

ภาคผนวกที่ 4

ใบรับรองการสอบเทียบเครื่องมือ

METHOD 5 PRE-TEST CONSOLE CALIBRATION
USING REFERENCE METER # WET TEST METER W-NK5A No. 540961
5-POINT METRIC UNIT

Meter Console Information	
Console Model Number	XC572V
Console Serial Number	0509047
DGM Model Number	SK25
DGM Serial Number	8001032

Calibration Conditions			
Date	Time	24-Feb-22	8:30 AM
Calibration Reference No.		HC65APE0023	
Barometric Pressure		758	mm Hg
Calibration Meter Gamma		0.9980	unitless

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

Calibration Data									
Run Time		Metering Console				Calibration Meter			
Elapsed	DGM Orifice ΔH	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final
(Θ)	(P_m)	(V_{mi})	(V_{mf})	(t_{mi})	(t_{mf})	(V_{wi})	(V_{wf})	(t_{wi})	(t_{wf})
min	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C	°C
15.00	13.0	3826.4749	3826.6201	26	26	268.44500	268.59380	26	26
10.00	25.0	3826.6500	3826.7934	26	26	268.61426	268.76088	26	26
8.00	50.0	3826.8148	3826.9870	26	26	268.77850	268.95544	26	26
7.00	80.0	3827.0198	3827.2147	26	26	268.98871	269.19091	26	26
5.00	120.0	3827.5000	3827.6865	26	26	269.19122	269.38615	26	26

Results								
Standardized Data				Dry Gas Meter				
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate	ΔH @	
($V_{m(std)}$)	($Q_{m(std)}$)	($V_{w(std)}$)	($Q_{w(std)}$)	Value	Variation	Std & Corr	.0212 m ³ _{std} /min	Variation
m ³	m ³ /min	m ³	m ³ /min	(Y)	(ΔY)	($Q_{m(std)(corr)}$)	($\Delta H @$)	($\Delta \Delta H @$)
m ³	m ³ /min	m ³	m ³ /min			m ³ /min	mm H ₂ O	
0.142	0.009	0.145	0.010	1.021	-0.002	0.010	61.378	12.190
0.140	0.014	0.143	0.014	1.018	-0.006	0.014	54.157	4.969
0.169	0.021	0.173	0.022	1.021	-0.003	0.022	47.830	-1.358
0.192	0.027	0.197	0.028	1.027	0.004	0.028	45.127	-4.061
0.184	0.037	0.190	0.038	1.031	0.007	0.038	37.447	-11.741
				1.024	Y Average		49.188	$\Delta H @$ Average

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 .

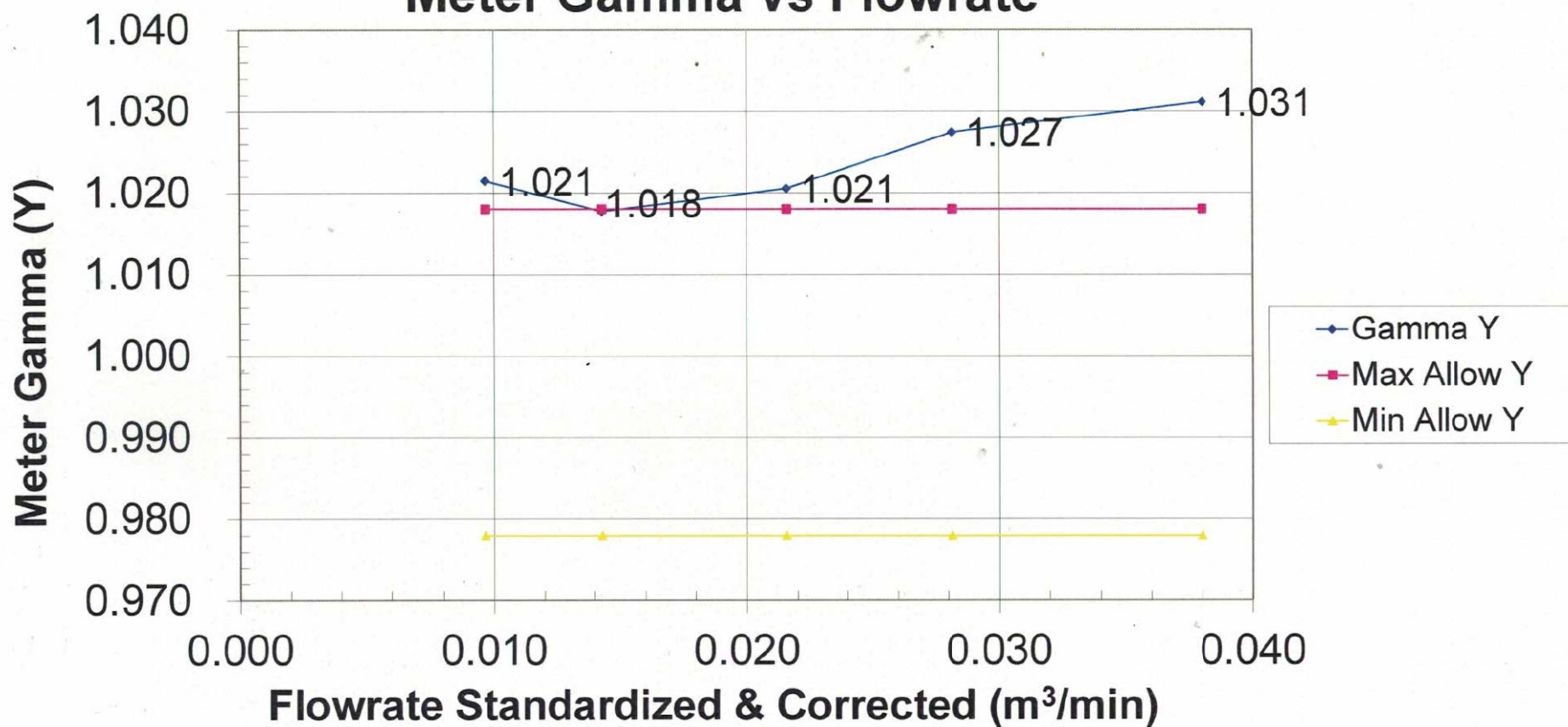
Note: For $\Delta H @$, orifice pressure differential that equates to 0.75cfm (0.0212m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 0.2 inches (5.1mm) H₂O.

Signature _____ **SITHIPHORN ASSOCIATES COMPANY LIMITED** Date 24/02/2022
Service Engineer

Calibration Date: 24-2-2022

Calibration Reference No: HC65APE0023

Meter Gamma vs Flowrate



Console Serial: 0509047

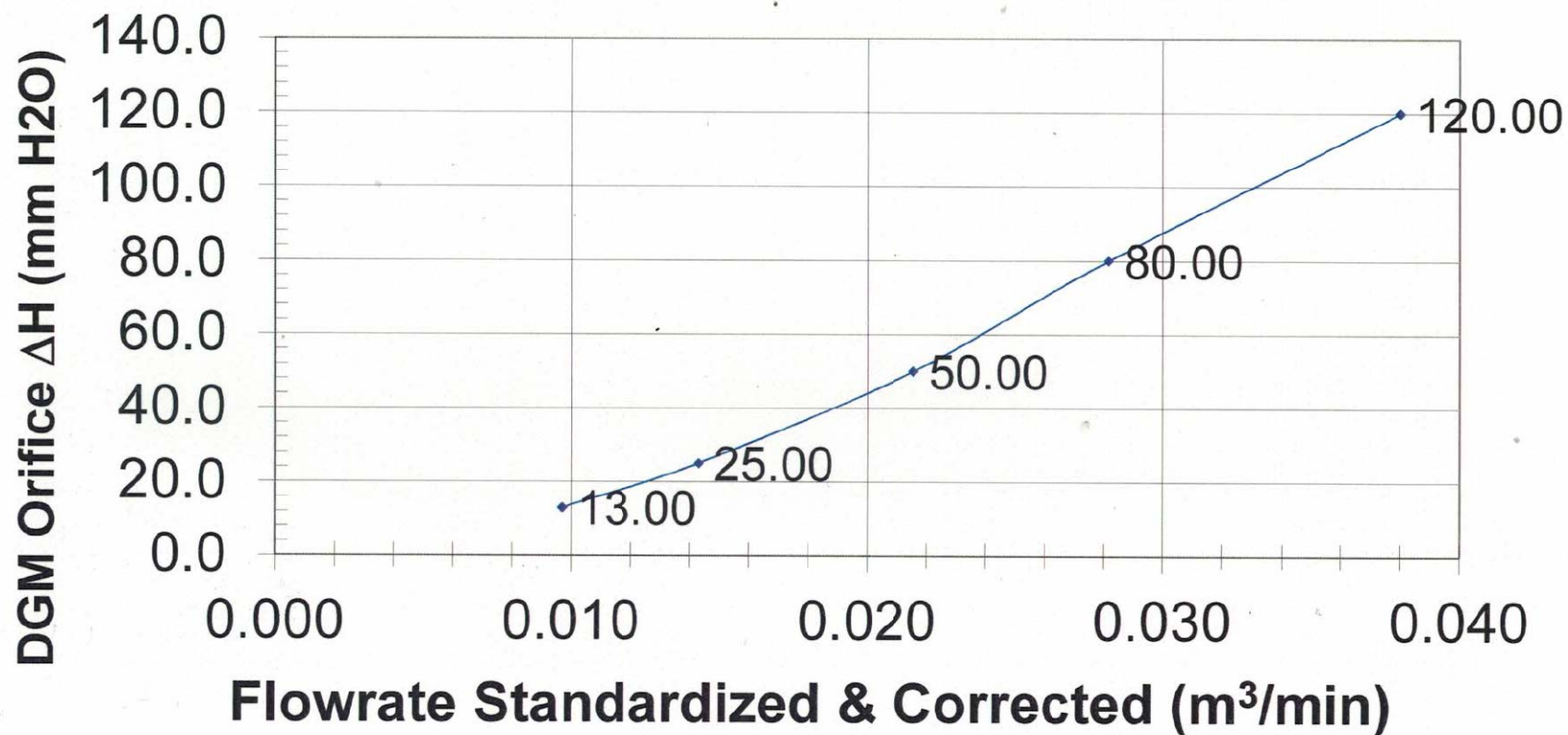
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SITHIPORN ASSOCIATES COMPANY LIMITED

Console Model: XC572V

Calibration Date: 24-2-2022

Calibration Reference No: HC65APE0023

Meter Pressure vs Flowrate



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Console Serial: 0509047

Console Model: XC572V

HEATER SYSTEM CALIBRATION

Sampling System Equipment Information	
Console Model Number	XC572V
Console Serial Number	0509047
DGM Model Number	SK25
DGM Serial Number	8001032
Probe Heater	Standard Method 5 Assemblies
Heated Filter Box	SB-2-V

Calibration Conditions			
Date	Time	24-Feb-22	8:30 AM
Calibration Reference No.	HC65APE0023		
Barometric Pressure	758	mm Hg	

Results				
System Heat	Control Acceptance	Reference thermometer temperature	Thermocouple potentiometer temperature	Temperature difference
	°C	°C	°C	°C
Probe Heater System for 5ft. Probe	120 °C ± 14 °C	121	120.5	0.13
Heated Filter Box	120 °C ± 14 °C	121	120	0.25

Note: Check Acceptance Limits, capable of maintaining 120 °C ± 14 °C at 20-lpm flow rate

Signature _____

Service Engineer

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THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information	
Console Model Number	XC572V
Console Serial Number	0509047
DGM Model Number	SK25
DGM Serial Number	8001032
Meter Box Model Number	JENCO 765
Meter Box Model Number	REX-C100

Calibration Conditions			
Date	Time	24-Feb-22	8:30 AM
Calibration Reference No.		HC65APE0023	
Barometric Pressure		758	mm Hg
Reference Thermometer		FLUKE 714	
Serial Number		9038005	

Results												
Console Thermocouple Simulator												
Channel and test point	Meter Box Channel Temperature Reading (°C)											
	0.0	25.0	38.0	93.0	149.0	260.0	371.0	482.0	593.0	816.0	1038.0	
Stack	0	25	38	94	152	260	371	485	596	818	1041	
Probe	0	25	38	94	151							
Filter	0	25	38	94	151							
Aux	0	25	38	94	152							
Exit	0	25	38									
Meter	0	25	38									

Tolerance Range

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

Aux + 3.0 °C
Exit + 2.0 °C
Meter ± 2.0 °C

Note. Cabel socket temp probe wrong + -

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Service Engineer

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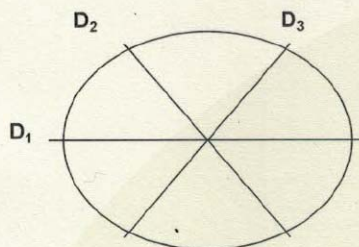
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NOZZLE CALIBRATION

Samplig System Equipment Information		Inspection Conditions			
Console Model Number	XC572V	Date	Time	24-Feb-22	8:30 AM
Console Serial Number	0509047	Calibration Reference No.	HC65APE0023		
DGM Model Number	SK25	Barometric Pressure	758	mm Hg	
DGM Serial Number	8001032	Calibration	Vernier ,0-150mm	0.01 mm increments	
		Method Reference	US.EPA Method		

Inspection 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	3.04	3.04	3.03	0.006	3.037
5	4.0	4.01	4.01	4.00	0.006	4.007
8	6.4	5.99	5.89	6.04	0.076	5.973
10	8.0	7.58	7.53	7.50	0.040	7.537
12	9.5	9.38	9.37	9.46	0.049	9.403
14	11.1	11.01	11.02	11.12	0.061	11.050
16	12.7	12.43	12.49	12.52	0.046	12.480

D1, D2, D3 = There difference nozzle diameters at 60 degrees to each other,
each measured to the nearest 0.025 mm
ΔD = Maximum difference between any two diameters, must be ≤ 0.100 mm
Davg = $(D_1 + D_2 + D_3) / 3$



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TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	May 14, 2021
Project Site				Start Time	10:30 AM
Sampler Number	TSP No.10	Transfer Standard Type	Orifice	Stop Time	10:35 AM
Motor Serial Number	BL-10	Calibrator Model	TE-5025A	Person	Mr.Preecha Srisuk
Recorder Serial Number	-	Calibrator Serial Number	1		

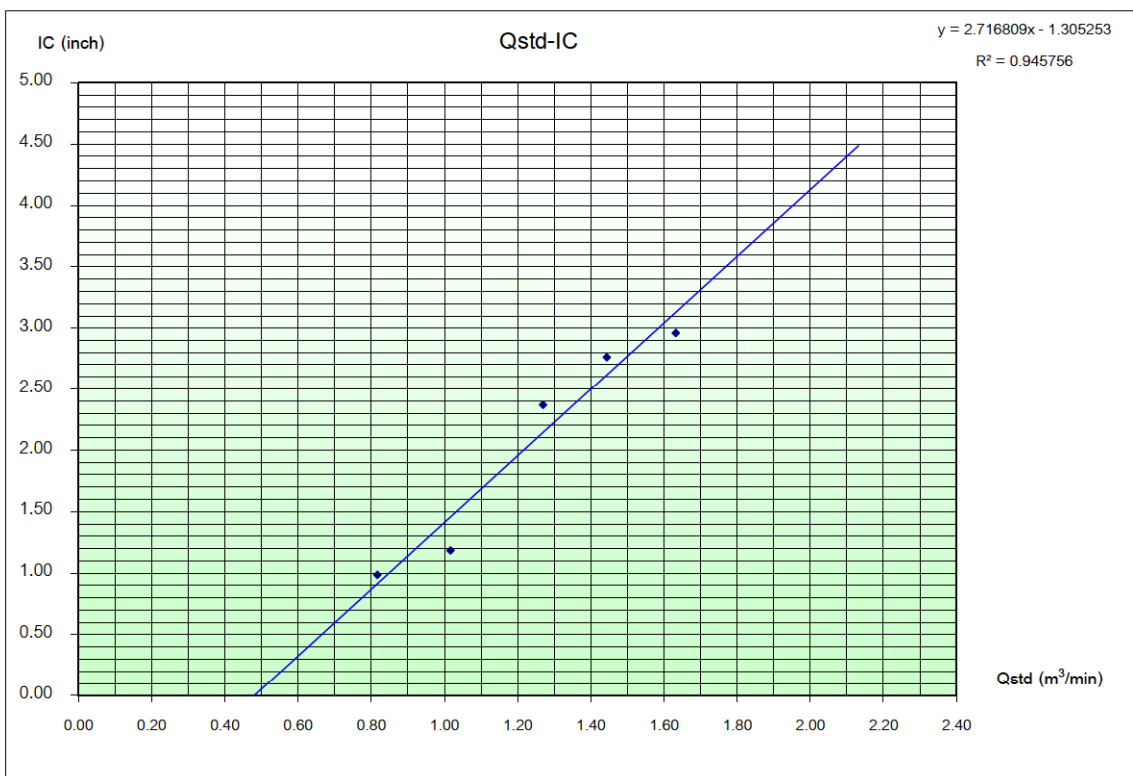
Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric	Start	Stop
	Positive	Negative	ΔH_2O	$[\Delta H_2O(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ (m ³ /min)	Sample Flow Rate Indication (inch)	$IC = [(Pa/P_{std})(T_{std}/T_a)]^{1/2}$ (°K = °C+273)	(°K = °C+273)	Pressure (mmHg)	Meter	Meter
5	1.3	1.3	2.6	1.59069	0.81683	1.0	0.99	305.0	757.0		
7	2.0	2.0	4.0	1.97301	1.01664	1.2	1.18	305.0	757.0		
10	3.1	3.1	6.2	2.45638	1.26925	2.4	2.37	305.0	757.0		
13	4.0	4.0	8.0	2.79026	1.44374	2.8	2.76	305.0	757.0		
18	5.1	5.1	10.2	3.15064	1.63209	3.0	2.96	305.0	757.0		

Linear Regression Y ON X : Y= mX + b

		Average		305.0	757.0		
1	Slope (m)	1.91345	Linear Equation		r ²	0.945756	Pstd(mmHg) 760.0
2	Intercept (b)	0.02773	Set Point Flow Rate (X) (m ³ /min)	1.133	r	0.9724987	T _{NTP} 298.0
3	Correlation Coefficient (r)	0.99995	Final Set Flow Rate = (I)	0	(Pa/Pstd)*(Tstd/Ta)		0.973192407
Result	C=(Pa/Pstd)*(Tstd/Ta)^0.5						0.986505148

COMMENT

Andersen Instruments, Inc.	
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Calibrated By

Field Environmental

Division Manager

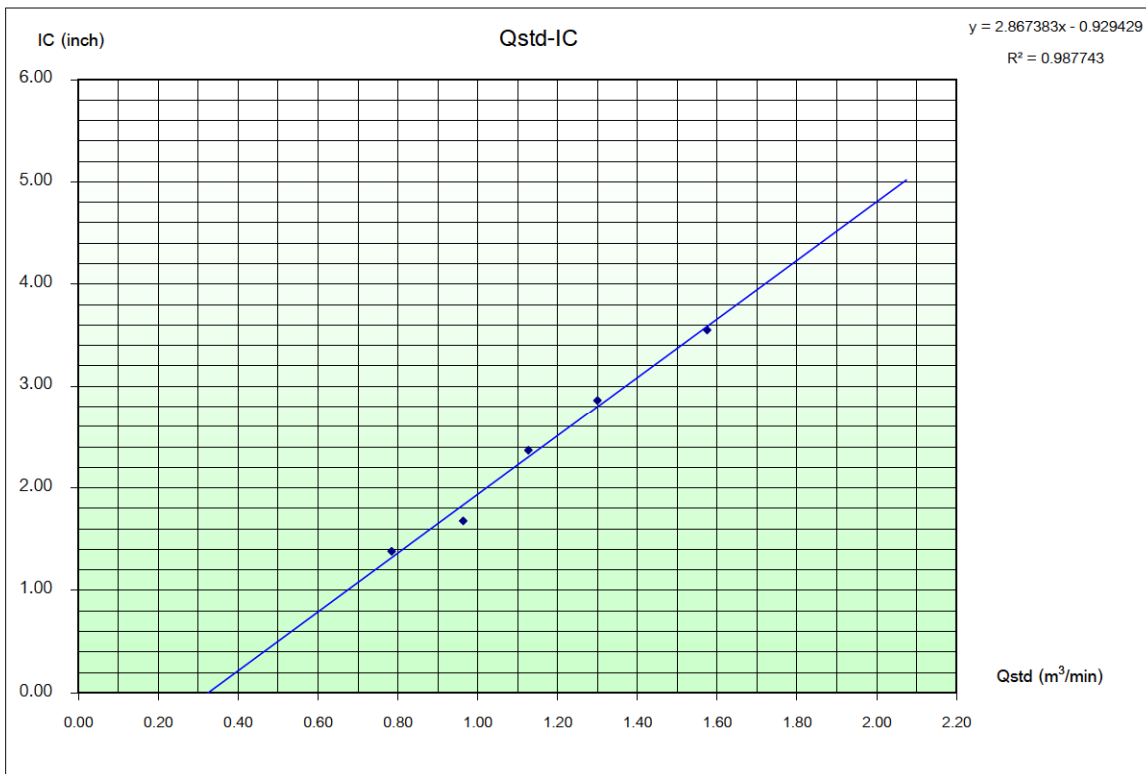
PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	May 14, 2021
Project Site				Start Time	11:30 PM
Sampler Number	PM-10 No.1	Transfer Standard Type	Orifice	Stop Time	11:35 PM
Motor Serial Number	HVL-01	Calibrator Model	TE-5025A	Person	Mr.Preecha Srisuk
Recorder Serial Number	-	Calibrator Serial Number	1		

Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter	
	Pressure Drop Across Orifice (inH ₂ O)			$[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$	$Qstd = (1/m)[(A-b)]$	Sample Flow Rate Indication	$IC = [(Pa/P_{std})(T_{std}/Ta)]^{1/2}$					
	Positive	Negative	ΔH_2O		(m ³ /min)	(inch)		(°K = °C+273)	(mmHg)			
5	1.2	1.2	2.4	1.52829	0.78422	1.4	1.38	305.0	757.0			
7	1.8	1.8	3.6	1.87176	0.96372	1.7	1.68	305.0	757.0			
10	2.4	2.5	4.9	2.18372	1.12676	2.4	2.37	305.0	757.0			
13	3.2	3.3	6.5	2.51510	1.29994	2.9	2.86	305.0	757.0			
18	4.7	4.8	9.5	3.04061	1.57458	3.6	3.55	305.0	757.0			
Linear Regression: Y ON X : Y= mX + b							Average	305.0	757.0			
1	Slope (m)			1.91345	Linear Equation			r ²	0.987743	Pstd(mmHg)	760.	
2	Intercept (b)			0.02773	Set Point Flow Rate (X) (m ³ /min)		1.133	r	0.9938526	T _{NTP}	298.	
3	Correlation Coefficient (r)			0.99995	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.973192407		
Result									C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.986505148	

COMMENT

Andersen Instruments, Inc.



Calibrated By ...

Field Environmental

Division Manager

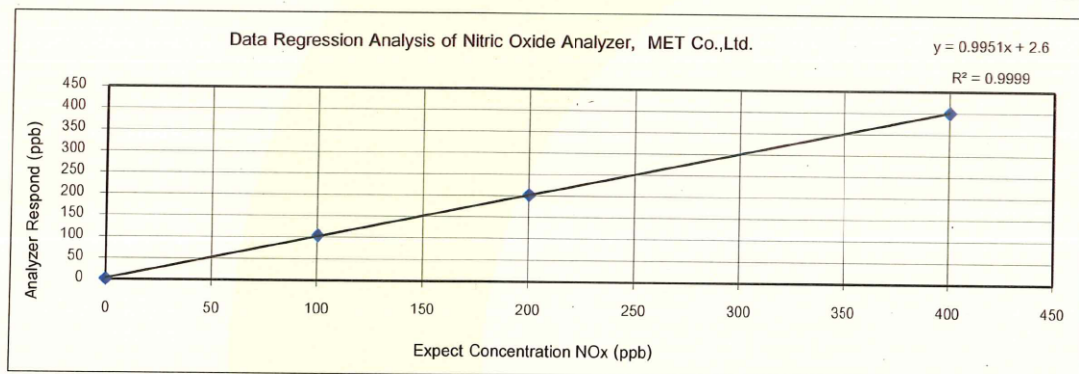
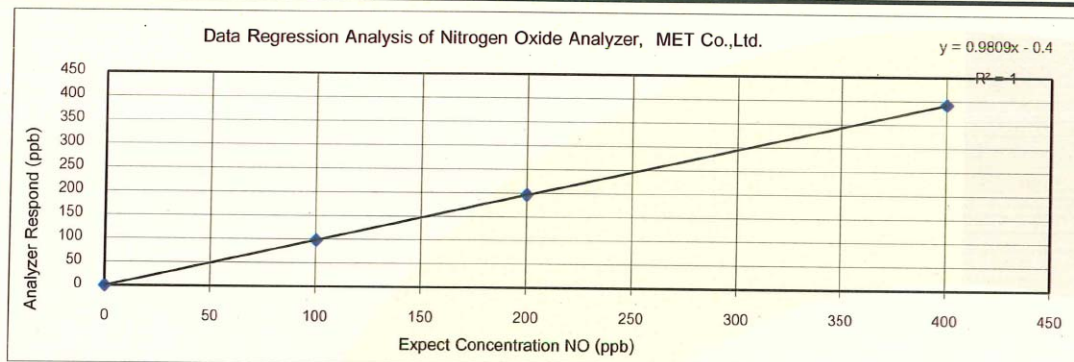
MULTIPOINT CALIBRATION

Nitrogen Oxide Analyzer

Station	MET CO.,LTD				
Brand	ECOTECH	Zero setting	0	Station Temp.	25 °C
Model	Serinus 40	Span Instrument Gain	2.63	Date	5-Jan-22
Range	500 ppb	Start Time	13:00	Span Source	Gas Cal 3000
S/N	12-1001	Finish Time	14:30		

NO Channel				
Span Set Point	Expect Concentration (ppb)	Analyzer Response (ppb)	Difference (ppb)	Percent Diff.
Zero	0	0	0	-
Point 1	400	392	-8	-2.00
Point 2	200	196	-4	-2.00
Point 3	100	97	-3	-3.00
Average Difference (%)				-2.33
Slope = 1.0055		Intercept = 0.5221		Correlation Coefficient = 1.000

NO _x Channel				
Span Set Point	Expect Concentration (ppb)	Analyzer Response (ppb)	Difference (ppb)	Percent Diff.
Zero	0	1	1	-
Point 1	400	400	0	0.00
Point 2	200	202	2	1.00
Point 3	100	104	4	4.00
Average Difference (%)				1.67
Slope = 0.996		Intercept = 2.1211		Correlation Coefficient = 1.000



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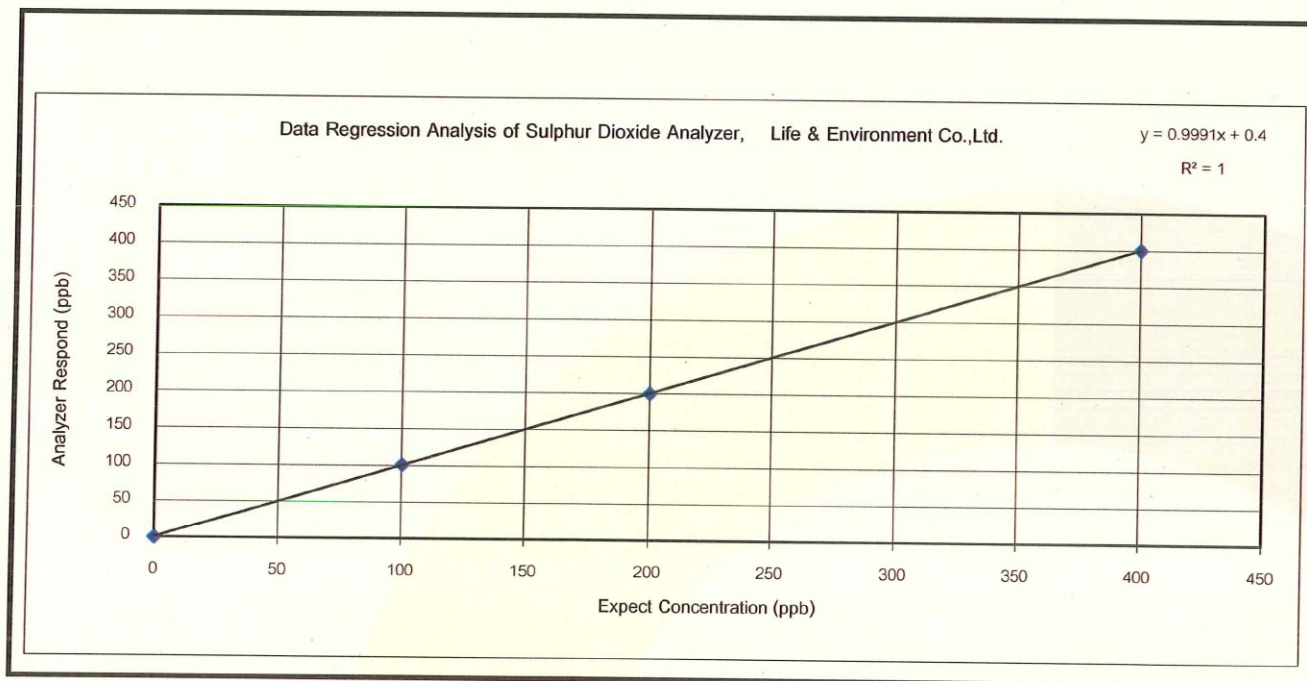
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MULTIPOINT CALIBRATION

Sulphur Dioxide Analyzer

Station	MET CO.,LTD				
Brand	ECOTECH	Zero setting	0	Station Temp.	25 °C
Model	Serinus 50	Span Instrument Gain	30.57	Date	5-Jan-22
Range	500 ppb	Start Time	13:00	Span Source	Gas Cal 3000
S/N	12-1402	Finish Time	14:30		

Span Set Point	Expect Concentration (ppb)	Analyzer Response (ppb)	Difference (ppb)	Percent Diff.
Zero	0	0	0	-
Point 1	400	400	0	0.00
Point 2	200	200	0	0.00
Point 3	100	101	1	1.00
Average Difference (%)				0.33
Slope = 1.0015		Intercept = 1.0027		Correlation Coefficient = 1.000



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MAINTENANCE AND IPV TEST CERTIFICATE MODEL

OPTIMA 8000

Customer : <u>M E T CO.,LTD.</u>	Date Tested: <u>October 6, 2021</u>
Address : <u>BANGBUATHONG,</u> <u>NONTHABURI,11110</u> <u>BANGKOK 10160</u>	Recommendation Recertification Period <u>6</u> Months Recertification Due: <u>April 6, 2022</u> Date Last Certified: <u>March 4, 2021</u>
User Name: 	Visit Number: <u>2 of 2</u>
Phone: 	PerkinElmer Phone: <u>02-719-6420 ext 206</u>
E-mail : <u>laboratorymet@gmail.com</u>	PerkinElmer Fax: <u>02-318-5597</u>

CONFIGURATION TESTED		
MODEL <u>OPTIMA 8000</u>	SERIAL NUMBER <u>078S1407053C</u>	SOFTWARE <u>ICP Syngistix Version 1.0</u>
TESTED EQUIPMENT <u>IPV Method</u>	CALIBRATION NUMBER <u> </u>	EXPIRATION <u> </u>
TEST STANDARD USED <u>Multielement Standard</u> <u>Instrument Cal. STD4</u>	PART NUMBER <u>N069-1579</u> <u>N930-0221</u>	EXPIRATION DATE <u>October 30,2022</u> <u>October 30,2021</u>
CUSTOMER SUPPLIED <u>2 % HNO3</u> <u>10 % HNO3</u>	COMMENTS <u> </u> <u> </u>	CUSTOMER INITIALS <u> </u> <u> </u>

MAINTENANCE AND IPV TEST CERTIFICATE MODEL

OPTIMA 8000

SERIAL NUMBER: 078S1407053CDATE TESTED: October 6, 2021**1. MECHANICAL CHECKS**

- A. Inspect and clean all fans and filters.
- B. Inspect and replace as necessary, all torch components including the RF coil.
- C. Inspect all tubing for sign of clacking or leaking.
- D. Adjust water and gas pressure regulator settings.
- E. Inspect and leak check pneumatics drawers.
- F. Clean the exterior of the instrument.

☐ OK☐ OK☐ OK☐ OK☐ OK☐ OK**2. OPTICAL CHECKS**

- A. Inspect and clean all optical components.
- B. As required, check and replace all purgebfilters.
- C. Recheck optical alignment.

☐ OK☐ OK☐ OK**3. COOLING SYSTEM CHECKS**

- A. Perform preventive maintenance on chiller.
- B. Flush out the chiller every year.

☐ OK☐ OK**4. PERFORMANCE CHECKS**

- A. Torch View Alignment.
- B. Wavelength Calibration.

☐ OK☐ OK

MAINTENANCE AND IPV TEST CERTIFICATE MODEL

OPTIMA 8000

SERIAL NUMBER: 078S1407053C		DATE TESTED: October 6, 2021	
PARAMETER	SPECIFICATION		FINAL VALUE
Spectral Resolution : UV			
As	193.696 nm	≤ 0.009 nm	0.00697 nm
Ni	231.604 nm	≤ 0.011 nm	0.00855 nm
Ni	341.476 nm	≤ 0.015 nm	0.01287 nm
Spectral Resolution : VIS			
Ba	455.403 nm	≤ 0.020 nm	0.01541 nm
Precision			
Zn	206.200 nm	% RSD ≤ 1.0 %	0.12 %
Mg	280.271 nm	% RSD ≤ 1.0 %	0.61 %
Mg	285.213 nm	% RSD ≤ 1.0 %	0.22 %
Ba	455.403 nm	% RSD ≤ 1.0 %	0.08 %
Detection Limits : Axial			
Tl	190.801 nm	3(sd)	6.31 ppb
As	193.696 nm	3(sd)	6.72 ppb
Se	196.026 nm	3(sd)	2.13 ppb
Pb	220.353 nm	3(sd)	5.21 ppb
Detection Limits : Radial			
As	193.696 nm	3(sd)	2.74 ppb
Zn	213.857 nm	3(sd)	0.54 ppb
Mn	257.610 nm	3(sd)	0.21 ppb
La	379.478 nm	3(sd)	0.13 ppb
Ba	455.403 nm	3(sd)	0.05 ppb
Ba	493.408 nm	3(sd)	0.04 ppb
BEC : Axial (IB X 1000)/(IS-IB)			
Mn	257.610 nm	≤ 30 ppb	10.46 ppb
BEC : Radial (IB X 1000)/(IS-IB)			
Mn	257.610 nm	≤ 30 ppb	10.44 ppb



MAINTENANCE AND IPV TEST CERTIFICATE MODEL
OPTIMA 8000

SERIAL NUMBER: 078S1407053C

DATE TESTED: October 6, 2021

Remarks :

Test all pass

This is to certify that the above tests have been performed and the configuration tested



meets



does not meet

the PerkinElmer Specifications listed on this certificate.

This certificate does not modify PerkinElmer's standard terms and condition of sale,
including warranty terms.

Service Department PerkinElmer Ltd.

Customer Service Engineer:



Service Engineer



National Institute of Metrology (Thailand)

Certificate of Calibration



Certificate No. : AA-2013-21
Issued by : Acoustics Laboratory
Acoustics and Vibration Group

Page 1 of 5 pages

MEASUREMENT ITEM : Sound Calibrator
MANUFACTURER : RION
MODEL/TYPE : NC-75
SERIAL NUMBER : 34480442
CUSTOMER : MET Co., Ltd.
36/659 Moo 6, T. Bangrakphatthana,
Bangbuathong, Nonthaburi 11110
MEASUREMENT DATE : 6 September 2021

*The calibration results only marked with an asterisk * in this certificate are not included in Appendix C of the MRA drawn up by the CIPM.*

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%. This calibration certificate may not be reproduced other than in full except with the permission of the Director of National Institute of Metrology (Thailand).

Reference
AUV084-01/21

Date
6 September 2021

Authorized Signatory

Person in charge

This certificate is consistent with the capabilities that are included in Appendix C of the MRA drawn up by the CIPM. Under the MRA, all participating institutes recognize the validity of each other's calibration and measurement certificates for the quantities, ranges and measurement uncertainties specified in Appendix C (for details see <http://www.bipm.org>).

National Institute of Metrology (Thailand)

Ministry of Higher Education, Science, Research and Innovation

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UNCERTAINTY OF MEASUREMENT

The stated uncertainty is the expanded uncertainty obtained by multiplying the standard uncertainty by the coverage factor $k=2$. It has been determined in accordance with EA publication EA-4/02 M:2013 "Evaluation of the Uncertainty of Measurement in Calibration" and JCGM 100:2008 "Evaluation of measurement data --Guide to the Expression of Uncertainty in Measurement (GUM 1995 with minor corrections)". The value of the measured lies within the assigned range of value with a probability of 95 %.

Parameter	Uncertainty at SPL94 dB	Maximum-permitted uncertainty of measurement for a coverage probability of 95%
1.Sound Pressure level	0.08	0.15
2. Frequency	0.1	0.2
3. THD+N	0.2	0.5

TRACEABILITY

This certificate provides traceability of measurement to recognized national standards, and to the realization of the International System of Units (SI).



ENVIRONMENTAL CONDITIONS

Ambient condition in the laboratory are as follows :

Temperature : (23.0 ± 1.0) °C
Pressure : (101.325 ± 1.500) kPa
Relative Humidity : (50.0 ± 15.0) %

Reference Condition : 101.325 kPa , 23.0 °C and 50.0 %RH.

Calibration Condition

Preconditionings : 16 hours at ambient conditions.

Measurement Con : The average values during measurement are

(100.965 ± 0.013) kPa, (22.3 ± 0.3) °C and (62.2 ± 2.6) %RH

MEASUREMENT METHOD

The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference microphone. The insert voltage technique was employed and the measurement procedure was based on IEC 60942-2017.

Reference Microphone

B&K Type 4180 serial no.1395446

TABULATION OF RESULTS

The following tables give the calibration results and associated measurement uncertainties at 95% of confidence level. The calibration results of sound pressure level which quoted in dB with reference to 20 µPa are corrected to the values under the reference environmental conditions.

The microphone volume corrections and the calibrator pressure corrections are excluded in the calibration results.



MEASUREMENT RESULTS

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value ^[1] (dB)	Acceptance Limit (dB)
Microphone 4180 Serial No.1395446			
94	94.12	0.12	0.25

Note ^[1] : The deviated value is the absolute value of the difference between the measured value and the corresponding specified sound pressure level.

2. Frequency*

Specified Frequency (Hz)	Measured value (Hz)	Deviated value ^[2] (%)	Acceptance Limit (%)
At the sound pressure level of 94 dB			
1000	1000.0	0.0	0.7

Note ^[2] : The deviated value is the absolute value of the difference in percent between the measured value and the corresponding specified frequency.



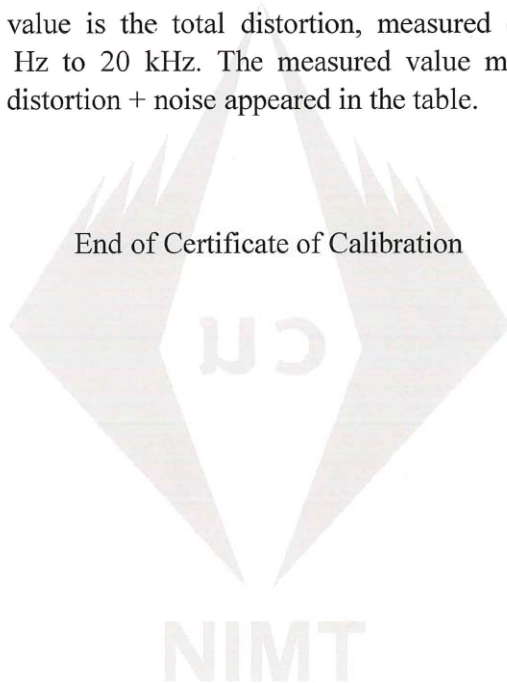
3. Total distortion + Noise*

Microphone 4180 Serial No.1395446

Measured value ^[3] (%)	Maximum total distortion + Noise (%)
At the sound pressure level of 94 dB	
1.5	2.5

Note ^[3]: The measured value is the total distortion, measured over the frequency range from 20 Hz to 20 kHz. The measured value must not exceed the maximum total distortion + noise appeared in the table.

End of Certificate of Calibration





Certificate of Calibration

Certificate Number : SPR21120189-2

Page : 1 of 3

Customer : MET CO.,LTD.

36/659 Moo. 6 Tambol Bangragpattana, Amphur Bangbuatong,
Nonthaburi 11110

Equipment Name : Sound Level Meter

Manufacturer : Rion

Model : NL-21

Serial Number : 00722043

ID. Number : SLM-45

Environmental Conditions

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

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

Location of Calibration : In-Lab

Calibration Procedure : SP-CPE-04-01

Received Date : 13 Dec 2021

Calibration Date : 13 Dec 2021

Recommend Due Date : 13 Dec 2022

Date of Issue : 14 Dec 2021

Method of Calibration

This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure. Standards used to perform this calibration are certified by to NIST or equivalent, National metrology institute, Natural physical constants, consensus standards. The result reported herein apply only to the calibration of the item described above as received. Our decision rule is to contact the customer if the item pass and fail calibration when the results include the uncertainties and the customer must determine if the results meets their needs.

All calibrations are performed within manufacture's specifications. The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by :



Authorized Signatory



Calibration Report

Certificate Number : SPR21120189-2

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Sound Level Calibrator	SC-942	B014059	EEL.BP.19/1063	15 Oct 2022

Traceability

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

TISTR - Thailand Institute of Scientific and Technological Research



Result of Calibration

Certificate No. : SPR21120189-2

Page : 3 of 3

Range : 94 to 114 dB

Function : @1kHz

Select A

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.0	94.0	0.0	0.0	0.15
114	114.1	114.1	0.1	0.1	0.15

Select C

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.0	94.0	0.0	0.0	0.15
114	114.1	114.1	0.1	0.1	0.15

Select F

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.1	94.1	0.1	0.1	0.15
114	114.1	114.1	0.1	0.1	0.15

Note:

The result of calibration was found accurate as show on date and place of calibration only.
This Certificate is not certified for any commercial transaction.

Measurement Uncertainty

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

- End of Certificate -



Certificate of Calibration

Certificate Number : SPR21120189- 1

Page : 1 of 3

Customer : MET CO.,LTD.

36/659 Moo. 6 Tambol Bangragpattana, Amphur Bangbuatong,
Nonthaburi 11110

Equipment Name : Sound Level Meter

Manufacturer : Rion

Model : NL-21

Serial Number : 00722042

ID. Number : SLM-46

Environmental Conditions

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

Received Date : 13 Dec 2021

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

Calibration Date : 13 Dec 2021

Location of Calibration : In-Lab

Recommend Due Date : 13 Dec 2022

Calibration Procedure : SP-CPE-04-01

Date of Issue : 14 Dec 2021

Method of Calibration

This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure. Standards used to perform this calibration are certified by to NIST or equivalent, National metrology institute, Natural physical constants, consensus standards. The result reported herein apply only to the calibration of the item described above as received. Our decision rule is to contact the customer if the item pass and fail calibration when the results include the uncertainties and the customer must determine if the results meets their needs.

All calibrations are performed within manufacture's specifications. The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by :

Authorized Signatory



Calibration Report

Certificate Number : SPR21120189- 1

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Sound Level Calibrator	SC-942	B014059	EEL.BP.19/1063	15 Oct 2022

Traceability

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

TISTR - Thailand Institute of Scientific and Technological Research



Result of Calibration

Certificate No. : SPR21120189-1

Page : 3 of 3

Range : 94 to 114 dB

Function : @1kHz

Select A

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.0	94.0	0.0	0.0	0.15
114	113.9	113.9	-0.1	-0.1	0.15

Select C

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.0	94.0	0.0	0.0	0.15
114	114.0	114.0	0.0	0.0	0.15

Select F

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.0	94.0	0.0	0.0	0.15
114	114.0	114.0	0.0	0.0	0.15

Note:

The result of calibration was found accurate as show on date and place of calibration only.
This Certificate is not certified for any commercial transaction.

Measurement Uncertainty

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

- End of Certificate -



GIIC Calibration Laboratory

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NSC-TISI-TIS 17025
CALIBRATION 0256

CERTIFICATE No.CAL01652-21..... PAGE1..... OF3.....

Certificate of Calibration

Equipment : DIGITAL LIGHT METER

Manufacturer : DIGICON

Model / Type : LX-73

Serial No. : T.017761


ID No. : -


Customer : M E T CO., LTD.
36/659 Moo 6 T.Bangrakpattana A.Bangbuathong Nonthaburi
11110.

C.S.R. No. : L0001697-21

Received Date : 15 December 2021

Calibration Date : 17 December 2021

Calibrated By : 

Approved By : 

Issue Date : 18 December 2021

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

This certificate may not be reproduced except in full unless permission for the reproduction has been obtained in writing from the laboratory.

CERTIFICATE No.: CAL01652-21

PAGE : 2

OF: 3

CALIBRATION REPORT

Condition of this calibration result :

1. Environment : Temperature : $(23 \pm 3) ^\circ\text{C}$
 Relative Humidity : $(50 \pm 15) \%$

2. Reference / Procedure Used :

- This Instrument was calibrated by substitution with reference illuminance meter, the Instrument and reference illuminance meter were mounted with the plane of its diffuser vertical and normal to the direction of measurement. Calibration was illuminated by the luminous standard lamp (operated at colour temperature 2856K) according to GIIIC Calibration Laboratory calibration procedure No.GIIICLAB-CP-L01.

3. Reference Standard Instrument :

Instrument	Model	Serial No	Certificate No	Due Dated
Illuminance meter	PMA2200 / PMA2130	25531 / 025000	TP-1010-21	27 May 22

4. This Certification is traceable to the SI unit through :

- The National Institute of Metrology (Thailand) .

5. Uncertainty :

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



CALIBRATION REPORT

All data shown below were as received value : Without adjustment

Calibration result :

Function: Illuminance Measurement

U.U.C. Range (lux)	Standard Setting (lux)	U.U.C. Reading (lux)	Error (lux)	Uncertainty of measurement \pm (lux)
400	0	0.0	0.0	0.60
	50	49.4	-0.6	1.6
	250	242.1	-7.9	6.5
4000	500	504	4	13
	1000	1012	12	26
	1500	1515	15	36
	2000	2017	17	48
	3000	3007	7	72
40000	4000	4000	0	96
	5000	5010	10	0.12 klux

- U.U.C. = Unit Under Calibration

This result of calibration was found accurate as show on data and place of calibration only.

- END -

Certificate of Calibration

Certificate No. : 65-420003-2

Page : 1 of 2

Submitted by : M E T Company Limited
36/659 Moo 6, T. Bangrakpattana, A. Bangbuatong, Nonthaburi 11110

Equipment : pH Meter with electrode
pH meter
Manufacturer : Thermo Scientific Model : pH 150
Range : N/A pH Resolution : 0.01 pH
Serial No. : 2913288 ID No. : MET-PH05/63
Electrode
Model : N/A Serial No. : 48393

Environment : Ambient Temperature : $(25 \pm 2) ^\circ \text{C}$
Relative Humidity : $(50 \pm 15) \%$

Date of Received : 13 January 2022

Date of Calibration : 19 January 2022

Date of Issue : 19 January 2022

Calibrated by : Bunjerd Masri

Calibration Method : In-house method CAL-M4201 direct measurement by using standard voltage calibrator and using certified reference material (CRM)

Reference Standard Instruments : This certification is traceable to the International System of Units

1. Multiproduct Calibrator

ID No.	Cert. No.	Due Date	Traceability
440001	21E997	17 Mar 2023	National Institute of Metrology Thailand (NIMT)

2. Standard Buffer Solution

pH	Cert. No.	Lot No.	Exp. Date	Traceability
4.004	61218215	769926	15 May 2022	CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025
6.985	61223875	769927	15 May 2022	CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025
9.963	61208865	769928	15 May 2022	CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025

Approved by

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 65-420003-2

Page : 2 of 2

Result of Calibration :

UUC Condition As-Received : Good

Function : Electrical measurement

pH meter

Performing standard curve by Multiproduct Calibrator at pH (4,7,10)

Adjustment Curve at nominal pH	Applied Voltage (mV)	Nominal Value (pH)	UUC Reading		Correction (mV)	Uncertainty (± mV)
			(pH)	(mV)		
4, 7, 10	177.4800	4	4.00	177.5	0.0	0.060
	0.0000	7	7.00	0.2	-0.2	0.058
	-177.4800	10	10.00	-177.2	-0.3	0.060

Function : pH meter with electrode

Performing a three - buffer standard curve using buffer nominal pH (4,7,10)

Adjustment Curve at nominal pH	Standard Buffer (pH)	UUC Reading (pH)	Correction (pH)	Uncertainty (± pH)
4, 7, 10	4.004	4.01	0.00	0.011
	6.985	7.00	-0.01	0.011
	9.963	10.01	-0.04	0.016

Remark

UUC : Unit Under Calibration

This result of calibration was found accurate as shown on date and place of calibration only.

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

- oOo -



Certificate of Calibration

Certificate No. : 65-400021-2

Page : 1 of 2

Submitted by : M E T Company Limited
6/659 Moo 6, T. Bangrakpattana, A. Bangbuatong, Nonthaburi 11110

Equipment : Digital Thermometer with Thermistor Probe
Temperature Indicator

Manufacturer : Thermo Scientific

Model : pH 150

Range : N/A

Resolution : 0.1 °C

Serial No. : 2913288

ID No. : MET-PH05/63

Thermistor Probe

Model : PHWPTM01W

Sheath Material : Stainless

Diameter : 3 mm.

Length : 85 mm.

Serial No. : 459

ID No. : MET-PH05/63

Environment : Ambient Temperature : (23 ± 2) °C
Relative Humidity : (50 ± 15) %
Line Voltage : (220 ± 22) VAC

Date of Received : 13 January 2022

Date of Calibration : 19 January 2022

Date of Issue : 19 January 2022

Calibrated by : Chortip Samchusri

Calibration Method : This instrument was calibrated by In-house method comparison technique CAL-M4003 by compared with PRT in the liquid bath at the constant controlled temperature.

The temperature scale used was based on ITS-90


Reference Standard Instruments : This certification is traceable to the International System of Units

1. Platinum Resistance Thermometer (PRT)

ID No.	Cert. No.	Due Date	Traceability
400001	TT-0016-20	04 Mar 2022	National Institute of Metrology Thailand (NIMT)

2. Standard Digital Thermometer

ID No.	Cert. No.	Due Date	Traceability
400003	21E1850	14 Jun 2023	National Institute of Metrology Thailand (NIMT)
400004	21E1850	14 Jun 2023	National Institute of Metrology Thailand (NIMT)

Approved by : 

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 65-400021-2

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

Immersion Depth (mm.)	Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
85	10.0024	10.1	-0.1	0.11
85	50.0038	50.4	-0.4	0.11

Remark

UUC : Unit Under Calibration

This result of calibration was found accurate as shown on date and place of calibration only.

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

- o()o -



www.calibratech.co.th

Certificate of Calibration

Certificate No. : 64-400425-5

Page : 1 of 2

Submitted by : M E T Company Limited

36/659 Moo 6, T.Bangrakpattana, A.Bangbuatong, Nonthaburi 11110

Equipment : Air Chamber (Incubator)

Manufacturer : M-LAB

Model : BIC-140

Range : N/A °C

Resolution : 0.1 °C

Serial No. : 240412

ID No. : MET-BI01/55

Environment : On site calibration was carried out at the Laboratory, M E T Company Limited

Ambient Temperature : (31.0 to 33.0) °C

Relative Humidity : (50 to 55) %

Line Voltage : (210.0 to 210.8) V

Date of Received : 23 August 2021

Date of Calibration : 23 August 2021

Date of Issue : 23 August 2021

Calibrated by : Permpon Chanpu

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

Reference Standard Instruments : This certification is traceable to the International System of Units

Standard Digital Thermometer with Thermocouple probe

ID No.

Cert. No.

Due Date

Traceability

400029 & 400032 64-400106-1

30 Sep 2021

National Institute of Metrology Thailand (NIMT)

Approved by :



Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 64-400425-5

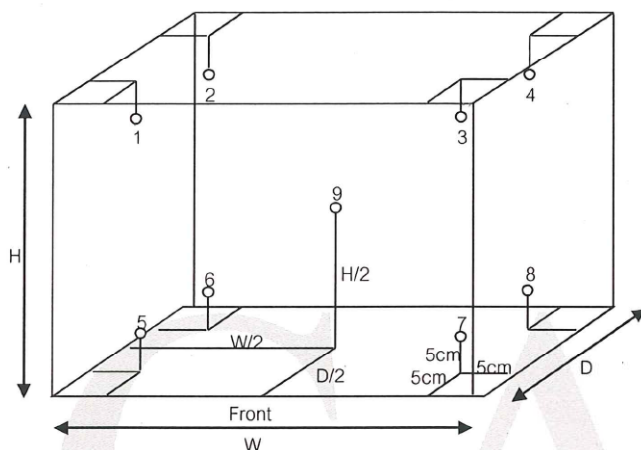
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

This instrument was setting air ventilation at position 0 (close)



Inside of Chamber

W = 0.37 m

D = 0.33 m

H = 1.14 m

Capacity = 0.14 m³

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.									Uncertainty (± °C)
			1	2	3	4	5	6	7	8	9	
20.0	20.0	20.0	19.9	19.8	19.7	19.5	20.4	20.4	20.3	20.1	20.4	0.57

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
20.0	20.0	20.0	1.0	0.1	1.0

Remark The uncertainty is not combine uniformity of the air chamber

This result of calibration was found accurate as shown on date and place of calibration only.

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

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Certificate of Calibration

Certificate No. : 64-400425-7

Page : 1 of 2

Submitted by : M E T Company Limited

36/659 Moo 6, T.Bangrakpattana, A.Bangbuatong, Nonthaburi 11110

Equipment : Air Chamber (Refrigerator)

Manufacturer : Sanden Intercool

Model : SRR3-0687 AR

Range : N/A °C

Resolution : 1 °C

Serial No. : SRR3675A-210400065 R

ID No. : MET-RE04/64

Environment : On site calibration was carried out at the Laboratory, M E T Company Limited

Ambient Temperature : (28.6 to 30.5) °C

Relative Humidity : (55 to 58) %

Line Voltage : (220.0 to 220.8) V

Date of Received : 23 August 2021

Date of Calibration : 23 August 2021

Date of Issue : 23 August 2021

Calibrated by : Bunjerd Masri

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

Reference Standard Instruments : This certification is traceable to the International System of Units

Standard Digital Thermometer with Thermocouple probe

ID No.

Cert. No.

Due Date

Traceability

400022 & 400028

64-400103-1

02 Sep 2021

National Institute of Metrology Thailand (NIMT)

Approved by :

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full except with the prior written approval of the Calibratech Co.,Ltd.



Certificate of Calibration

Certificate No. : 64-400425-7

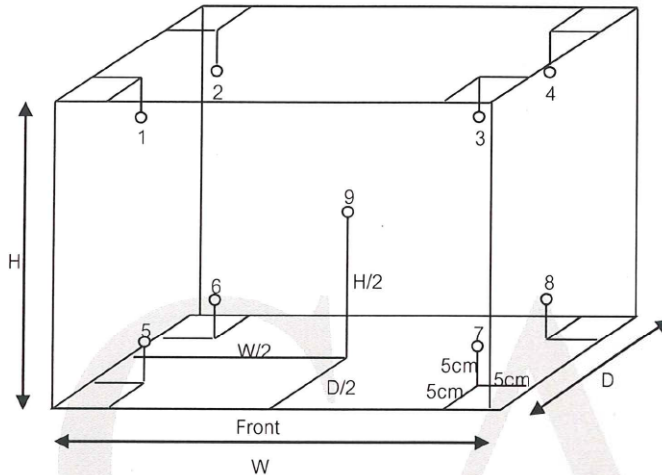
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

This instrument was setting air ventilation at position 0 (close)



Inside of Chamber

W = 0.58 m

D = 0.60 m

H = 1.45 m

Capacity = 0.50 m³

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.									Uncertainty (± °C)
			1	2	3	4	5	6	7	8	9	
3	3	3	3.5	3.6	3.4	3.2	3.1	2.7	3.1	3.0	3.1	0.83

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
3	3	3	0.6	0.2	1.4

Remark The uncertainty is not combine uniformity of the air chamber

This result of calibration was found accurate as shown on date and place of calibration only.

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

- o0o -



CERTIFICATE OF CALIBRATION

Equipment : COD Test Tube Heater

Meter Model : HI839800-02 **Serial No. :** 1021810

Manufacturer : Hanna Instruments

Made in : Romania

Condition As-Received : Used Product

Reference : RE211263

Customer name : MET Co., Ltd.
36/659 Moo. 6, Bang Rak Phatthana,
Bang Bua Thong, Nonthaburi 11110

Received date : 1 September 2021

Calibrate date : 1 September 2021

Issue date : 6 September 2021

Ambient Temperature : (25 ± 2) °C

Relative Humidity : (50 ± 15) % RH

Calibrated Location : Hanna Instruments (Thailand) Ltd.

Calibrated by :

Calibration Engineer

Authorized Signatory



This certificate was certified only for the instrument we calibrated.

This result of calibration was found accurate on date and place of calibration only.

**** This certificate may not be reproduced other than in full, except with the prior written ****

approval of the head of Hanna Instrument (Thailand)

Condition of this result of calibration**Reference Standard Instruments :**

Instruments	Model	Serial No.	Certificate No.	Traceable
Thermometer With Sensor	HI935005	03250060101	21T167	Technology Promotion Association (Thailand-Japan)

Reference / Procedure :

This equipment was calibration by comparison to the reference standard (Standard platinum resistance thermometer) whose accuracy is traceable to the national standard. The calibration was performed by generating the specified working point of temperature then recorded the temperature reading values against the reference standard according to Hanna Calibration Laboratory work Instruction No. 141.

This temperature scale used was based on ITS-90

All data shown below were as-received values without adjustment.

SITE CALIBRATION

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Result of Calibration :

Calibration Point	Unit Under Calibration Setting	Unit Under Calibration Reading	Temperature Stability	Uncertainty of Measurement
150.0 (°C)	150.2 (°C)	150.5 (°C)	1.3 (°C)	±0.40 (°C)

Calibration Point (°C)	Average Standard Reading (°C)				
	Position				
150.0	1	2	3	4	5
	149.9	150.7	150.9	151.1	150.2
	6	7	8	9	10
	150.0	149.9	150.4	150.9	150.6
	11	12	13	14	15
	150.3	150.8	151.1	150.9	150.5
	16	17	18	19	20
	149.9	149.9	150.5	151.0	150.5
	21	22	23	24	25
	150.5	150.7	150.6	150.4	149.8

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

**** End of certificate ****

Certificate of Calibration

Certificate No. : 64-400425-2

Page : 1 of 2

Submitted by : M E T Company Limited
36/659 Moo 6, T.Bangrakpattana, A.Bangbuatong, Nonthaburi 11110

Equipment : Air Chamber (Oven)
Manufacturer : Binder Model : ED53
Range : N/A °C Resolution : 1 °C
Serial No. : 13-07419 ID No. : MET-OV02/57

Environment : On site calibration was carried out at the Laboratory, M E T Company Limited
Ambient Temperature : (31.0 to 33.0) °C
Relative Humidity : (50 to 55) %
Line Voltage : (210.0 to 210.8) V

Date of Received : 23 August 2021

Date of Calibration : 23 August 2021

Date of Issue : 23 August 2021

Calibrated by : Permpon Chanpu

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

Reference Standard Instruments : This certification is traceable to the International System of Units
Standard Digital Thermometer with Thermocouple probe

ID No.	Cert. No.	Due Date	Traceability
400029 & 400030	64-400104-1	29 Sep 2021	National Institute of Metrology Thailand (NIMT)

Approved by

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 64-400425-2

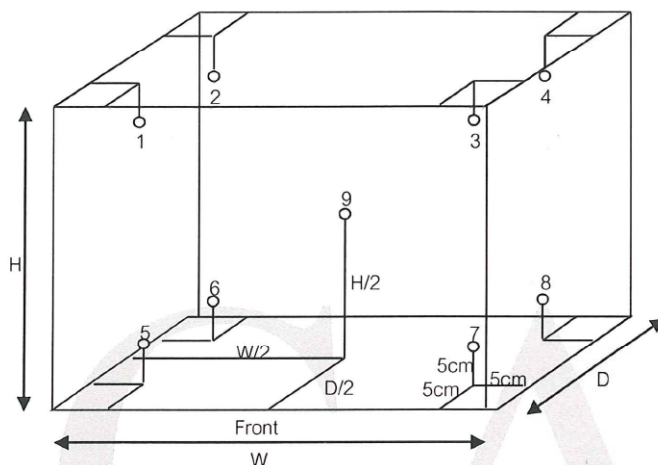
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

This instrument was setting air ventilation at position 0 (close)



Inside of Chamber

W = 0.40 m

D = 0.33 m

H = 0.40 m

Capacity = 0.05 m³

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.									Uncertainty (± °C)
			1	2	3	4	5	6	7	8	9	
104	109	109	104.8	105.0	104.4	104.6	103.4	103.5	103.6	103.7	103.7	0.96
180	184	184	180.8	181.8	179.9	180.6	180.6	180.8	180.6	180.9	180.5	1.1

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
104	109	109	1.5	0.2	1.8
180	184	184	1.6	0.2	2.3

Remark The uncertainty is not combine uniformity of the air chamber

This result of calibration was found accurate as shown on date and place of calibration only.

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

- o0o -



Certificate of Calibration

Certificate No. : 64-400425-1

Page : 1 of 2

Submitted by : M E T Company Limited

36/659 Moo 6, T.Bangrakpattana, A.Bangbuatong, Nonthaburi 11110

Equipment : Air Chamber (Oven)

Manufacturer : Memmert

Model : UM 100

Range : N/A °C

Resolution : 0.1 °C

Serial No. : b197.0985

ID No. : MET-OV01/46

Environment : On site calibration was carried out at the Laboratory, M E T Company Limited

Ambient Temperature : (31.0 to 33.0) °C

Relative Humidity : (50 to 55) %

Line Voltage : (210.0 to 210.8) V

Date of Received : 23 August 2021

Date of Calibration : 23 August 2021

Date of Issue : 23 August 2021

Calibrated by : Permpon Chanpu

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

Reference Standard Instruments : This certification is traceable to the International System of Units

Standard Digital Thermometer with Thermocouple probe

ID No.

Cert. No.

Due Date

Traceability

400029 & 400032

64-400106-1

30 Sep 2021

National Institute of Metrology Thailand (NIMT)

Approved by :

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 64-400425-1

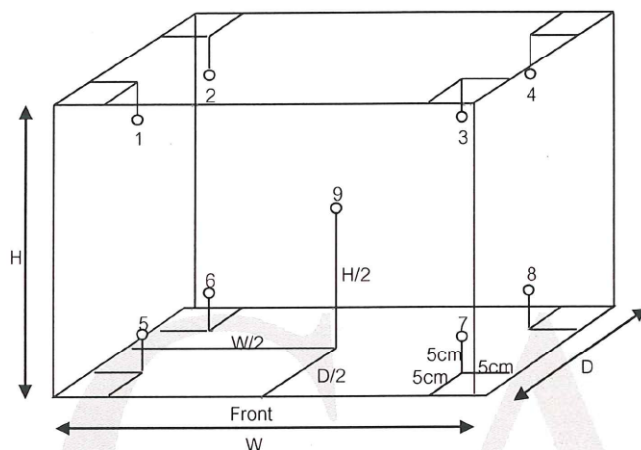
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

This instrument was setting air ventilation at position 0 (close)



Inside of Chamber

W = 0.32 m

D = 0.18 m

H = 0.24 m

Capacity = 0.01 m³

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.									Uncertainty (± °C)
			1	2	3	4	5	6	7	8	9	
180.0	180.0	180.0	180.9	181.2	180.7	181.0	181.1	181.3	180.6	180.7	179.6	0.95

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
180.0	180.0	180.0	1.9	0.2	2.0

Remark The uncertainty is not combine uniformity of the air chamber

This result of calibration was found accurate as shown on date and place of calibration only.

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

- o0o -



Certificate of Calibration

Certificate No. : 65-200064-1

Page : 1 of 2

Submitted by : M E T Company Limited

36/659 Moo 6, T.Bangrakpattana, A.Bangbuatong, Nonthaburi 11110

Equipment : Electronic Balance

Manufacturer : METTLER TOLEDO Model : AG285

Serial No. : 1122140126 ID No. : MET-EB01/46

Capacity : 210 g Resolution : 0.00001g/81g, 0.0001g/210g

Environment : On site calibration was carried out at the Laboratory, M E T Company Limited

Ambient Temperature : (26.2 to 26.8) °C

Relative Humidity : (55.3 to 64.1) %

Air Pressure : 1011.0 mbar

Date of Received : 09 March 2022

Date of Calibration : 09 March 2022

Date of Issue : 16 March 2022

Calibrated by : Akaradath Thippichai

Calibration Method : In-house method CAL-M2001 based on UKAS Publication ref : LAB 14

Edition 5, July 2015

Reference Standard Instruments : This certification is traceable to the International System of Units

Standard Weights

ID No.	Cert. No.	Due Date	Traceability
E261-E2624	C02213103	18 Nov 2022	National Institute of Metrology (Thailand), (NIMT)

Approved by :

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 65-200064-1

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Departure of indication from nominal value

Nominal Value (g)	Correction (g)	Uncertainty \pm (g)
0.01	0.00000	0.000016
0.1	0.00001	0.000021
1	-0.00001	0.000029
5	-0.00002	0.000043
10	-0.00006	0.000053
20	-0.00015	0.000071
50	-0.00035	0.00011
100	-0.0006	0.00021
150	-0.0009	0.00038
200	-0.0012	0.00038

This result of calibration was found accurate as shown on date and place of calibration only.

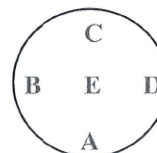
This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.23$, providing a level of confidence of approximately 95%

Eccentric error

Load test : 50 g

A B C D E

0.00044 0.00006 -0.00052 -0.00019 0.00000 g



Repeatability

Load test : 200 g

Stdev. : 0.000052 g

- oOo -



Certificate of Calibration

Certificate No. : 65-200064-2

Page : 1 of 2

Submitted by : M E T Company Limited
36/659 Moo 6, T.Bangrakpattana, A.Bangbuatong, Nonthaburi 11110

Equipment : Electronic Balance
Manufacturer : AND Model : FX-2000i
Serial No. : 15639789 ID No. : MET-EB03/61
Capacity : 2200 g Resolution : 0.01 g

Environment : On site calibration was carried out at the Laboratory, M E T Company Limited
Ambient Temperature : (26.1 to 26.2) °C
Relative Humidity : (55.5 to 61.9) %
Air Pressure : 1011.0 mbar

Date of Received : 09 March 2022

Date of Calibration : 09 March 2022

Date of Issue : 16 March 2022

Calibrated by : Akaradath Thippichai

Calibration Method : In-house method CAL-M2001 based on UKAS Publication ref : LAB 14
Edition 5, July 2015

Reference Standard Instruments : This certification is traceable to the International System of Units

Standard Weights

ID No.	Cert. No.	Due Date	Traceability
F181-F1821	65-210044-1	31 Jul 2022	National Institute of Metrology (Thailand), (NIMT)

Approved by :



Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 65-200064-2

Page : 2 of 2

Result of Calibration : After Adjustment

UUC Condition As-Received : Good

Departure of indication from nominal value

Nominal Value (g)	Correction (g)	Uncertainty \pm (g)	Error before Adjustment (g)
200	0.00	0.0083	-0.08
500	0.00	0.0085	-0.20
600	0.00	0.0086	-0.24
700	0.00	0.0087	-0.28
800	0.00	0.0089	-0.34
1000	0.01	0.0093	-0.41
1200	0.01	0.011	-0.50
1500	0.01	0.011	-0.61
2000	0.00	0.012	-0.79
2200	0.00	0.023	-0.87

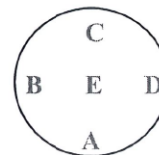
This result of calibration was found accurate as shown on date and place of calibration only.

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.00$, providing a level of confidence of approximately 95%

Eccentric error

Load test : 500 g

A	B	C	D	E	
0.00	0.01	0.00	0.00	0.00	g



Repeatability

Load test : 2000 g

Stdev. : 0.000 g

- o0o -



PinAAcle 900Z Preventive Maintenance Report

Company Name: S.P.S. CONSULTING SERVICE CO., LTD

Instrument Location: 7 Soi Phaholyothin 24 Phaholyothin Road


Jompol, Chatuchak, Bangkok 10900

Instrument Serial No.: PZAS19090402

Date: 01-Dec-2021

PinAAcle 900Z Preventive Maintenance (PM)

Company Name:	S.P.S. CONSULTING SERVICE CO., LTD		
Address (Instrument Location):	7 Soi Phaholyothin 24 Phaholyothin Road., Jompol, Chatuchak, Bangkok 10110		
Serial Number:	PZAS19090402	PM Number:	2/2
Customer Name (if applicable):	K. PHENPHA	Telephone Number:	083-926-9252
Customer Support Engineer Name:	K. DUANG	Service Order Number:	WO-01473846
Date PM Performed: (DD-MMM-YYYY)	01-Dec-2021	Next PM Due Date: (DD-MMM-YYYY)	01-Jun-2022
Standard Labor Hours to Complete PM :		5 hours	

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

Scope

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

The customer should save their method before the PM begins.

General Instructions:

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

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

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

Update the PM sticker and instrument logbook as required.

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Component List

Component / Specific Model	Serial #	Configuration Notes

Parts Lists

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

Additional Reagents and Standards Required for PM				
Part Number (if applicable)	Description	Quality	Batch/Lot #	Expired Date (MM/YY)
N9300244	GFAAS Mixed Standard	AR	53-255CRY1	28-Feb-2022

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

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

Procedure Checklist

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

1. General:

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

2. PC Instrument Software:

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

3. Mechanical:

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

4. Electrical:

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

5. Optics:

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

6. Gasses:

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

7. After PM Performance tests [THGA]:

7.1 Furnace Gas Flows

Description: Ensures the flow rates are within specification.

Parameter	Specification	Test Results	Pass/Fail
Internal Flow Rate	250 mL/min \pm 25 mL/min	250	Passed
External Flow Rate	100 mL/min \pm 10 mL/min	100	Passed

7.2 Chromium Baseline Noise

Description: Signal to noise check.

Parameter	Specification	Results	Pass/Fail
Baseline Noise	\leq 0.005 Abs.	0.0001	Passed
Standard Deviation	\leq 0.005	0.0001	Passed

7.3 Chromium Characteristic Mass and Precision

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

Parameter	Specification	Results	Pass/Fail
Cr m ₀ Results	\leq 7.0 pg/0.0044 A-s	3.8	Passed
Precision	\leq 2.0 %	1.64	Passed

7.4 Copper Characteristic Mass and Zeeman Ratio

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

Parameter	Specification	Results	Pass/Fail
Cu m ₀ Result	≤ 16.5 pg/0.0044 A-s	13.9	Passed
Zeeman Ratio	0.52 ± 0.04	0.52	Passed

8. Review:

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

Additional Comments

Additional Comments Regarding the PM	
Zeeman Ratio	$= \frac{\text{Atomic Signal (Peak area)}}{\text{Atomic Signal (Peak area)} + \text{Background Signal (Peak area)}}$ $= \frac{0.1593}{0.1593+0.1414}$ $= 0.52$

Review

<i>The preventive maintenance checks and if applicable performance tests for PinAAcle 900Z have been completed.</i>		
<i>This PinAAcle 900Z Passes <input checked="" type="checkbox"/> Fails <input type="checkbox"/> the preventive maintenance.</i>		
Review of Preventive Maintenance:		
Authorized PerkinElmer Representative:	<div style="background-color: #cccccc; width: 100px; height: 60px; margin: 0 auto;"></div>	Date: 01-Dec-2021 <small>(DD-MMM-YYYY)</small>
Authorized Customer Representative:	<div style="background-color: #cccccc; width: 100px; height: 60px; margin: 0 auto;"></div>	Date: 01-Dec-2021 <small>(DD-MMM-YYYY)</small>



Certificate of Calibration

Equipment:	SPECTROPHOTOMETER	Certificate No.:	C06210488
Model:	SP-2100	Issued Date:	21 October 2021
Serial No. (or ID.):	KJOGO5083001 (MET-SP 01/46)	Job No.:	KSPR2114279
Manufacturer:	Spectrum	Page:	1 of 2
Condition:	In Condition		

Customer: M E T CO.,LTD.
36/659 Moo 6, Tambol Bangrakpattana,
Amphur Bangbuathong, Nonthaburi 11110 Thailand.

Environment Condition:

Temperature	27.4	°C	±	0.0	°C
Humidity	65.3	%RH	±	0.0	%RH

Calibration Place: M E T CO.,LTD. (Laboratory Room)
36/659 Moo 6, Tambol Bangrakpattana,
Amphur Bangbuathong, Nonthaburi 11110 Thailand.

Calibration By: Mr.Imron Ama

Calibration Date: 21 October 2021

The Method used: In house method, SPCC-WI-24, base on ASTM E 275-08 and ASTM E 387-04

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

The standard for Wavelength Certificate No. 80284 and 80285

The standard for Photometric Certificate No. 94010

Person in charge

Authorized signatory

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

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

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

Calibration Results:

Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 4 nm and UUC at 4 nm

Standard Wavelength	Unit Under Calibration	Correction	Uncertainty
418.48	418	0.48	0.59
536.90	537	-0.10	0.59
637.94	638	-0.06	0.59
748.28	748	0.28	0.59
879.70	879	0.70	0.59

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5816	0.579	0.0026	0.0045
	0.7130	0.717	-0.0040	0.0045
	1.0151	1.018	-0.0029	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.5649	0.563	0.0019	0.0045
	0.7012	0.701	0.0002	0.0045
	0.9982	0.997	0.0012	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.5249	0.523	0.0019	0.0045
	0.6621	0.661	0.0011	0.0045
	0.9420	0.941	0.0010	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5214	0.520	0.0014	0.0045
	0.6982	0.695	0.0032	0.0045
	0.9947	0.990	0.0047	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5549	0.554	0.0009	0.0045
	0.7736	0.771	0.0026	0.0045
	1.1041	1.100	0.0041	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.5621	0.561	0.0011	0.0045
	0.7630	0.761	0.0020	0.0045
	1.0890	1.086	0.0030	0.0045

The End of Certificate