
Shutter opened • Passed

Shutter closed - Passed

Shuffle opened - Passed
Critical Action Butler: Calculated Value is 2

Peak Intensity Axis mode 310250.49 - Pa

1

September 13, 2021 5:50:41 PM

011 130 13000

Document Name:

Instrument's Test Report

Radio-Acid Activity Ratio (Range 0-1000) - LCD - Passed
Peak Activity Ratio - Passed
Shutter closed - Passed
Cycle Test Completed - Passed
Instrument Performance - Passed
Instrument Performance Completed - Passed

General

Document Name:

Instrument's Test Report

Report Summary
Instrument Model Agilent 5100S110 SVDV ICP-QES
Instrument ID G8010AG0614A
Instrument Serial Number MY16010005
Software Version 7.5.3.11553
Firmware Version 5255
Tested By Kangnam S.
Test started on 9/13/2021 5:33:48 PM
Test Completed On 9/13/2021 5:46:59 PM

Result Summary

Subsystem Communications Test	Pass
Air Flow Test	Pass
Water Flow Test	Pass
Gas Flow Test	Pass
RF Generator Test	Pass
Camera Test	Pass
Cycle Test	Pass
Advanced Valve System Test	Skipped
Resolution Test	Skipped
Sensitivity Test	Skipped
Precision Test	Skipped

Subsystem Communications Test

Pass

Air Flow Test

50% Air Flow (relative speed)	50% Air Flow (relative speed)
11.00	16.00

Water Flow Test

50% Water Flow (L/min)	Calibrated Water Flow (L/min)	Water inlet Temperature (°C)
1.21	1.14	23.01

Document Name:

Instrument's Test Report

Gas Flow Test				Pass	
Non-leak	Actual Flow	Blank Pressure	Actual Flow	Blank Pressure	
0.70	0.71	293.73	2.00	108.21	
Monovac	Actual Flow	Socket Pressure	Plasma Target Flow	Actual Flow	Blank Pressure
2.00	2.00	106.63	18.00	17.86	19.78
RF Generator Test				Pass	
RF Power Supply Test	Passed				
RF Power Supply (V)	130.332				
RF Oscillator Test	Passed				
RF Oscillator Frequency	25.917				
RF Oscillator Amplitude					
RF Peak Coil Current (A)	44.872				
RF Power Supply Current (A)	1.388				
Generate Test				Pass	
Blank Level Test	None Test				
Blank Response Test	Passed				
Gallia Test				Pass	
Radial	Aval				
Intensity	2565833				
Wavelength	737.212				
	737.212				

Page 2 of 4

Parent Detail

Test Run - Operator: Kanyaborn S.	Subsystem Status
Subsystem Communications Test- Started	
Milins Power Module - Passed	
Gas Control Module - Passed	
RF Generator - Passed	
Impedance Module - Passed	
Control Module - Passed	

Document Name:

Instrument's Test Report

Specimen Data - Passed	
Subsystem Communications Test Completed - Passed	
Air Flow-Started	
Fan Speed(N) Air Flow(airflow speed) Status	
30% N - Passed	
60% N - Passed	
Air Flow Completed - Passed	
Water Flow-Started	
Rf Water Flow(L/min) = 0.71	
Current Water Flow (L/min) = 1.14	
Water Inlet Temperature = 22.01	
Rf Water Flow(L/min)(off) = 0.00	
Water Flow Completed - Passed	
Gas Flow-Started	
Channel Target Actual Pressure Failure Status	
Auxiliary Gas 0.00 0.08 N/A N/A - Passed	
Avalanche Gas 2.00 2.00 N/A N/A - Passed	
Nebulizer Gas 0.00 0.07 0.00 N/A - Passed	
Plasma Gas 0.00 0.00 0.00 N/A - Passed	
Plasma Gas 6.00 6.18 N/A N/A - Passed	
Melasma Gas 16.00 17.96 N/A N/A - Passed	
Melasma Gas 0.00 0.08 N/A N/A - Passed	
Melasma Gas 0.00 0.00 0.00 N/A - Passed	
Purge Gas 0.70 0.70 N/A N/A - Passed	
Purge Gas 3.70 3.70 N/A N/A - Passed	
All Channel Flows OK! - Passed	
All Channel Flows Off! - Passed	
Gas Flow Completed - Passed	
RF Generation-Started	
RF generator turned off - Passed	
RF generator turned on - Passed	
RF Control = 0 V - Passed	
RF Power Supply - Set Value = 150W, Actual Value = 130.25W - Passed	
RF Oscillator Frequency(MHz) = 26.02, Workcoil Current(Amps) = 44.87, RF Power Supply Current(Amps) = 2.00 - Passed	
RF Oscillator diodepp - Passed	
RF generator turned off - Passed	
RF Generation Completed - Passed	
Camera Test- Started	
Black level test - PASSED	
Noise test - PASSED	
Photo response test - PASSED	
Camera Test Completed - Passed	
Cycle Test- Started	
Test View Note Intensities Status	
ED OFF - Passed	

Page 3 of 4

Instrument's Test Report

Fluorescein dye stained	
Fluorescein stain	- Passed
Waiting 5 min for placenta warm up	
Shedder opened	- Passed
Peak Intensity RefRM (mm) 2945002.00	- Passed
Fluid removed	
Shedder closed (and then shedder handle mode 55-48)	- Passed
Shedder closed	- Passed
Critical Apopto Ratio; Calculated Value = 2.53, Factory Value = 2.60	
Peak Intensity Axial mm 3009547.23	- Passed
Red-Load Intensity Ratio Range (5-100)	- Passed
Shedder closed (and then shedder mode 2020538-45)	- Passed
Shedder closed	- Passed
Optics Test Completed	- Passed

Page 4 of 4

Agilent CrossLab Compliance Services

Electronic Signature

Purpose

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Details

Full Name of Signer: Kanyakorn Sukpathajareon
Logged On User Name: pti@prapha.jeepraphong@gmail.com
Signature Creation Date: September 13, 2021
Reason for Signature: Executed protocol and published this o

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User Name: phimgapha.jee@shong
Host Name: ASQHXW328
System Id: M716010005
Print Date: September 13, 2021 5:09:44 PM

User Name: philegrapha.janaphong
Host Name: ABB00V328
System ID: MY569-19335
Print Date: September 13, 2021 5:50:44 PM

QCIW 216 ICPIQUES ALS (656x21 Transaction log :						
Time	Transaction Date	Activity Performed	Type of Transaction	Optional Information		
September 8, 2021 8:09:09 AM	Auto	Session Created	Session	None		
September 8, 2021 8:09:25 AM	Start	Configuration	Session	None		
September 8, 2021 8:09:59 AM	Auto	Enrollment	Licensing	User is FirstLogon and does not require an unlock code		
September 8, 2021 8:07:56 AM	Auto	Exp.Located	Session	EOP details for primary technique (Eti) - File path: Photos\MyALS\Config\all serv\CS\ALS\02.50.mpg, EOP File Name: [E]02.50.mpg, EOP Name: MyALSRoom.mpeg		
September 8, 2021 8:07:11 AM	End	Configuration	Session	None		
September 8, 2021 8:07:15 AM	Start	Qualification	Session	OQ		
September 8, 2021 8:07:16 AM	Start	Examination	Preparation : \$100 SYNC; Qualitative Test - No airports associated	None		
September 8, 2021 9:44:35 AM	End	Examination	Preparation : \$100 SYNC; Qualitative Test - No airports associated	Run Count : 1		
September 8, 2021 9:24:39 AM	Start	Examination	Instrument Tests : \$102 SYNC; Qualitative Test - No airports associated	None		
September 8, 2021 9:11:27 AM	End	Examination	Instrument Tests : \$102 SYNC; Qualitative Test - No airports associated	Run Count : 1		

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 8, 2021 9:41:30 AM	Start	Execution	Advantage® Operation : Advantage® 1 - SP54; Qualifier Test - No aspects associated	None
September 8, 2021 9:51:06 AM	End	Execution	Advantage® Operation : Advantage® 1 - SP54; Qualifier Test - No aspects associated	Run Count : 1
September 8, 2021 9:51:08 AM	End	Qualification	Session	OQ
September 8, 2021 9:51:08 AM	Start	Reporting	Session	None
September 8, 2021 10:55:43 AM	Avail	AccClosed	Session	None
September 13, 2021 5:01:26 PM	Avail	AccUnflashed	Session	None
September 13, 2021 5:01:26 PM	Avail	SessionReleased	Session	None
September 13, 2021 5:01:26 PM	Start	Qualification	Session	OQ
September 13, 2021 4:47:55 PM	Avail	Reporting	Session	Report Generated : Certificate

analytikjena

REVIEW BY	Changthi N
APPROVED BY	Savita N
NEXT CAL. DATE	10/01/2022

Maintenance Protocol

Atomic Fluorescence Spectrometer
mercur / mercur plus

User Name: phengapha.jengphong Hostname: A315XW0328		System ID: MY16010005 Print Date: September 13, 2021 5:50:44 PM		
OQW 5100 ICPOES ALS 0524p21 Transaction log:				
Time	Transaction Date	Activity Performed	Type of Transaction	Optional Information
September 13, 2021 5:45:13 PM	Audi	Reporting	Session	Report Signed: Certificate PDF Name: OQW 5100 ICPOES ALS 0524p21_20210913_Certificate 1_1.pdf User Name: phengapha.jengphong@agilent.com Full Name of Signer: Kanyakorn Subparajonorn Reason for signature: Executed protocol and published this original version of document Report Generated: Report

analytikjena

Device parameter	nominal value	actual value
visual check general lighthness inside the Mercur	o.k.:	<input type="checkbox"/> changed;
visual check Goldtraps	o.k.:	<input type="checkbox"/> changed;
visual check spectrometer		
cuvette	o.k.:	<input type="checkbox"/> changed;
lens	o.k.:	<input type="checkbox"/> changed;
check pump hoses	o.k.:	<input type="checkbox"/> changed;
check hoses and hose connectors	o.k.:	<input type="checkbox"/> changed;
check and clean reactor	o.k.:	<input checked="" type="checkbox"/> changed;
check drying hose output Gas-liquid-separator	o.k.:	<input type="checkbox"/> changed;
check bubble-sensor	o.k.:	<input type="checkbox"/> changed;
Check gasflow	o.k.:	not o.k.:
Valve 1	10 Nl/h	0.2284 L/min
Valve 2	50 Nl/h	1.1962 L/min
Valve 3	5 Nl/h	0.1951 L/min
Valve 4	10 Nl/h	0.2130 L/min
Check liquidflow		
Acid	2.5ml/min ± 1 ml	2.5 ml
Red-agent	2.5ml/min ± 1 ml	2.5 ml
Sample	10ml/min ± 2 ml	10.0 ml
Adventitious light - values	from file	
100	0	0
200	0	0
300	0	0
350	0	0
400	0	0
450	3	1
500	2	2
550	15	6
575	21	13
600	30	19
		27.

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Device parameter	nominal value	actual value
Analytical parameters		
Conditions.: max conc.: 10µg/L PMT-voltage: 4/14 V		
Blank-solution without enrichment / FBR 30 ng/L	F > 0.0013 RSD < 3 %	F... 0.0033 F... 0.00377 RSD... 1.51 %
Conditions.: max conc.: 1.7µg/L PMT-voltage: 395 V		
Blank-solution with enrichment / FBR 30 ng/L	F > 0.009 RSD < 3 %	F... 0.00299 F... 0.00297 RSD... 0.232 %
Fok - factor (F ₂ / F ₁)	> 4	
Comments	Reference Material Control. Mercury Calibration Std. Ref # : 8800-6941 Lot # : 12-20 HGVZA.	

Signature: *Patheeraya H.*
 Signature Technician

9/6/2021
 Place, Date (DDMMYYYY)

Signature: *Patheeraya H.*
 Signature Customer

9/6/2021
 Place, Date (DDMMYYYY)