

ภาคผนวก 7-1

สำเนา ใบสอบเทียบเครื่องมือตรวจวัด
และวิเคราะห์

PM10 Sampler Calibration

SITE

Project: High Volume Sampler Calibration
Location: Life & Environment Co., Ltd
Date of calibration: February 14, 2023

DETAIL OF SAMPLER

Sampler Model: TE-6070 PM-10
Motor Model: TISCH
Motor Serial No.: 2094

CONDITIONS

Pressure of Ambient Air (Pa) (mm Hg):	758
Temperature of Ambient Air (Ta) (K):	300
Average Pressure (Pa) (mm Hg):	758
Average Temperature (Ts) (K):	301

CALIBRATION ORIFICE

Make : Tisch	Slope :	1.26202
Model : TR-5025A	Intercept:	-0.01176
Serial#: 5		

Plate or Test #	H ₂ O (in)	Qa (m ³ /min)	CALIBRATION		LINEAR REGRESSION
			I (chart)	IC (corrected)	
1	11.20	1.678	55.0	34.60	Slope = 18.5512
2	9.40	1.538	50.0	31.46	Intercept = 3.2399
3	7.30	1.356	45.0	28.31	Corr. coeff. = 0.9993
4	4.20	1.031	36.0	22.65	SFR = 1.126
5	2.40	0.782	28.0	17.62	SSP = 37.75

of Observations: 5

Calibrated by:

(Mr. Vachiraphun Jaisumran)

Approved by :

Industrial Hygiene Specialist



Industrial Health Association of Asia
สมาคมสุขภาพอุตสาหกรรมเอเชีย



PM10 Sampler Calibration

SITE

Project: High Volume Sampler Calibration
Location: Life & Environment Co., Ltd
Date of calibration : February 14, 2023

DETAIL OF SAMPLER

Sampler Model: TE-6070 PM-10
Motor Model: TISCH
Motor Serial No.: 2179

CONDITIONS

Pressure of Ambient Air (Pa) (mm Hg):	758
Temperature of Ambient Air (Ta) (K):	300
Average Pressure (Ps) (mm Hg):	758
Average Temperature (Ts) (K):	301

CALIBRATION ORIFICE

Make : Tisch	Slope :	1.26202
Model : TE-5025A	Intercept:	-0.01176
Serial#: 5		

Plate or Test #	H ₂ O (in)	Qa (m ³ /min)	CALIBRATION		LINEAR REGRESSION
			I (chart)	IC (corrected)	
1	10.70	1.640	56.0	59.0	Slope = 29.4756 Intercept = 10.6709 Corr. coeff. = 0.9961 SFR = 1.126 SSP = 37.75
2	8.80	1.488	51.0	55.0	
3	7.00	1.328	45.0	50.0	
4	4.60	1.078	36.0	41.0	
5	2.50	0.798	25.0	35.0	

of Observations: 5

Calibrated by:

(Mr. Vachiraphun Jaisumran)

Approved by :

Industrial Hygiene Specialist

PM10 Sampler Calibration

SITE

Project: High Volume Sampler Calibration
Location: Life & Environment Co., Ltd
Date of calibration : February 14, 2023

DETAIL OF SAMPLER

Sampler Model: TE-6070 PM-10
Motor Model: TISCH
Motor Serial No.: 2184

CONDITIONS

Pressure of Ambient Air (Pa) (mm Hg):	758
Temperature of Ambient Air (Ta) (K):	300
Average Pressure (Ps) (mm Hg):	758
Average Temperature (Ts) (K):	301

CALIBRATION ORIFICE

Make : Tisch	Slope :	1.26202
Model : TE-5025A	Intercept:	-0.01176
Serial#: 5		

CALIBRATION

Plate or Test #	H ₂ O (in)	Qa (m ³ /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	11.50	1.700	58.0	36.49	Slope = 20.1085
2	9.50	1.546	52.0	32.71	Intercept = 1.9461
3	7.40	1.365	46.0	28.94	Corr. coeff. = 0.9971
4	4.40	1.055	38.0	23.91	SFR = 1.126
5	2.90	0.858	30.0	18.87	SSP = 37.75

of Observations: 5

Calibrated by:



Approved by :



Industrial Hygiene Specialist

CALIBRATION TEST REPORT

Instrument : AIR CHECK SAMPLER (Low Flow)

Serial No. 20150601078

Model : BDX-II

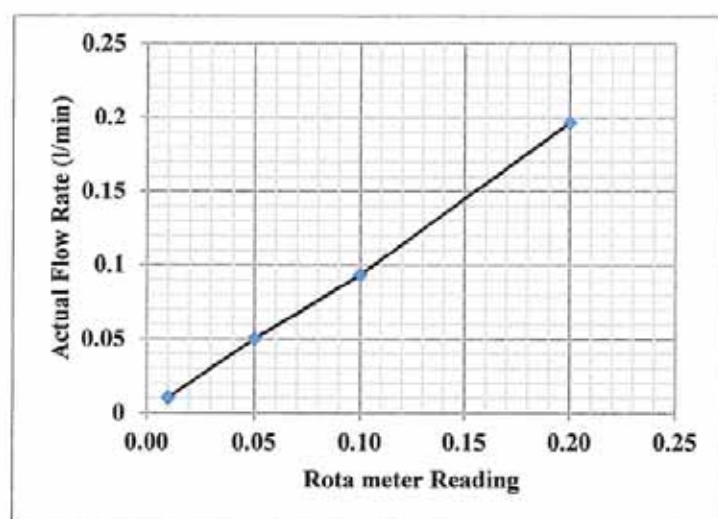
Manufacture : Gilian

Date of Calibration : MARCH 11, 2023

GN-03

Next Time Calibration : MARCH 11, 2024

Standard Criteria : Rota Meter					Ambient Condition		
SKC Model1355EZ30 S/N 0107070345011/003					Temperature = 25.0 °C		
					Pressure = 758 mmHg		
Rota Meter Reading	Actual Flow Rate (l/min)				Deviation (l/min)	Permissible Deviation (l/min)	Status
	1	2	3	Average			
0.01	0.01	0.01	0.01	0.010	0.0000	±0.05	Pass
0.05	0.05	0.05	0.05	0.050	0.0000	±0.10	Pass
0.10	0.09	0.09	0.10	0.093	0.0058	±0.15	Pass
0.20	0.20	0.20	0.19	0.197	0.0058	±0.20	Pass



Calibrated by



(Mr. Nonthawat Chuaytao)

Approved by



Industrial Hygiene Specialist

CALIBRATION TEST REPORT

Instrument : AIR CHECK SAMPLER (Low Flow)

Serial No. 20170104064

Model : BDX-II

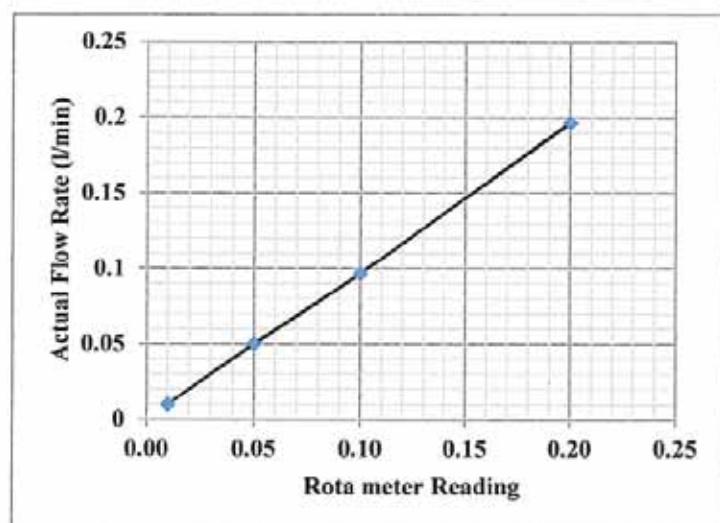
Manufacture : Gilian

Date of Calibration : MARCH 11, 2023

GN-10

Next Time Calibration : MARCH 11, 2024

Standard Criteria : Rota Meter					Ambient Condition		
SKC Model1355EZ30 S/N 0107070345011/003					Temperature = 25.0 °C		
					Pressure = 758 mmHg		
Rota Meter Reading	Actual Flow Rate (l/min)				Deviation (l/min)	Permissible Deviation (l/min)	Status
	1	2	3	Average			
0.01	0.01	0.01	0.01	0.010	0.0000	±0.05	Pass
0.05	0.05	0.05	0.05	0.050	0.0000	±0.10	Pass
0.10	0.10	0.09	0.10	0.097	0.0058	±0.15	Pass
0.20	0.20	0.19	0.20	0.197	0.0058	±0.20	Pass



Calibrated by

[Redacted Signature]

(Mr. Nonhawat Chuaytao)

Approved by

[Redacted Signature]

Industrial Hygiene Specialist

CALIBRATION TEST REPORT

Instrument : AIR CHECK SAMPLER (Low Flow)

Serial No. 20170104065

Model : BDX-II

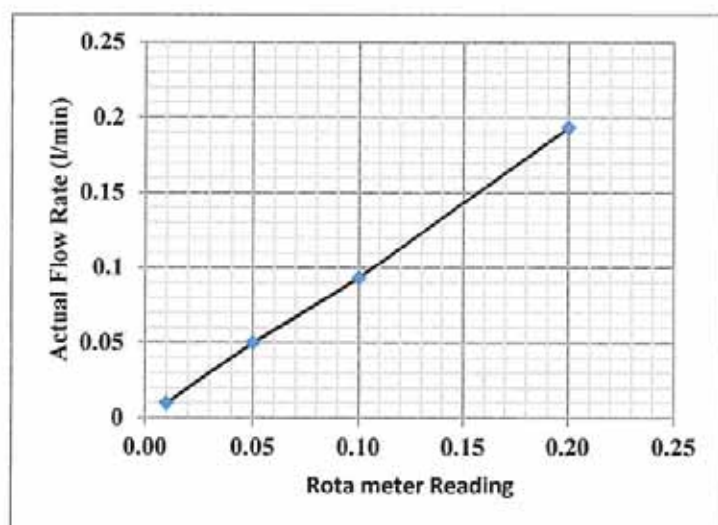
Manufacture : Gilian

Date of Calibration : MARCH 11, 2023

GN-11

Next Time Calibration : MARCH 11, 2024

Standard Criteria : Rota Meter					Ambient Condition		
SKC Model1355EZ30 S/N 0107070345011/003					Temperature = 25.0 °C		
					Pressure = 758 mmHg		
Rota Meter Reading	Actual Flow Rate (l/min)				Deviation (l/min)	Permissible Deviation (l/min)	Status
	1	2	3	Average			
0.01	0.01	0.01	0.01	0.010	0.0000	±0.05	Pass
0.05	0.05	0.05	0.05	0.050	0.0000	±0.10	Pass
0.10	0.10	0.09	0.09	0.093	0.0058	±0.15	Pass
0.20	0.19	0.19	0.20	0.193	0.0058	±0.20	Pass



Calibrated by

(Mr. Nonthawat Chuaytao)

Approved by

Industrial Hygiene Specialist

CALIBRATION TEST REPORT

Instrument : AIR CHECK SAMPLER (Low Flow)

Serial No. 20170104066

Model : BDX-II

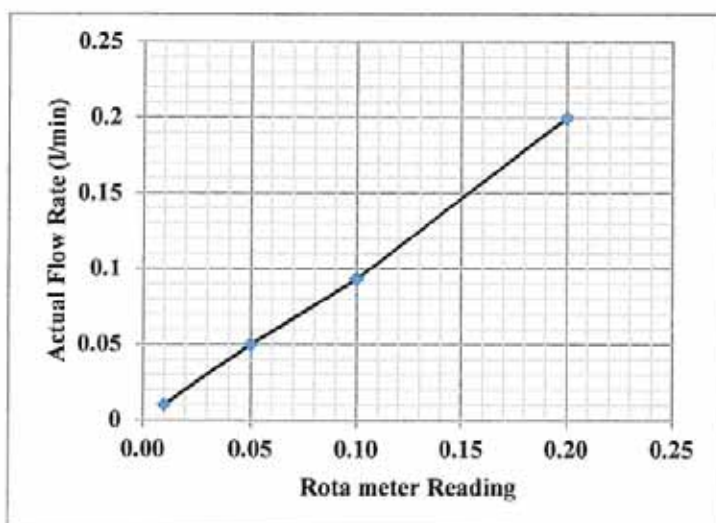
Manufacture : Gillian

Date of Calibration : MARCH 11, 2023

GN-12

Next Time Calibration : MARCH 11, 2024

Standard Criteria : Rota Meter					Ambient Condition		
SKC Model1355EZ30 S/N 0107070345011/003					Temperature = 25.0 °C		
					Pressure = 758 mmHg		
Rota Meter Reading	Actual Flow Rate (l/min)				Deviation (l/min)	Permissible Deviation (l/min)	Status
	1	2	3	Average			
0.01	0.01	0.01	0.01	0.010	0.0000	±0.05	Pass
0.05	0.05	0.05	0.05	0.050	0.0000	±0.10	Pass
0.10	0.09	0.10	0.09	0.093	0.0058	±0.10	Pass
0.20	0.19	0.20	0.20	0.200	0.0058	±0.15	Pass



Calibrated by

(Mr. Nonhawatt Chuaytao)

Approved by

Industrial Hygiene Specialist

CALIBRATION TEST REPORT

Instrument : AIR CHECK SAMPLER (Low Flow)

Serial No. 20170104067

Model : BDX-II

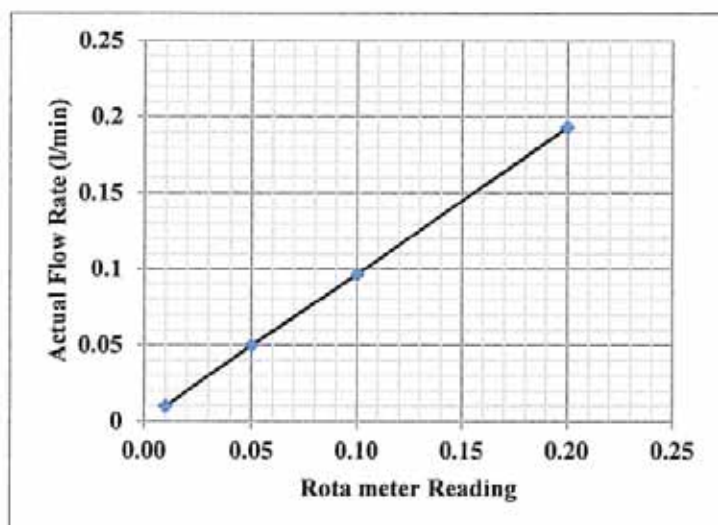
Manufacture : Gillian

Date of Calibration : MARCH 11, 2023

GN-13

Next Time Calibration : MARCH 11, 2024

Standard Criteria : Rota Meter					Ambient Condition		
SKC Model1355EZ30 S/N 0107070345011/003					Temperature = 25.0 °C		
					Pressure = 758 mmHg		
Rota Meter Reading	Actual Flow Rate (l/min)				Deviation (l/min)	Permissible Deviation (l/min)	Status
	1	2	3	Average			
0.01	0.01	0.01	0.01	0.010	0.0000	±0.05	Pass
0.05	0.05	0.05	0.05	0.050	0.0000	±0.10	Pass
0.10	0.10	0.09	0.10	0.097	0.0058	±0.15	Pass
0.20	0.19	0.19	0.20	0.193	0.0058	±0.15	Pass



Calibrated by



(Mr. Nonhawatt Chuaytao)

Approved by



Industrial Hygiene Specialist

CALIBRATION TEST REPORT

Instrument : AIR CHECK SAMPLER (High Flow)

Serial No. 20150601078

Model : BDx-II

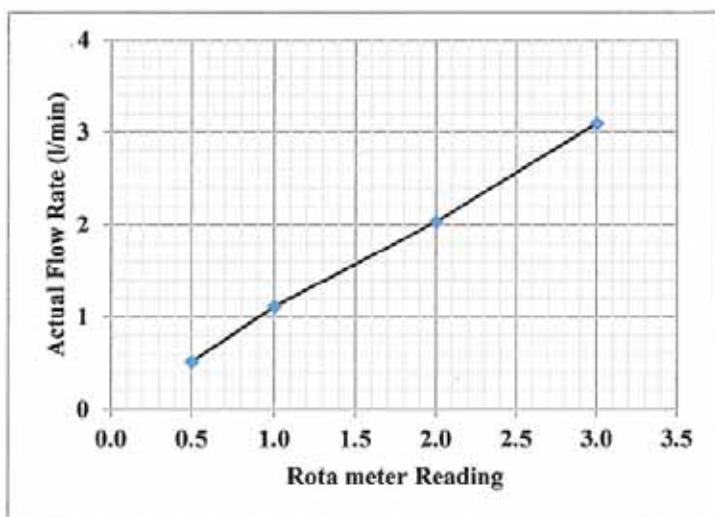
Manufacture : Gilian

Date of Calibration : MARCH 11, 2023

GN-03

Next Time Calibration : MARCH 11, 2024

Standard Criteria : Rota Meter					Ambient Condition		
SKC Model1355EZ30 S/N 0107070345011/003					Temperature = 25.0 °C		
					Pressure = 758 mmHg		
Rota Meter Reading	Actual Flow Rate (l/min)				Deviation (l/min)	Permissible Deviation (l/min)	Status
	1	2	3	Average			
0.5	0.50	0.55	0.50	0.517	0.0289	±0.05	Pass
1.0	1.05	1.15	1.15	1.117	0.0577	±0.10	Pass
2.0	2.00	2.05	2.05	2.033	0.0289	±0.15	Pass
3.0	3.00	3.15	3.15	3.100	0.0866	±0.20	Pass



Calibrated by

(Mr. Nonthawat Chuaytao)

Approved by

Industrial Hygiene Specialist

CALIBRATION TEST REPORT

Instrument : AIR CHECK SAMPLER (High Flow)

Serial No. 20170104064

Model : BDX-II

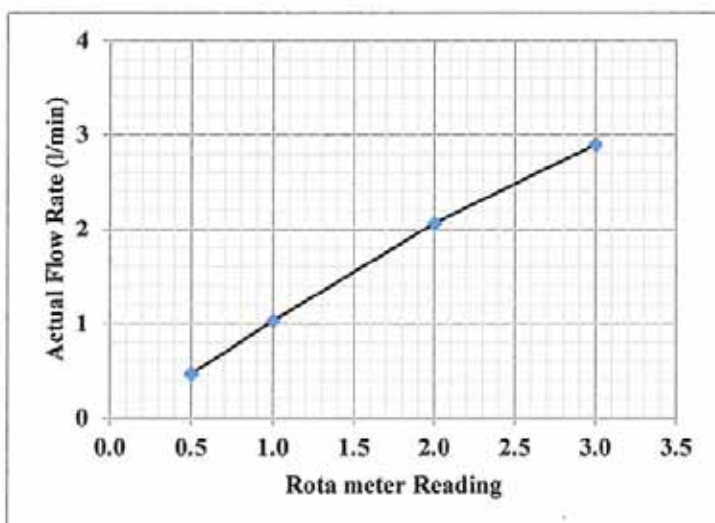
Manufacture : Gilian

Date of Calibration : MARCH 11, 2023

GN-10

Next Time Calibration : MARCH 11, 2024

Standard Criteria : Rota Meter					Ambient Condition		
SKC Model1355EZ30 S/N 0107070345011/003					Temperature = 25.0 °C		
					Pressure = 758 mmHg		
Rota Meter Reading	Actual Flow Rate (l/min)				Deviation (l/min)	Permissible Deviation (l/min)	Status
	1	2	3	Average			
0.5	0.45	0.45	0.50	0.467	0.0289	±0.05	Pass
1.0	1.00	1.10	1.00	1.033	0.0577	±0.10	Pass
2.0	2.05	2.10	2.05	2.067	0.0289	±0.15	Pass
3.0	2.90	2.90	2.90	2.900	0.0000	±0.20	Pass



Calibrated by

(Mr. Nonthawat Chuaytao)

Approved by

Industrial Hygiene Specialist

CALIBRATION TEST REPORT

Instrument : AIR CHECK SAMPLER (High Flow)

Serial No. 20170104065

Model : BDX-II

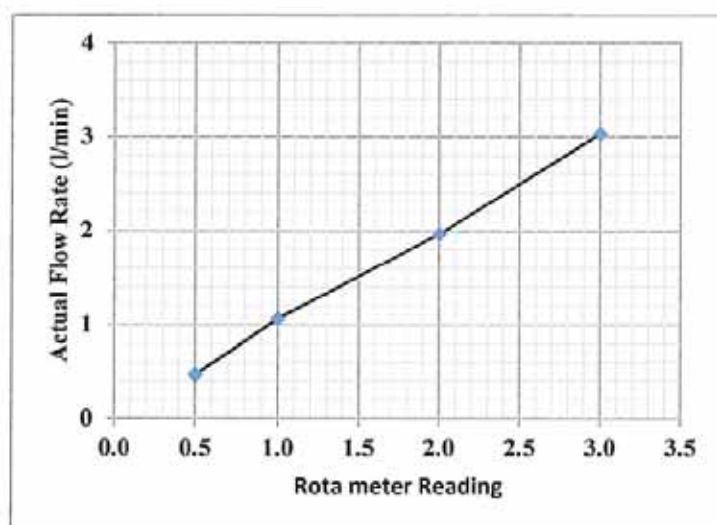
Manufacture : Gilian

Date of Calibration : MARCH 11, 2023

GN-11

Next Time Calibration : MARCH 11, 2024

Standard Criteria : Rota Meter					Ambient Condition		
SKC Model1355EZ30 S/N 0107070345011/003					Temperature = 25.0 °C		
					Pressure = 758 mmHg		
Rota Meter Reading	Actual Flow Rate (l/min)				Deviation (l/min)	Permissible Deviation (l/min)	Status
	1	2	3	Average			
0.5	0.45	0.45	0.50	0.467	0.0289	±0.05	Pass
1.0	1.00	1.15	1.05	1.067	0.0764	±0.10	Pass
2.0	2.00	1.95	1.95	1.967	0.0289	±0.15	Pass
3.0	3.00	3.05	3.05	3.033	0.0289	±0.20	Pass



Calibrated by

(Mr. Nonthawat Chuaytao)

Approved by

Industrial Hygiene Specialist

CALIBRATION TEST REPORT

Instrument : AIR CHECK SAMPLER (High Flow)

Serial No. 20170104066

Model : BDX-II

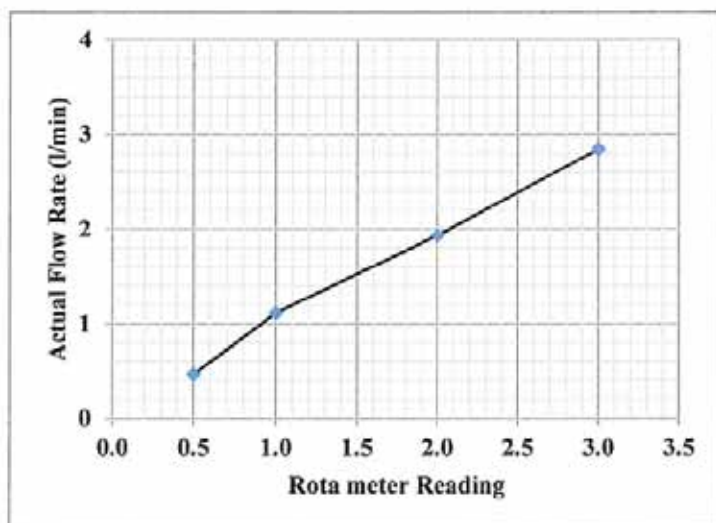
Manufacture : Gillian

Date of Calibration : MARCH 11, 2023

GN-12

Next Time Calibration : MARCH 11, 2024

Standard Criteria : Rota Meter					Ambient Condition		
SKC Model1355EZ30 S/N 0107070345011/003					Temperature = 25.0 °C		
					Pressure = 758 mmHg		
Rota Meter Reading	Actual Flow Rate (l/min)				Deviation (l/min)	Permissible Deviation (l/min)	Status
	1	2	3	Average			
0.5	0.50	0.45	0.45	0.467	0.0289	±0.05	Pass
1.0	1.05	1.15	1.15	1.117	0.0577	±0.10	Pass
2.0	2.00	1.85	1.95	1.933	0.0764	±0.10	Pass
3.0	3.00	2.90	2.80	2.846	0.1000	±0.15	Pass



Calibrated by

(Mr. Nonhawat Chuaytao)

Approved by

Industrial Hygiene Specialist

CALIBRATION TEST REPORT

Instrument : AIR CHECK SAMPLER (High Flow)

Serial No. 20170104067

Model : BDX-II

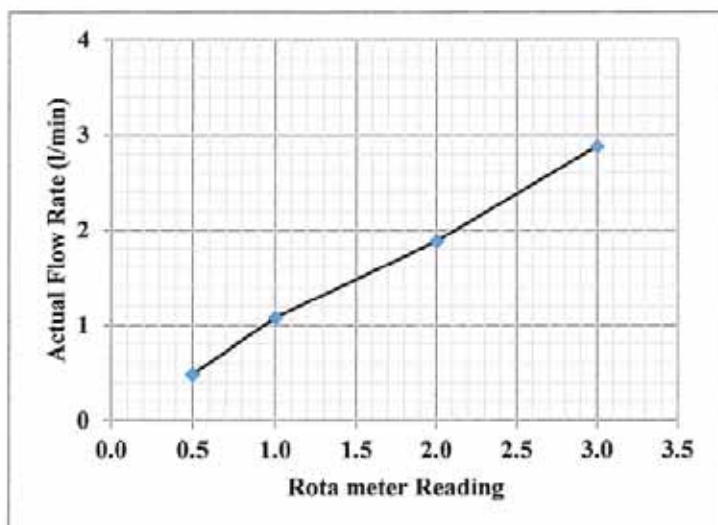
Manufacture : Gilian

Date of Calibration : MARCH 11, 2023

GN-13

Next Time Calibration : MARCH 11, 2024

Standard Criteria : Rota Meter					Ambient Condition		
SKC Model1355EZ30 S/N 0107070345011/003					Temperature = 25.0 °C		
					Pressure = 758 mmHg		
Rota Meter Reading	Actual Flow Rate (l/min)				Deviation (l/min)	Permissible Deviation (l/min)	Status
	1	2	3	Average			
0.5	0.50	0.45	0.50	0.483	0.0289	±0.05	Pass
1.0	1.10	1.10	1.05	1.083	0.0289	±0.10	Pass
2.0	1.95	1.85	1.85	1.883	0.0577	±0.15	Pass
3.0	2.95	2.90	2.80	2.883	0.0764	±0.15	Pass



Calibrated by

(Mr. Nonhawat Chuaytao)

Approved by

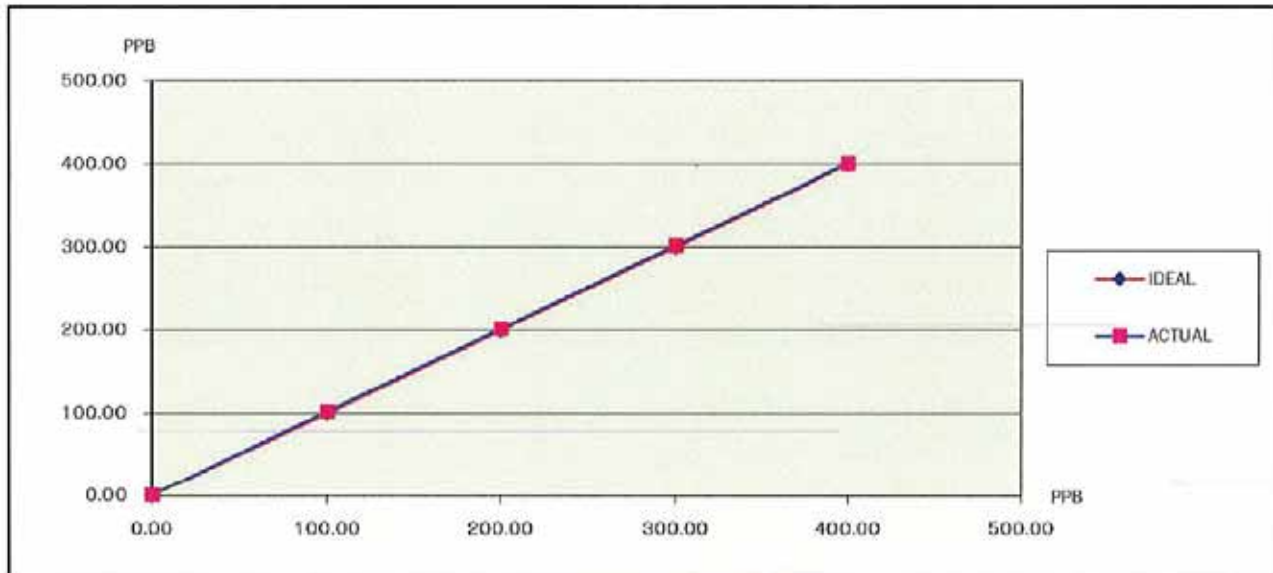
Industrial Hygiene Specialist

TEST REPORT

CUSTOMER NAME : All-Quip Co., Ltd. (บริษัท ออล ควิป จำกัด (สำนักงานใหญ่))			
EQUIPMENT NAME : SO ₂ Analyzer			
MANUFACTURER : HORIBA	MODEL : APSA-370	SERIAL NO : TXLX1955	
STANDARD GAS CONCENTRATION (PPM) : 53.29 PPM		CYLINDER NO : CC734373	
CYLINDER PRESSURE (PSI) : 1,400 PSI		CERTIFIED DATE : 12/05/2020	
CERTIFIED BY : AIRGAS		EXPIRED DATE : 12/05/2028	

TEST RESULTS

POINT NO	TEST RESULTS			
	IDEAL	ACTUAL	ERROR	%ERROR
ZERO	0.00	0.300	0.30	-
1	100.00	101.840	1.8	1.84
2	200.00	201.400	1.4	0.70
3	300.00	301.600	1.6	0.53
4	400.00	400.900	0.9	0.22
AVERAGE (%)				0.82



CALIBRATED BY :



DATE :

4/10/65

CHECKED BY :



DATE :

4/10/65

ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : เจ้าหน้าที่ฝ่ายบริการหลังการขาย , โทร 02-868-0812 # 15-16 , E-Mail : Engineer@jiranatee.com

เลขที่ 63/14-15,67/35-36 ถนน ขอบเพชรเกษม 7,7/1 เพชรเกษม แขวงวัดท่าพระ เขตบางกอกใหญ่ กรุงเทพฯ 10600 โทร 02-868-0812-13 โทรสาร 02-868-1889

CHECK LIST

CUSTOMER NAME : All-Oulp Co., Ltd. (บริษัท ออล อู๊ป จำกัด (สำนักงานใหญ่))		
EQUIPMENT NAME : SO ₂ Analyzer		
MANUFACTURER : HORIBA	MODEL : APSA-370	SERIAL NO. : TXLX1955

TEST VALUES				
NO.	Ambient SO ₂ Monitor	UNIT	BEFORE	AFTER
1	SIGNAL	mV (Voltage of the measured SO ₂ Value)	8.30	9.20
2	LAMP	mV (200mV to 1200 mV)	377.80	384.40
3	CELL	°C (Ambient tembient temperature +(5°C to 15°C))	30.10	36.40
4	PUMP	kPa (65 kPa or less)	41.90	42.90
5	AMBIENT	kPa	100.70	100.80
6	SAMPLE	L/min (0.6 L/min to 1.0 L/min)	-	-
7	DC 24 V	V (24 V ± 0.5 V)	23.90	23.90
8	DC 5 V	V (5 V ± 0.5 V)	5.00	5.00
9	SAMPLE SO2 Reading	PPB	1.20	0.10
10	Zero	PPB	0.40	0.30
11	Span	PPB	381.10	400.90

Remark : Reference EX-EN-019-56 , Ambient SO2 Monitor APSA-370 Operetion Manual Page #78

(Ambeint temperature = 5°C to 40°C)

อาการที่ตรวจพบ

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รายละเอียดการดำเนินการ

- ทำความสะอาดระบบ . ทำ Calibration Zero/Span , Multipoint , เช็ค Dianostics

ผลการดำเนินการ

- เรียบร้อย เครื่องสามารถดำเนินการตรวจวัดได้ตามปกติ

CALIBRATED BY :



DATE : 4/10/65

CHECKED BY :

DATE : 4/10/65

ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : เจ้าหน้าที่ฝ่ายบริการหลังการขาย , โทร 02-868-0812 # 15-16 , E-Mail : Engineer@jiranatee.com

เลขที่ 63/14-15 , 67/35-36 ซอยเพชรเกษม 7,7/1 ถนนเพชรเกษม แขวงวัดท่าพระ เขตบางกอกใหญ่ กรุงเทพฯ 10600 โทร : 02-868-0812-13 โทรสาร : 02-868-1889

MULTI POINT CALIBRATION REPORT

CUSTOMER NAME : บริษัท ชีวและสิ่งแวดล้อม จำกัด

EQUIPMENT NAME : SO₂ Analyzer

MANUFACTURER : Teledyne - API

MODEL : 100E

SERIAL NUMBER : 2661

STANDARD GAS CONCENTRATION (PPM) : 53.79

CERTIFIED DATE : CC745169

CYLINDER PRESSURE (PSIG) : 1600

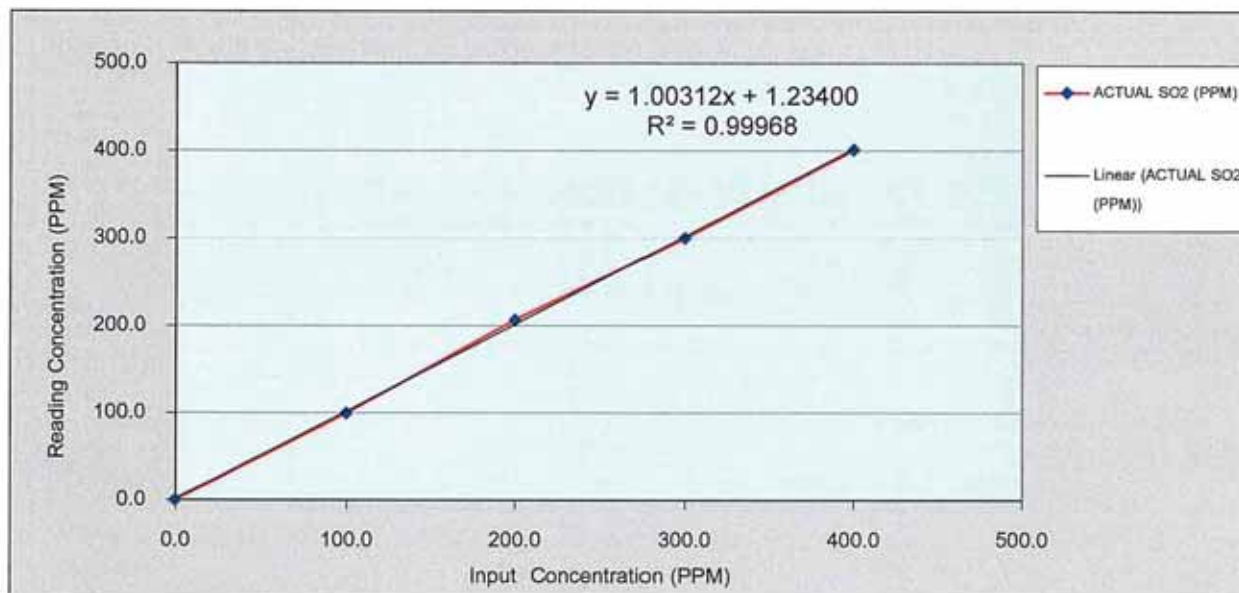
CERTIFIED DATE : Mar 10 2021

CERTIFIED BY : AIRGAS SPECIALTY GASES

EXPIRED DATE : Mar 10 2029

CALIBRATION RESULTS

POINT NO	CALIBRATION RESULTS			
	IDEAL (PPM)	ACTUAL SO ₂ (PPM)	ERROR SO ₂ (PPM)	% ERROR SO ₂
ZERO	0.0	0.2	0.1	0.0
1	100.0	100.1	0.1	0.10
2	200.0	206.9	6.9	3.45
3	300.0	300.6	0.6	0.20
4	400.0	401.5	1.5	0.38
AVERAGE (%)				0.010



CALIBRATED BY : คุณพรชัย ผาติวนารักษ์

DATE : 20/02/2566

ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : คุณพรชัย ผาติวนารักษ์ โทรศัพท์ : 02-515-8987



บริษัท ไคเนติกส์ คอร์ปอเรชั่น จำกัด

KINETICS CORPORATION LTD.

รายงานผลการซ่อมและปรับเทียบอุปกรณ์ตรวจวัดคุณภาพอากาศ

ลูกค้า / หน่วยงาน : บริษัท ชีวิตและสิ่งแวดล้อม จำกัด

วันที่ : 20/02/2566

รายชื่ออุปกรณ์ / เครื่องมือ : SO₂ Analyzer

บริษัทผู้ผลิต : Teledyne API

รุ่นของอุปกรณ์ / เครื่องมือ : 100E

หมายเลขอุปกรณ์ / เครื่องมือ : 2661

TEST VALUES			
API MODEL 100E		BEFORE	AFTER
1	RANGE	50 - 20,000 PPB	500
2	STABILITY	≤ 1 PPB	0.17
3	PRESSURE	25 - 35 in - Hg-A	29.9
4	SAMPLE FLOW	650 ± 10% cc/min	68.6
5	PMT	mV	111.8
6	NORM PMT	mV	111.6
7	UV LAMP	1000 - 4800 mV	3988.5
8	LAMP RATIO	30 To 120 %	99.6
9	STRAY LIGHT	≤ 100 PPB	28.66
10	DARK PMT	-50 ± 200 mV	111.7
11	DARK LAMP	-50 ± 200 mV	0.6
12	SO ₂ SLOPE	1.0 ± 0.3	0.970
13	SO ₂ OFFSET	< 250 mV	59.1
14	HVPS	400 - 900 V	641
15	RX CELL TEMP	50 ± 1 °C	50.0
16	BOX TEMP	AMBIENT ± 5 °C	32.3
17	PMT TEMP	7 ± 2 °C	6.3
18	SO ₂ SAMPLE READING	PPB	35.4
19	OPTIC TEST	2000 ± 1000 mV	3130.8
20	ELECTRICAL TEST	2000 ± 1000 mV	2192.2
21	VOLTAGE TEST	+5 V +12 V +15 V -15 V	5.25/12.33/15.67/-15.7
22	ZERO GAS	0.00 PPB	36.68
23	SPAN GAS	400.00 PPB	180.5

หมายเหตุ

- เปลี่ยน SS Filter 1 PC / เปลี่ยน O-ring 2 PCs

ลงนามเจ้าหน้าที่ (Signature)

ต้องการข้อมูลเพิ่มเติมทางด้านเทคนิค กรุณาติดต่อ : คุณพรชัย ผาติวนารักษ์

โทรศัพท์ : 0-2515-8987

เลขที่ 388 ถนนรัชดาภิเษก แขวงจันทระเกษม เขตจตุจักร กรุงเทพฯ 10900 โทรศัพท์ : 0-2515-8999 โทรสาร : 0-2515-8988 E-Mail : Info@kinetics.co.th

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04NI99E15A0622
Cylinder Number: CC745169
Laboratory: 124 - Plumsteadville - PA
PGVP Number: A12021
Gas Code: CO,NO,NOX,SO2,BALN

Reference Number: 160-402045691-1
Cylinder Volume: 144.4 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 660
Certification Date: Mar 10, 2021

Expiration Date: Mar 10, 2029

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

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

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	53.00 PPM	53.40 PPM	G1	+/- 1.1% NIST Traceable	03/03/2021, 03/10/2021
NITRIC OXIDE	53.00 PPM	53.40 PPM	G1	+/- 1.1% NIST Traceable	03/03/2021, 03/10/2021
SULFUR DIOXIDE	53.00 PPM	53.79 PPM	G1	+/- 0.9% NIST Traceable	03/03/2021, 03/10/2021
CARBON MONOXIDE	4500 PPM	4512 PPM	G1	+/- 0.6% NIST Traceable	03/04/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	07060227	EB0079116	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Jul 23, 2023
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
GMIS	124208889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	16010203	KAL003087	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/-0.8%	Dec 23, 2021
NTRM	08012341	KAL004716	4857 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 07, 2024

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 N1KD579	NDIR	Feb 26, 2021
Nicolet IS50 FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicolet IS50 FTIR AUP2010245 NO2	FTIR	Feb 22, 2021
Nicolet IS50 FTIR AUP2010245 SO2	FTIR	Feb 18, 2021

Triad Data Available Upon Request

NOTES:

Gross Weight: 28.1 Kg
Net Weight: 4.6 Kg



Approved for Release

Test Report Calibration

Ecotech EC9850 Sulphur Dioxide Analyzer

Issued By	Sithiporn Associates Company Limited	Calibration Date	2-Mar-2023
Owner Name	Life & Environment Co.,Ltd.	Product Brand	Ecotech
Certificate Number	17690-2	Type Systematic	Analyzer Ambient Monitoring

Model :	EC9850	Serial Number :	02-0314
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Calibration Standard equipment : Std. Gas Mixture Cylinder Number EB0140749 Expired Date 10-Mar-2024

Brand : Airgas

Components	Concentration
Carbon Monoxide (CO)	4498 PPM
Nitric Oxide (NO)	45.69 PPM
Sulfur Dioxide (SO ₂)	45.54 PPM
Nitrogen (N ₂)	Balance

Calibration Setting

Span Instrument Gain	13.219	Start Time	13:00
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Reading (Before Adj.)			
Span Set Point	Expected Concentration (PPB)	Analyzer Response (PPB)	Error %
Zero	0	0	-
Span	400	400	0.00

Span Instrument Gain	25.833	Finish Time	13:35
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Signature	 บริษัท สิทธีพรแอสโซซิเอต จำกัด SITHIPHORN ASSOCIATES COMPANY LIMITED	Approved	 Don
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บริษัท สิทธีพร แอสโซซิเอต จำกัด Sithiporn Associates Co., Ltd.

451-451/1 ถนนสีรินธร แขวงบางนาเหนือ เขตบางพลี กรุงเทพฯ 10700 โทร. 0-2433-8331, 0-2435-8800, 0-2434-9191 แฟกซ์ : 0-2433-1679, 0-2434-9510
 451-451/1 Srinthorn Road, Bangbunru, Bangplud, Bangkok 10700 Thailand Tel. (662) 433-8331, 435-8800, 434-9191 Fax: (662) 433-1679, 434-9510

EMAIL:center@sithiphorn.com www.sithiphorn.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E04NI99E15A00V3	Reference Number:	160-402036564-1
Cylinder Number:	EB0140749	Cylinder Volume:	144.4 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
PGVP Number:	A12021	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Mar 10, 2021

Expiration Date: Mar 10, 2024

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

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

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.70 PPM	G1	+/- 1.1% NIST Traceable	03/03/2021, 03/10/2021
NITRIC OXIDE	45.00 PPM	45.69 PPM	G1	+/- 1.1% NIST Traceable	03/03/2021, 03/10/2021
SULFUR DIOXIDE	45.00 PPM	45.54 PPM	G1	+/- 1.1% NIST Traceable	03/03/2021, 03/10/2021
CARBON MONOXIDE	4500 PPM	4498 PPM	G1	+/- 0.6% NIST Traceable	03/04/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	200611-04	CC707968	49.82 PPM NITRIC OXIDE/NITROGEN	+/-1.0%	Feb 02, 2025
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL003190	49.67 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 20, 2022
NTRM	08012341	KAL004718	4857 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 07, 2024

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 N1KD579	NDIR	Feb 26, 2021
Nicolet IS50 FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicolet IS50 FTIR AUP2010245 NO2	FTIR	Feb 22, 2021
Nicolet IS50 FTIR AUP2010245 SO2	FTIR	Feb 18, 2021

Triad Data Available Upon Request

NOTES:

Gross Weight: 28.4 Kg
Net Weight: 4.6 Kg
PO# 5221000722



Approved for Release



MULTI POINT CALIBRATION REPORT

CUSTOMER NAME : บริษัท ซีวีและสิ่งแวดล้อม จำกัด

EQUIPMENT NAME : NO_x Analyzer

MANUFACTURER : Teledyne API

MODEL : 200E

SERIAL NUMBER : 2287

STANDARD GAS CONCENTRATION (PPM) : 53.4

CERTIFIED DATE : CC745169

CYLINDER PRESSURE (PSIG) : 1600

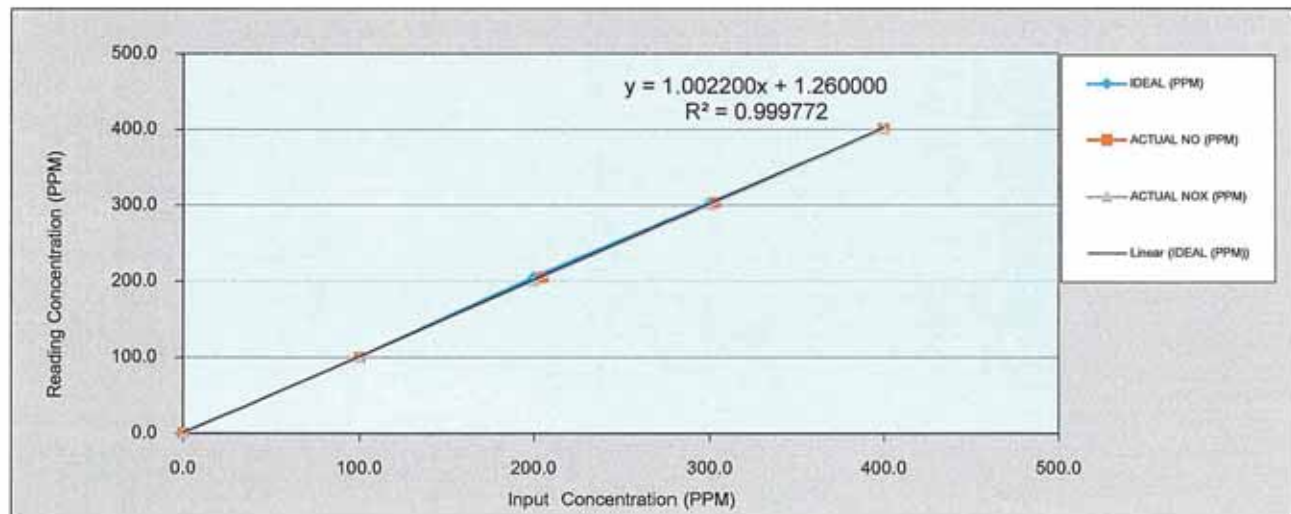
CERTIFIED DATE : Mar 10 2021

CERTIFIED BY : AIRGAS SPECIALTY GASES

EXPIRED DATE : Mar 10 2029

CALIBRATION RESULTS

POINT NO	CALIBRATION RESULTS						
	IDEAL (PPM)	ACTUAL NO (PPM)	ERROR NO (PPM)	% ERROR NO	ACTUAL NO _x (PPM)	ERROR NO _x (PPM)	% ERROR NO _x
ZERO	0.00	0.20	0.00	0.00	0.40	0.00	0.00
1	100.00	100.10	0.10	0.10	100.00	100.9	0.50
2	200.00	205.30	5.30	2.65	200.00	200.4	1.00
3	300.00	303.10	3.10	1.03	300.00	308.7	1.52
4	400.00	399.80	-0.20	-0.05	400.00	399.9	1.99
AVERAGE (%)				0.00			0.01



CALIBRATED BY : คุณพรชัย มาติตนารักษ์

DATE : 22/02/2566

ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : คุณพรชัย มาติตนารักษ์ โทรศัพท์ : 02-515-8987

[Signature]

เลขที่ 388 ถนนรัชดาภิเษก แขวงจันทระเกษม เขตจตุจักร กรุงเทพฯ 10900 โทรศัพท์ : 0-2515-8999 โทรสาร : 0-2515-8988 E-Mail : Info@kinetics.co.th

รายงานผลการซ่อมและปรับเทียบอุปกรณ์ตรวจวัดคุณภาพอากาศ

ลูกค้า / หน่วยงาน : บริษัท ซีวีและสิ่งแวดลอม จำกัด

วันที่ : 22/02/2566

รายชื่ออุปกรณ์ / เครื่องมือ : NO_x Analyzer

บริษัทผู้ผลิต : Teledyne API

รุ่นของอุปกรณ์ / เครื่องมือ : 200E

หมายเลขอุปกรณ์ / เครื่องมือ : 2287

TEST VALUES			
	API MODEL 200E	BEFORE	AFTER
1	RANGE 50 - 20,000 PPM	500.0	500.0
2	STABILITY ≤ 1 PPM	0.4	0.1
3	SAMPLE FLOW $500 \pm 10\%$ cc/min	506	513
4	OZONE FLOW $80 \pm 10\%$ cc/min	81	80
5	PMT mV	53.8	61.5
6	NORM PMT mV	5.7	31.6
7	A ZERO -20 To 150 mV	48.4	39.3
8	HPVS 400 - 900 V	753	756
9	RX CELL TEMP $50 \pm 1^{\circ}\text{C}$	50.0	50.0
10	BOX TEMP AMBIENT $\pm 5^{\circ}\text{C}$	30.0	30.5
11	PMT TEMP $7 \pm 2^{\circ}\text{C}$	6.6	6.7
12	MOLY TEMP $315 \pm 5^{\circ}\text{C}$	315.7	314.6
13	RX CELL PRESSURE < 10 in - Hg-A	7.5	7.7
14	SAMPLE PRESSURE 25 - 35, in - Hg-A	29.1	28.4
15	NOX SLOPE 1.0 ± 0.3	0.324	1.070
16	NOX OFFSET -50 To 150	1.9	5.4
17	NO SLOPE 1.0 ± 0.3	0.342	0.943
18	NO OFFSET -50 To 150	-1.0	-2.7
19	NO SAMPLE READING PPM	1.5	5.6
20	NO ₂ SAMPLE READING PPM	13.8	10.4
21	NO _x SAMPLE READING PPM	23.3	16.1
22	OPTIC TEST 2000 ± 1000 mV	2178.5	2188.5
23	ELECTRICAL TEST 2000 ± 1000 mV	1724.2	1728.2
24	VOLTAGE TEST +5 V +12 V +15 V -15 V	5.18/ 12.40 /15.40/ -15.18	5.20/ 12.50 /15.60/ -15.14
25	ZERO GAS NO / NO _x 0.00 / 0.00 PPM	0.3 /13.6	0.2 /0.7
26	SPAN GAS NO / NO _x 400.00 / 400.00 PPM	341.9 /300.6	399.8 /399.9

หมายเหตุ

- เปลี่ยน O -Ring 6 PCs , เปลี่ยน SS Filter 3 PCs ,เปลี่ยน Spring 3 PCs

ลงนามเจ้าหน้าที่ (Signature)

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04NI99E15A0622
Cylinder Number: CC745169
Laboratory: 124 - Plumsteadville - PA
PGVP Number: A12021
Gas Code: CO,NO,NOX,SO2,BALN

Reference Number: 160-402045691-1
Cylinder Volume: 144.4 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 860
Certification Date: Mar 10, 2021

Expiration Date: Mar 10, 2029

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

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

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	53.00 PPM	53.40 PPM	G1	+/- 1.1% NIST Traceable	03/03/2021, 03/10/2021
NITRIC OXIDE	53.00 PPM	53.40 PPM	G1	+/- 1.1% NIST Traceable	03/03/2021, 03/10/2021
SULFUR DIOXIDE	53.00 PPM	53.79 PPM	G1	+/- 0.9% NIST Traceable	03/03/2021, 03/10/2021
CARBON MONOXIDE	4500 PPM	4512 PPM	G1	+/- 0.6% NIST Traceable	03/04/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	07060227	EB0079116	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Jul 23, 2023
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
GMIS	124206889	CC323707	4.026 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	16010203	KAL003087	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/-0.8%	Dec 23, 2021
NTRM	08012341	KAL004716	4857 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 07, 2024

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 N1KD579	NDIR	Feb 26, 2021
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Feb 22, 2021
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Feb 18, 2021

Triad Data Available Upon Request

NOTES:

Gross Weight: 28.1 Kg
Net Weight: 4.6 Kg



Approved for Release

MULTI POINT CALIBRATION REPORT

CUSTOMER NAME : บริษัท ชีวและสิ่งแวดล้อม จำกัด

EQUIPMENT NAME : NO_x Analyzer

MANUFACTURER : Teledyne API

MODEL : 200E

SERIAL NUMBER : 2288

STANDARD GAS CONCENTRATION (PPM) : 53.4

CERTIFIED DATE : CC745169

CYLINDER PRESSURE (PSIG) : 1600

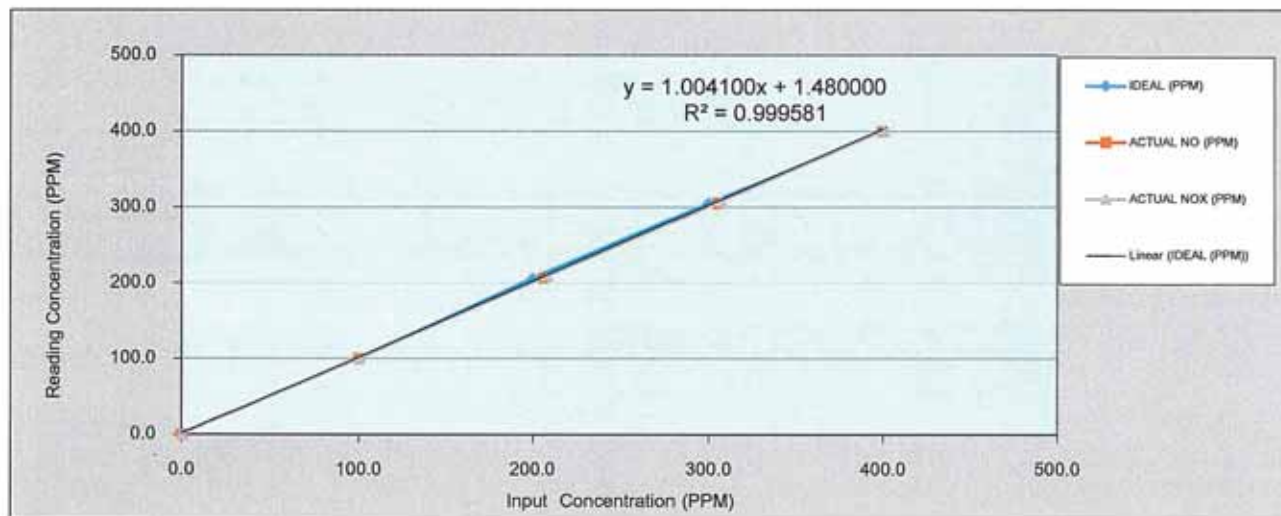
CERTIFIED DATE : Mar 10 2021

CERTIFIED BY : AIRGAS SPECIALTY GASES

EXPIRED DATE : Mar 10 2029

CALIBRATION RESULTS

POINT NO	CALIBRATION RESULTS						
	IDEAL (PPM)	ACTUAL NO (PPM)	ERROR NO (PPM)	% ERROR NO	ACTUAL NO _x (PPM)	ERROR NO _x (PPM)	% ERROR NO _x
ZERO	0.00	0.10	0.10	-	0.00	0.00	-
1	100.00	100.10	0.10	0.10	100.60	0.60	0.60
2	200.00	206.40	6.40	3.20	208.70	8.70	4.35
3	300.00	305.40	5.40	1.80	307.30	7.30	2.43
4	400.00	399.50	-0.50	-0.13	400.50	0.50	0.13
AVERAGE (%)				0.01			0.01



CALIBRATED BY : คุณพรชัย ผาติวนารักษ์

DATE : 20/02/2566

ต้องการข้อมูลทางด้านเทคนิคเพิ่มเติม : คุณพรชัย ผาติวนารักษ์ โทรศัพท์ : 02-515-8987

[Signature]

เลขที่ 388 ถนนรัชดาภิเษก แขวงจันทระเกษม เขตจตุจักร กรุงเทพฯ 10900 โทรศัพท์ : 0-2515-8999 โทรสาร : 0-2515-8988 E-Mail : Info@kinetics.co.th

รายงานผลการซ่อมและปรับเทียบอุปกรณ์ตรวจวัดคุณภาพอากาศ

ลูกค้า / หน่วยงาน : บริษัท ซีวีและสิ่งแวดล้อม จำกัด

วันที่ : 20/02/2566

รายชื่ออุปกรณ์ / เครื่องมือ : NO_x Analyzer

บริษัทผู้ผลิต : Teledyne API

รุ่นของอุปกรณ์ / เครื่องมือ : 200E

หมายเลขอุปกรณ์ / เครื่องมือ : 2288

TEST VALUES			
API MODEL 200E		BEFORE	AFTER
1	RANGE	50 - 20,000 PPM	500.0
2	STABILITY	≤ 1 PPM	0.2
3	SAMPLE FLOW	500 ± 10% cc/min	488
4	OZONE FLOW	80 ± 10% cc/min	80
5	PMT	mV	61.1
6	NORM PMT	mV	-5.1
7	A ZERO	-20 To 150 mV	56.8
8	HPVS	400 - 900 V	728
9	RX CELL TEMP	50 ± 1 °C	49.8
10	BOX TEMP	AMBIENT ± 5 °C	29.0
11	PMT TEMP	7 ± 2 °C	6.8
12	MOLY TEMP	315 ± 5 °C	316.5
13	RX CELL PRESSURE	< 10 in - Hg-A	5.1
14	SAMPLE PRESSURE	25 - 35 in - Hg-A	29.5
15	NOX SLOPE	1.0 ± 0.3	1.038
16	NOX OFFSET	-50 To 150	0.5
17	NO SLOPE	1.0 ± 0.3	0.998
18	NO OFFSET	-50 To 150	-2.9
19	NO SAMPLE READING	PPM	1.6
20	NO ₂ SAMPLE READING	PPM	3.9
21	NO _x SAMPLE READING	PPM	5.5
22	OPTIC TEST	2000 ± 1000 mV	2613.6
23	ELECTRICAL TEST	2000 ± 1000 mV	2477.2
24	VOLTAGE TEST	+5 V +12 V +15 V -15 V	5.20/ 12.50 /15.60/ -15.14
25	ZERO GAS NO / NO _x	0.00 / 0.00 PPM	2.4/ 2.7
26	SPAN GAS NO / NO _x	400.00 / 400.00 PPM	332.1/ 209.9

หมายเหตุ

- เปลี่ยน O -Ring 6 PCs , เปลี่ยน SS Filter 3 PCs ,เปลี่ยน Spring 3 PCs



ลงนามเจ้าหน้าที่ (Signature)

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04NI99E15A0822	Reference Number: 160-402045691-1
Cylinder Number: CC745169	Cylinder Volume: 144.4 CF
Laboratory: 124 - Plumsteadville - PA	Cylinder Pressure: 2015 PSIG
PGVP Number: A12021	Valve Outlet: 680
Gas Code: CO,NO,NOX,SO2,BALN	Certification Date: Mar 10, 2021

Expiration Date: Mar 10, 2029

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

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

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	53.00 PPM	53.40 PPM	G1	+/- 1.1% NIST Traceable	03/03/2021, 03/10/2021
NITRIC OXIDE	53.00 PPM	53.40 PPM	G1	+/- 1.1% NIST Traceable	03/03/2021, 03/10/2021
SULFUR DIOXIDE	53.00 PPM	53.79 PPM	G1	+/- 0.9% NIST Traceable	03/03/2021, 03/10/2021
CARBON MONOXIDE	4500 PPM	4512 PPM	G1	+/- 0.6% NIST Traceable	03/03/2021, 03/10/2021
NITROGEN	Balance				03/04/2021

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	07060227	EB0079116	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Jul 23, 2023
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	16010203	KAL003087	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/-0.8%	Dec 23, 2021
NTRM	08012341	KAL004716	4857 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 07, 2024

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 N1KD579	NDIR	Feb 26, 2021
Nicolet IS50 FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicolet IS50 FTIR AUP2010245 NO2	FTIR	Feb 22, 2021
Nicolet IS50 FTIR AUP2010245 SO2	FTIR	Feb 18, 2021

Triad Data Available Upon Request

NOTES:

Gross Weight: 28.1 Kg
Net Weight: 4.6 Kg



Approved for Release

Test Report Calibration

Ecotech EC9841 Nitrogen Oxides Analyzer

Issued By	Sithiporn Associates Company Limited	Calibration Date	2-Mar-2023
Owner Name	Life & Environment Co.,Ltd.	Product Brand	Ecotech
Certificate Number	17690-1	Type Systematic	Analyzer Ambient Monitoring

Model :	EC9841	Serial Number :	02-0409
---------	--------	-----------------	---------

Calibration Standard equipment : Std. Gas Mixture Cylinder Number EB0140749 Expired Date 10-Mar-2024

Brand : Airgas

Components

Carbon Monoxide (CO)
Nitric Oxide (NO)
Sulfur Dioxide (SO₂)
Nitrogen (N₂)

Concentration

4498 PPM
45.69 PPM
45.54 PPM
Balance

Calibration Setting

Span Instrument Gain 9.637

Start Time 13:00

Reading (After Adj.)			
Span Set Point	Expected Concentration (PPB)	Analyzer Response (PPB)	Error %
Zero NO	0	0	-
Zero NO _x	0	1	-
Span NO	400	399	-0.25
Span NO _x	400	401	0.25

Span Instrument Gain 13.546

Finish Time 13:35

Signature

บริษัท สิทธีพรแอสโซซิเอต จำกัด
SITHIPHORN ASSOCIATES COMPANY LIMITED
Approved

RON

บริษัท สิทธีพร แอสโซซิเอต จำกัด

Sithiporn Associates Co., Ltd.

451-451/1 ถนนสีรินธร แขวงบางนาพรุ เขตบางพลัด กรุงเทพฯ 10700 โทร. 0-2433-8331, 0-2435-8800, 0-2434-9191 แฟกซ์ : 0-2433-1679, 0-2434-9510
451-451/1 Sirinthorn Road, Bangbunru, Bangplud, Bangkok 10700 Thailand Tel. (662) 433-8331, 435-8800, 434-9191 Fax: (662) 433-1679, 434-9510

EMAIL:center@sithiphorn.com www.sithiphorn.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E04NI99E15A00V3	Reference Number:	160-402036564-1
Cylinder Number:	EB0140749	Cylinder Volume:	144.4 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
PGVP Number:	A12021	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Mar 10, 2021

Expiration Date: Mar 10, 2024

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

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

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.70 PPM	G1	+/- 1.1% NIST Traceable	03/03/2021, 03/10/2021
NITRIC OXIDE	45.00 PPM	45.69 PPM	G1	+/- 1.1% NIST Traceable	03/03/2021, 03/10/2021
SULFUR DIOXIDE	45.00 PPM	45.54 PPM	G1	+/- 1.1% NIST Traceable	03/03/2021, 03/10/2021
CARBON MONOXIDE	4500 PPM	4498 PPM	G1	+/- 0.6% NIST Traceable	03/04/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	200611-04	CC707968	49.82 PPM NITRIC OXIDE/NITROGEN	+/-1.0%	Feb 02, 2025
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL003190	49.67 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 20, 2022
NTRM	08012341	KAL004718	4857 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 07, 2024

The SRM, PRM or RGM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 N1KD579	NDIR	Feb 26, 2021
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Nicolet IS50 FTIR AUP2010245 SO2	FTIR	Feb 18, 2021

Triad Data Available Upon Request

NOTES:

Gross Weight: 28.4 Kg
Net Weight: 4.6 Kg
PO# 5221000722



Approved for Release



Maintenance and Calibration Report

Wind Direction Sensor

Met One Instrument

Model: 034B

S/N. : Y1846

Date 31 January 2023

Start Time 14:30

Data Logger : Metone

Model: 466A

S/N.: Y1191

Customer : Life & Environment Co.,Ltd.

Maintenance

Replace Front Bearing

☐ Yes ☒ No

Replace Back Bearing

☐ Yes ☒ No

Replace Potentiometer

☐ Yes ☒ No

Calibration Result

Reading			Analog Output (Volt)	
Expected	Logger	% Error	Expected	Measured
360,0	0	0.0	2.500	2.500
90	90	0.0	0.625	0.625
180	180	0.0	1.250	1.250
270	270	0.0	1.875	1.875

Finish Time 17:00

Comment : Check the rotation of WD (potentiometer) is change as characteristic.

Performed rotate the WD increase 90 degree per 1 step from 0.360 , 90, 180 and 270 degree.

Data Logger Metone Model 466A, S/N. Y1191

Engineer Name :



Maintenance and Calibration Report

Wind Speed Sensor

Met One Instrument	Model: 034B	S/N. : Y1846
Date 31 January 2023		Start Time 14:30
Calibrator : Metone	Model: 053-220	S/N.: W15225
Data Logger : Metone	Model: 466A	S/N.: Y1191

Customer : Life & Environment Co.,Ltd.

Maintenance

Replace Front Bearing	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Replace Back Bearing	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Replace Shaft Coupler	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Replace Hub	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No

Testing Result

Generate Speed	Reading		% Error
	Expect (MPS)	Logger	
0	0.30	0.30	0.0
100	2.94	3.10	-5.4
200	5.61	5.50	2.0
300	8.27	8.30	-0.4
400	10.93	11.10	-1.6
500	13.60	13.50	0.7

Finish Time 17:00

Comment : Set the offset of WS is 0.3 m/s.

Test by force to rotate the WS sensor from 0 - 500 round per second.

Data Logger Metone Model 466A, S/N. Y1191

Engineer Name :





Calibration Report

Certificate Number : SPR23020564-1

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Sound Level Calibrator	ST-120	211203773	EEL.BP. 114/0166	17 Jan 2024

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. : SPR23020564-1

Range : 94 to 114 dB

Select A

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.1	94.1	0.1	0.1	0.15
114	113.9	113.9	-0.1	-0.1	0.15

Select C

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.1	94.1	0.1	0.1	0.15
114	113.9	113.9	-0.1	-0.1	0.15

Select Z

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.1	94.1	0.1	0.1	0.15
114	113.9	113.9	-0.1	-0.1	0.15

Note:

Measurement Uncertainty

- End of Certificate -



Certificate of Calibration

Certificate Number : SPR23020564-2

Page : 1 of 3

Customer : Life and Environment Co., Ltd.

90, 92, 94 Soi On-Nuch 64, Srinakarin Rd., On-Nuch, Suanluang,
Bangkok 10250

Equipment Name : Sound Level Meter

Manufacturer : Pulsar

Model : 45

Serial Number : PN2450

ID. Number : N/A

Environmental Conditions

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

Received Date : 28 Feb 2023

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

Calibration Date : 01 Mar 2023

Location of Calibration : In-Lab

Recommend Due Date : 01 Mar 2024

Calibration Procedure : SP-CPE-04-01

Date of Issue : 02 Mar 2023

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 : Mr.Chumpon Dokpikul

Approved by :

Calibration Officer

(Ms.Bussakorn Chaikaew)

Authorized Signatory



Calibration Report

Certificate Number : SPR23020564-2

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Sound Level Calibrator	ST-120	211203773	EEL.BP. 114/0166	17 Jan 2024

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. : SPR23020564-2

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	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	113.9	113.9	-0.1	-0.1	0.15

Select Z

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

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 : SPR23020564-3

Page : 1 of 3

Customer : Life and Environment Co., Ltd.

90, 92, 94 Soi On-Nuch 64, Srinakarin Rd., On-Nuch, Suanluang,
Bangkok 10250

Equipment Name : Sound Level Meter

Manufacturer : Pulsar

Model : 45

Serial Number : PN2451

ID. Number : N/A

Environmental Conditions

Ambient Temperature : $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$ Received Date : 28 Feb 2023

Relative Humidity : $50\% \pm 15\%$ Calibration Date : 01 Mar 2023

Location of Calibration : In-Lab Recommend Due Date : 01 Mar 2024

Calibration Procedure : SP-CPE-04-01 Date of Issue : 02 Mar 2023

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 : Mr.Chumpon Dokpikul

Calibration Officer

Approved by :

(Ms.Bussakorn Chaikaew)

Authorized Signatory



Calibration Report

Certificate Number : SPR23020564-3

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Sound Level Calibrator	ST-120	211203773	EEL.BP. 114/0166	17 Jan 2024

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. : SPR23020564-3

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	94.1	94.1	0.1	0.1	0.15
114	114.0	114.0	0.0	0.0	0.15

Select C

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.1	94.1	0.1	0.1	0.15
114	114.0	114.0	0.0	0.0	0.15

Select Z

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.1	94.1	0.1	0.1	0.15
114	114.0	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 -



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0221

MTC No. EEL. BP. 159/0166

CALIBRATION CERTIFICATE

Submitted by : Life and Environment Co., Ltd.

Address : 90,92,94 Soi On-Nuch 64, Srinakarin Rd., On-Nuch, Suanluang, Bangkok 10250.

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 :

Description : Integrating Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial No. : 142011

Microphone : Type 7052NR No.52766

Preamplifier : -

Ambient Environment

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

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

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

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
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 : 16 Jan. 2023

Date of Calibration : 7-8 Feb. 2023

1 / 9

Ph.

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

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FM.BL.MTC.002 Rev.4

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Amphoe Muang, Changwat Samutprakan 10280, Thailand
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Thailand
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E-mail : sumalee@tistr.or.th



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0221

MTC No. EEL. BP. 159/0166

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 (2013). 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 : 7-8 Feb. 2023

2 / 9

Ph.

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0221

MTC No. EEL. BP. 159/0166

1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.96	114.2	114.0	0.0	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 114.2 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
18.3	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	13.9	0.10	N/A
C-Weight	20.2	0.10	N/A
Flat	25.9	0.10	N/A

Date of Calibration : 7-8 Feb. 2023

3 / 9

Ph

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FM.BL.MTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0221

MTC No. EEL. BP. 159/0166

3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response			Acceptance limit class 2 (dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
	A-weight	C-weight	Flat			
125	0.2	0.1	0.2	± 1.5	0.45	0.6
1 000	-0.4	-0.4	-0.4	± 1.0	0.45	0.6
8 000	-4.1	-4.1	-3.8	± 5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response			Acceptance limit class 2 (dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
	A-weight	C-weight	Flat			
63	0.1	0.1	0.0	± 2.0	0.20	0.6
125	-0.1	0.0	0.0	± 1.5	0.20	0.6
250	0.0	0.0	0.0	± 1.5	0.20	0.6
500	0.0	0.0	0.0	± 1.5	0.20	0.6
1 000	0.0	0.0	0.0	± 1.0	0.20	0.6
2 000	-0.2	-0.1	0.1	± 2.0	0.20	0.6
4 000	-0.4	-0.3	0.0	± 3.0	0.20	0.6
8 000	-0.5	-0.4	-0.2	± 5.0	0.20	0.7

Date of Calibration : 7-8 Feb. 2023

4 / 9

Ph

The results relate only to the items tested/calibrated or value assigned.
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FM.BLMTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0221

MTC No. EEL. BP. 159/0166

5. Long-term stability

Time	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.1	0.1	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 7-8 Feb. 2023

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Ph.

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FM.BLMTC.002 Rev.4

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0221

MTC No. EEL. BP. 159/0166

7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
122	122.2	0.2	1.1	0.30	0.3
121	121.2	0.2	1.1	0.30	0.3
120	120.2	0.2	1.1	0.30	0.3
119	118.9	-0.1	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.1	0.1	1.1	0.30	0.3
104	104.1	0.1	1.1	0.30	0.3
99	99.1	0.1	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.1	0.1	1.1	0.30	0.3
84	84.1	0.1	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.1	0.1	1.1	0.30	0.3
69	69.2	0.2	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	54.0	0.0	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3
34	34.0	0.0	1.1	0.30	0.3

Date of Calibration : 7-8 Feb. 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0221

MTC No. EEL. BP. 159/0166

7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
33	33.2	0.2	1.1	0.30	0.3
32	32.2	0.2	1.1	0.30	0.3
31	31.3	0.3	1.1	0.30	0.3
30	30.3	0.3	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	94.0	94.1	0.1	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	94.0	0.0	1.1	0.30	0.3
20-100	94.0	93.9	-0.1	1.1	0.30	0.3

Date of Calibration : 7-8 Feb. 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0221

MTC No. EEL. BP. 159/0166

8. Level linearity including the level range control

At reference level at 5 dB greater than the signal level that first clause an indication of under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (\pm dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
40-130	45	45.0	0.0	1.1	0.30	0.3
30-120	35	35.0	0.0	1.1	0.30	0.3
20-110	25	25.3	0.3	1.1	0.30	0.3
20-100	25	25.5	0.5	1.1	0.30	0.3
20-90	25	25.2	0.2	1.1	0.30	0.3
20-80	25	25.4	0.4	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (\pm dB)	Maximum-permitted uncertainty of measurement (\pm dB)
Fast	200	115.8	-0.2	± 1.0	0.20	0.3
	2	98.8	-0.2	+1.0; -2.5	0.20	0.3
	0.25	89.6	-0.4	+1.5; -5.0	0.20	0.3
Slow	200	109.4	-0.2	± 1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
SEL	200	109.9	-0.1	± 1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 7-8 Feb. 2023

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FM.8L.MTC.002 Rev.4

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0221

MTC No. EEL. BP. 159/0166

10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.8	0.4	3.0	0.20	0.35
Positive half cycle	124.4	124.2	-0.2	2.0	0.20	0.35
Negative half cycle	124.4	124.2	-0.2	2.0	0.20	0.35

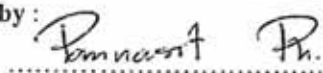
11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
131.1	131.1	0.0	2.0	0.20	0.25

12. High-level stability


Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	119.0	0.0	0.3	0.10	0.1
End	119.0				

Calibrated by :



(Mr. Pannasit Phasingsri)

Approved by :



(Mr. Prawate Kluaypa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 7-8 Feb. 2023

Date of Issue : 13 Feb. 2023

Ref : 2011266011600170002

End of Certificate

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Certificate of Calibration

Certificate Number : SPR23030570-2

Page : 1 of 3

Customer : Life and Environment Co., Ltd.

90, 92, 94 Soi On-Nuch 64, Srinakarin Rd., On-Nuch, Suanluang,
Bangkok 10250

Equipment Name : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial Number : 142012

ID. Number : NO.4

Environmental Conditions

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

Received Date : 31 Mar 2023

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

Calibration Date : 07 Apr 2023

Location of Calibration : In-Lab

Recommend Due Date : 07 Apr 2024

Calibration Procedure : SP-CPE-04-01

Date of Issue : 08 Apr 2023

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 : Mr.Chumpon Dokpikul

Approved by :

Calibration Officer

(Mr.Nirut Loha)

Authorized Signatory



Calibration Report

Certificate Number : SPR23030570-2

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Sound Level Calibrator	ST-120	211203773	EEL.BP. 114/0166	17 Jan 2024

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. : SPR23030570-2

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	113.8	113.8	-0.2	-0.2	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	113.7	113.7	-0.3	-0.3	0.15

Select Z

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.0	94.0	0.0	0.0	0.15
114	113.7	113.7	-0.3	-0.3	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 : SPR23030570-1

Page : 1 of 3

Customer : Life and Environment Co., Ltd.

90, 92, 94 Soi On-Nuch 64, Srinakarin Rd., On-Nuch, Suanluang,
Bangkok 10250

Equipment Name : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial Number : 142013

ID. Number : No.5

Environmental Conditions

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

Received Date : 31 Mar 2023

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

Calibration Date : 07 Apr 2023

Location of Calibration : In-Lab

Recommend Due Date : 07 Apr 2024

Calibration Procedure : SP-CPE-04-01

Date of Issue : 08 Apr 2023

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 : Mr.Chumpon Dokpikul

Approved by :

Calibration Officer

(Mr.Nirut Loha)

Authorized Signatory



Calibration Report

Certificate Number : SPR23030570-1

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Sound Level Calibrator	ST-120	211203773	EEL.BP. 114/0166	17 Jan 2024

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. : SPR23030570-1

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	113.7	113.7	-0.3	-0.3	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	113.7	113.7	-0.3	-0.3	0.15

Select Z

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.1	94.1	0.1	0.1	0.15
114	113.8	113.8	-0.2	-0.2	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 -



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0221

MTC No. EEL. BP. 158/0166

CALIBRATION CERTIFICATE

Submitted by : Life and Environment Co.,Ltd.

Address : 90,92,94 Soi On-Nuch 64, Srinakarin Rd., On-Nuch, Suanluang, Bangkok, 10250.

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

Instrument Calibrated :

Description : Acoustic Calibrator

Manufacturer : Quest Technologies

Model : QC-20

Serial No. : QOF110014

Ambient Environment

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

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

Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$

Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.

2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.

3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.

4. Digital Multimeter Agilent 34401A S/N MY44005560.

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

6. Audio Analyzer Keithley 2015-P S/N 4106495.

7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871.

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

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

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

Date of Receipt : 16 Jan. 2023

Date of Calibration : 23 Jan. 2023

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0221

MTC No. EEL. BP. 158/0166

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

Nominal Output of Unit Under Test = 94 dB re 20 μ Pa at 1000 Hz

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	93.95	-0.05	± 0.10	± 0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	999.4	-0.6	± 1.5	$\pm 1.0\%$

3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	2.65	± 0.70	$\pm 3.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Date of Calibration : 23 Jan. 2023

2/3

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0221

MTC No. EEL. BP. 158/0166

Nominal Output of Unit Under Test = 114 dB re 20 μ Pa at 1000 Hz

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	113.95	-0.05	± 0.10	± 0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	999.4	-0.6	± 1.5	$\pm 1.0\%$

3. Total Distortion


Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	0.40	± 0.50	$\pm 3.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :


(Mr. Weerachai Deechaiyae)

Approved by :


(Mr. Prawate Kluaypa)
Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 23 Jan. 2023

Date of Issue : 24 Jan. 2023

Ref : 2011266011600170001

End of Certificate

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BARA SCIENTIFIC CO., LTD.

PREVENTIVE MAINTENANCE/ CALIBRATION

GC SYSTEM

GC-14B/C-R5A

ID NO.	:
REPORT NO.	:C-A3-TK-6611-0300
DATE OF REPORT	:15 November 2023
COMPLETION DATE	:15 November 2023
NEXT DUE DATE	:On November 2024

GAS CHROMATOGRAPHY

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PHONE	02-320-0277-8 EXT.304,308
FAX	023200293
DONE BY	Mr.Thanawat Pumpaka
SERVICE REPORT NO.	TK-6611-0300

SIGNED FOR AND ON BEHALF OF
BARA SCIENTIFIC CO.,LTD.



MR.Thanawat Pumpaka



บริษัท พาราไซแอนติฟิค จำกัด
BARA SCIENTIFIC CO., LTD.

CERTIFICATE

THIS CERTIFIES THE PERFORMANCE OF SHIMADZU GAS CHROMATOGRAPHY AT

LIFE AND ENVIROMENT CO., LTD.ADDRESS : 90,92,94 SOI ON-NUCH 64,
SRINAKARIN ROAD,SUANLUANG, BANGKOK 10250.

SYSTEM CONFIGURATION : GC-14B, C-R5A

DETECTOR TYPE : FLAME IONIZATION DETECTOR (FID)

METHOD : SENSITIVITY TEST OF FID BY SHIMADZU CORPORATION, JAPAN.

CHEMICAL : N-HEXADECANE(C₁₆) 100ng/uL (HEPTANE SOVENT)

SPECIFICATION OF FID :S(C/g)OF C16 IS MORE THAN 0.01(C/g)

RESULT : SENSITIVITY OF FID CH1 = 0.0163 C/g

REPRODUCIBILITY : Area Value CH1 CV \leq 10.00 % = 1.566 %

Retention Time CH1 CV \leq 2.00 % = 0.348 %

ISSUED ON : 15 November 2023

ISSUED AT : SERVICE SECTION, BARASCIENTIFIC CO.,LTD.

APPROVED BY :



(Mr.Thanawat Pumpaka)

SERVICE ENGINEER

Sartorius (Thailand) Co., Ltd.

129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310

Tel: +66 2643 8361-8, e-mail: service.thailand@sartorius.com



NSC-TIS-TIS 17025

CALIBRATION No.0426

SARTORIUS

Certificate of Calibration

Model Number : MSE125P-100-DU Certificate No. : 22BCI0254
Description : Semi-micro Balance Issued Date : Monday, September 19, 2022
Serial Number : 28606077 Reference No. : 193856
Manufacturer : Sartorius Page No. : 1 Of 3

Customer Name : Life and Environment Co.,Ltd.
90,92,94 Soi On-Nuch 64, Srinakarin Rd., Suanluang Suanluang Bangkok 10250 Thailand.

Calibrated Place : Lab Room

Calibrated By : Mr. Chonchai Inthana Calibration
Calibration Date : Friday, September 16, 2022 Procedure No. : This calibration was conducted by
Using in-house calibration procedure number (WI-003)
Based on UKAS LAB 14 : 2019

Metrological data :

Capacity : 60 /120 g Readability : 0.01/0.1 mg Temperature : 24.7 °C ± 5.0 °C

Humidity : 44.0 % RH ± 10.0 % RH

Pressure : ±

Reasons for calibration

☐ New Installation ☐ Service / Repaired ☒ Re-calibration/ Maintenance

Equipment Condition: ☒ Good Operate ☐ Fair

Measurement Method UKAS Publication Ref :Lab 14

The measurement uncertainty stated is the expended 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). The calibration certificate documents the traceability to National Standards, which realise the unit of measurement according to the International Standard System of Units (SI). Report of Tolerance came from list of Sartorius Metrological Specifications.

Traceability:

Model Number	Description	Traceability	Certificate No.	Due Date
YCS011-522-00	Sartorius weight set 1mg - 5000g E2,YCS011-522-00	SPC-RT	C02212565	14-Sep-2023
MHB-382SD	Humidity/Barometer/Temp Lutron MHB-382SD	SPC-RT	C19220444	5-Sep-2023

This certificate relate and apply this equipment only.

This certificate may not be reproduced other than in full except with the prior written approval of the Verification Operation Division Sartorius (Thailand) Co., Ltd.

SOP FM 33 03 February 2022

Mr.Chonchai Inthana(Technical Manager)

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T
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Sartorius (Thailand) Co., Ltd.

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SARTORIUS

Certificate of Calibration

Model Number : MSE125P-100-DUDescription : Semi-micro BalanceSerial Number : 28606077Manufacturer : SartoriusCertificate No. : 22BCI0254Issued Date : Monday, September 19, 2022Reference No. : 193856Page No. : 2 of 3

Calibration Results : Without Adjustment

Repeatability

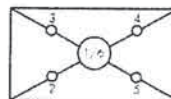
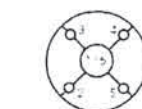
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

Nominal Value : (Low Load)	5.00001	50.00002
5 g	5.00001	50.00002
Tolerance	5.00001	50.00002
0.000015 g	5.00001	50.00002
	5.00002	50.00002
Nominal Value : (High Load)	5.00001	50.00001
50 g	5.00002	50.00001
Tolerance	5.00002	50.00001
0.000015 g	5.00001	50.00002
	5.00001	50.00002
Standard Deviation	0.000005	0.000005

Eccentricity (Off-center loading error)

The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R76).

Nominal value : 50 g
Tolerance 0.00015 g



Difference

1	—
2	-0.00003
3	0.00000
4	0.00000
5	-0.00003
6	—

Linearity

The linearity, also called linearity error. Describes the deviation of the characteristic curve of a weighing instrument from the linear slope.

Tolerance 0.00004 g

Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
0.01	0.01000	0.01000	0.00000	0.000013
0.1	0.10000	0.10000	0.00000	0.000014
1	1.00000	1.00000	0.00000	0.000017
2	2.00002	2.00002	0.00000	0.000019
5	5.00002	5.00002	0.00000	0.000023
10	10.00002	10.00003	0.00001	0.000029
20	20.00000	20.00001	0.00001	0.000047
30	30.00002	30.00003	0.00001	0.000089
40	40.00003	40.00004	0.00001	0.000089
50	50.00002	50.00002	0.00000	0.000089

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SARTORIUS

Certificate of Calibration

Model Number : MSE125P-100-DUDescription : Semi-micro BalanceSerial Number : 28606077Manufacturer : SartoriusCertificate No. : 22BCI0254Issued Date : Monday, September 19, 2022Reference No. : 193856Page No. : 3 of 3**Calibration Results : Without Adjustment****Repeatability**

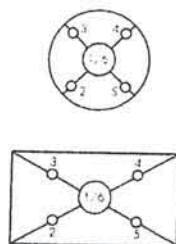
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

Nominal Value : (Low Load)		100.0000
g		100.0000
Tolerance		100.0000
0.00006 g		100.0000
		100.0000
		100.0000
Nominal Value : (High Load)		100.0000
100 g		100.0000
Tolerance		100.0000
0.00006 g		100.0000
		100.0000
		100.0000
Standard Deviation		0.00000

Eccentricity (Off-center loading error)

The off-center loading error is yielded by the difference between the readout of the load, i.e. 1/3 or 1/4 of maximum capacity, placed in the middle of the weighing pan and between each of four additional measurement points (positions defined according to OIML R76).

Nominal value : 50 g
Tolerance 0.00015 g

**Difference**

1	-
2	-
3	-
4	-
5	-
6	-

Linearity

The linearity, also called linearity error. Describes the deviation of the characteristic curve of a weighing instrument from the linear slope.

Tolerance 0.00015 g

Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
65	65.0001	65.0001	0.0000	0.00014
70	70.0000	70.0001	0.0001	0.00013
75	75.0000	75.0001	0.0001	0.00015
80	80.0000	80.0001	0.0001	0.00015
85	85.0001	85.0001	0.0000	0.00017
90	90.0001	90.0001	0.0000	0.00017
95	95.0001	95.0001	0.0000	0.00019
100	100.0000	100.0000	0.0000	0.00026
110	110.0000	110.0000	0.0000	0.00026
120	120.0000	120.0000	0.0000	0.00026

End of Report.

Accredited by

NSC-TISI-TIS 17025

Calibration 0426



Calibration certificate

Calibration Certificate No. 23BCI0349

Object	Electronic non-automatic weighing instrument	This calibration certificate documents the traceability to national standards.
Manufacturer	Sartorius	Uncertainties of measurements are taken into account when only statements of compliance are made.
Type	MSE125P-100-DU	This certificate was prepared by Sartorius Corporation in accordance to the current ISO/IEC 17025:2017 standard and Sartorius Work Instruction (Method) SOP WI 08.
Serial QM Ident. no.	0028606077 N/A	This certificate relate and apply this equipment only.
Customer	Life and Environment Co., Ltd. 90, 92, 94 Soi On-Nuch 64, Srinakarin Road, On-Nuch, Suanluang, Bangkok 10250. Thailand.	
Order no.	218684	
Number of pages	4	
Date of calibration	15 Sep 2023	

This calibration certificate may not be reproduced other than in full except with the permission of NSC-TISI-TIS-17025 and the issuing laboratory. Calibration certificates without signature are not valid.

The user is obliged to have the object recalibrated at appropriate intervals.

Date 15 Sep 2023 Approval of the Calibration Certificate Person in charge

Chonchai Inthana

Chonchai Inthana

Mr. Chonchai Inthana

Chonchai Inthana

Calibration object

Multi interval instrument

Model	MSE125P-100-DU	
Serial Number	0028606077	
QM Ident. no Inventory no.	N/A —	
Range	1	2
Maximum capacity (Max. load)	60.00000 g	120.0000 g
Measured range	60.00000 g	120.0000 g
Scale interval	0.00001 g	0.0001 g

Place of calibration

Address	According to page 1
Department Cost center	Laboratory Testing. —
Building Floor	— 1st Floor.
Room	Air(TSP/PM10) Testing Laboratory.
Maximum temperature variation at place of calibration	5 K

Calibration procedure

EURAMET cg-18, V4.0 - Guidelines on the Calibration of Non-Automatic Weighing Instruments

Test equipment

Test equipment type	Test equipment ID	Valid until
Thermometer	MHB382-SD Cer No.C19231845,(Traceable to SI unit through DKSH)	23 Aug 2024
Test weight set OIML R111 E2	Certificate No.M2308197S ,E2(Traceable to SI unit through TCS)	23 Aug 2026

Adjustment Status

The measuring device was internally adjusted before the calibration.

Environmental and measuring conditions

Date of calibration	15 Sep 2023
Temperature at place of calibration Temp. diff. $T_{\text{weights}} - T_{\text{place}}$	25.8 °C 0.2 K
Measuring conditions	The installation site is suitable. The device was levelled. Balance was loaded up to Max before test.
Comments	Humidity 40.0 %RH.

Measurement results | Measurement uncertainties

Repeatability

Test load (nominal): 50 g | 100 g

	50 g	100 g
1	50.00002 g	100.0000 g
2	50.00001 g	100.0000 g
3	50.00001 g	100.0000 g
4	50.00001 g	100.0000 g
5	50.00001 g	100.0000 g
6	50.00002 g	100.0000 g
7	50.00002 g	99.9999 g
8	50.00002 g	100.0000 g
9	50.00001 g	100.0000 g
10	50.00002 g	100.0000 g
s	$s = 0.000005$ g	$s = 0.000003$ g

Eccentricity

Test load (nominal):	50 g
Center	50.00002 g
Front left	50.00001 g
Back left	50.00004 g
Back right	50.00004 g
Front right	50.00001 g
Maximum deviation from centric loading indication $ \Delta/ecc _{\text{max}} = 0.00002$ g	

Error of indication

Testload L	Indication I	Error E	Expansion factor k	Uncertainty $U(E)$	Uncertainty relative $U_{\text{rel}}(E)$
0.01000 g	0.01000 g	0.00000 g	2.00	0.000024 g	-0.24 %
0.10000 g	0.10000 g	0.00000 g	2.00	0.000037 g	0.037 %
1.00000 g	1.00000 g	0.00000 g	2.00	0.000037 g	0.0037 %
10.00002 g	10.00002 g	0.00000 g	2.00	0.000069 g	0.00069 %
20.00002 g	20.00002 g	0.00000 g	2.00	0.000069 g	0.00034 %
55.00004 g	55.00003 g	-0.00001 g	2.00	0.00017 g	0.00031 %
70.0000 g	70.0000 g	0.0000 g	2.00	0.00017 g	0.00024 %
80.0001 g	80.0001 g	0.0000 g	2.00	0.00018 g	0.00023 %
100.0000 g	100.0000 g	0.0000 g	2.00	0.00017 g	0.00017 %
110.0000 g	110.0000 g	0.0000 g	2.00	0.00028 g	0.00025 %
120.0000 g	120.0000 g	0.0000 g	2.00	0.00028 g	0.00023 %

Maximum error of indication

$|E|_{\text{max}} = 0.00001$ g

$U_{\text{rel}}(E)$ is the quotient of $U(E)$ and test load L . The uncertainty of measurement $U(E)$ is valid only if error E is considered. You will find reference notes on the uncertainty of measurement in use under: Appendix to the calibration certificate | Interpretation of measurement results.

Reference note: The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the documented Expansion factor, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

End of calibration certificate

Uncertainty of measurement in use

Device adjusted before measurement Yes
 Temperature deviation considered 1.5 K (isoCAL active)
 Temperature coefficient considered $1 \cdot 10^{-6}/K$

Uncertainty of the weighing result $U_{g1}(W)$

Partial weighing range 1 | 0.00000 g...60.00000 g

$$U_{g1}(W) = 0.000013 \text{ g} + 3.20 \cdot 10^{-6} \cdot R$$

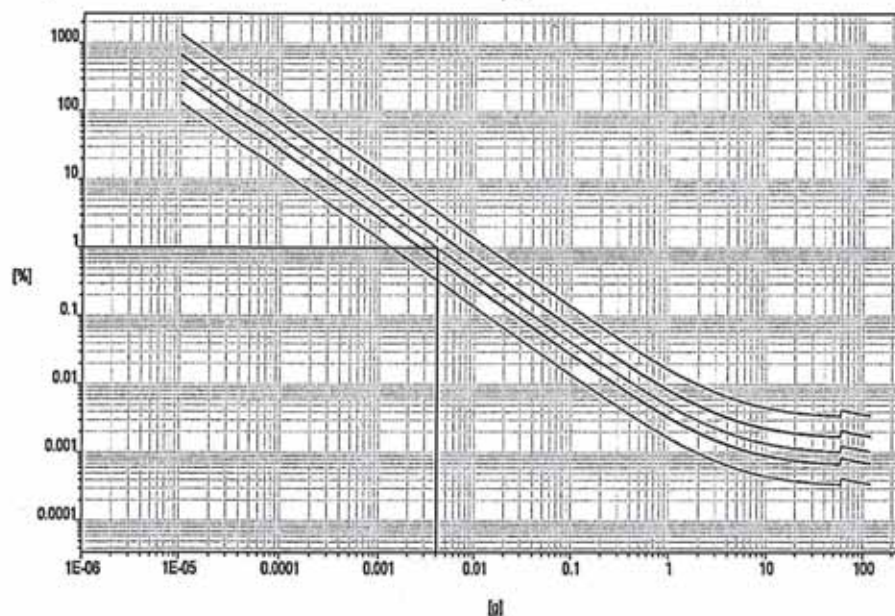
Partial weighing range 2 | 60.00000 g...120.0000 g

$$U_{g1}(W) = 0.000086 \text{ g} + 2.77 \cdot 10^{-6} \cdot R$$

Reference note: The current uncertainty of measurement is calculated by entering of the reading R into this formula. In relation to this, there is no need for a correction of the indication error. The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied with an Expansion factor of 2, determined in accordance with the European Calibration Guideline EURAMET cg-18, V4.0. There is a 95 % probability that the value of the measurand will be in the assigned value range.

Indication in % from Max1	Net indication R	Uncertainty $U_{g1}(W)$	Uncertainty relative $U_{g1}(W)_{rel}$
1 %	0.60000 g	0.000015 g	0.0025 %
25 %	15.00000 g	0.000061 g	0.00041 %
50 %	30.00000 g	0.00011 g	0.00036 %
75 %	45.00000 g	0.00016 g	0.00035 %
100 %	60.00000 g	0.00021 g	0.00034 %

Graphic realization of the relative uncertainty of measurement | process accuracy



Safety factor	
10	
5	
3	
2	
1	

Displayed example

Process accuracy 1.00 %
 Safety factor 3
 Minimum sample weight 0.00400 g



Certificate of Calibration

Equipment:	SPECTROPHOTOMETER	Certificate No.:	C06220637
Model:	CE 1011	Issued Date:	14 December 2022
Serial No. (or ID.):	920-252	Job No.:	KSPR2215667
Manufacturer:	CECIL	Page:	1 of 2
Condition:	In Condition		

Customer: LIFE & ENVIRONMENT CO., LTD.
90, 92, 94 Soi On-nuch 64, Srinakarin Road,
Suanluang, Bangkok 10250 Thailand.

Environment Condition:

Temperature	24.8	°C	±	0.4	°C
Humidity	59.5	%RH	±	2.3	%RH

Calibration Place: LIFE & ENVIRONMENT CO., LTD. (Air Testing Laboratory)
90, 92, 94 Soi On-nuch 64, Srinakarin Road,
Suanluang, Bangkok 10250 Thailand.

Calibration By: Mr.Siwapan Srijan
Calibration Date: 14 December 2022
The Method used: In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04
Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Starna Scientific Limited.

The standard for Wavelength Certificate No. 93907 and 93914

The standard for Photometric Certificate No. 94010



(Mr. Siwapan Srijan)
Person in charge



(Mr. Thalerngkeat Pongngam)
Authorized signatory

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

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

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

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

Calibration Results:
Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 5 nm and UUC at 8 nm

Standard Wavelength	Unit Under Calibration	Correction	Uncertainty
418.40	421.2	-2.80	0.13
447.20	450.5	-3.30	0.13
459.30	459.8	-0.50	0.13
537.00	539.5	-2.50	0.13
638.00	641.3	-3.30	0.13
585.56	589.5	-3.94	0.13

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5816	0.580	0.0016	0.0045
	0.7130	0.715	-0.0020	0.0045
	1.0151	1.018	-0.0029	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.5649	0.560	0.0049	0.0045
	0.7012	0.697	0.0042	0.0045
	0.9982	0.992	0.0062	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.5249	0.523	0.0019	0.0045
	0.6621	0.660	0.0021	0.0045
	0.9420	0.939	0.0030	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5214	0.519	0.0024	0.0045
	0.6982	0.697	0.0012	0.0045
	0.9947	0.992	0.0027	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5549	0.551	0.0039	0.0045
	0.7736	0.765	0.0086	0.0045
	1.1041	1.090	0.0141	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.5621	0.559	0.0031	0.0045
	0.7630	0.757	0.0060	0.0045
	1.0890	1.080	0.0090	0.0045

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด

DKSH Technology Limited

2533 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260

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Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

The End of Certificate

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	MC 572
Console Serial Number	606186
DGM Model Number	SK25EX
DGM Serial Number	0005288

Calibration Conditions		
Date	Time	
Calibration Reference No.		2A/PE660010
Barometric Pressure		760 mm Hg
Calibration Meter Gamma		1.0010 unless

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

Run Time	Calibration Data									
Elapsed (t_e)	DGM Orifice ΔH (P_a) mm H ₂ O	Metering Console			Calibration Meter					
		Volume Initial (V_m) m ³	Volume Final (V_m) m ³	Outlet Temp Initial (t_m) °C	Outlet Temp Final (t_m) °C	Volume Initial (V_w) m ³	Volume Final (V_w) m ³	Outlet Temp Initial (t_w) °C	Outlet Temp Final (t_w) °C	
min										
15.00	13.0	386.9734	387.1422	26	26	329.24232	329.41298	26	26	26
10.00	25.0	387.1556	387.3129	27	27	329.42909	329.56884	27	27	27
8.00	50.0	387.3129	387.4934	27	27	329.59684	329.77018	27	27	27
7.00	80.0	387.4934	387.6936	27	27	329.77018	329.97162	27	27	27
5.00	120.0	387.6936	387.8692	27	27	329.97162	330.14723	27	27	27

Results									
Standardized Data				Dry Gas Meter					
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate		ΔH	
(V_{std})	(Q_{std})	(V_{cal})	(Q_{cal})	Value	Variation	Std & Corr		ΔH_{std}	Variation
m^3	m^3/min	m^3	m^3/min	(%)	(ΔV)	$(Q_{std/corr})$	m^3/min	m^3/min	(ΔH_{corr})
0.166	0.011	0.167	0.011	1.011	0.008	0.011	46.259		0.549
0.154	0.015	0.156	0.016	1.014	0.011	0.016	45.379		-0.232
0.177	0.022	0.177	0.022	1.001	-0.002	0.022	45.295		-0.315
0.197	0.028	0.197	0.028	0.999	-0.004	0.028	45.226		-0.384
0.173	0.035	0.172	0.034	0.990	-0.013	0.034	45.893		0.282
				1.003	Y Average		45.610		ΔH_{std} Average

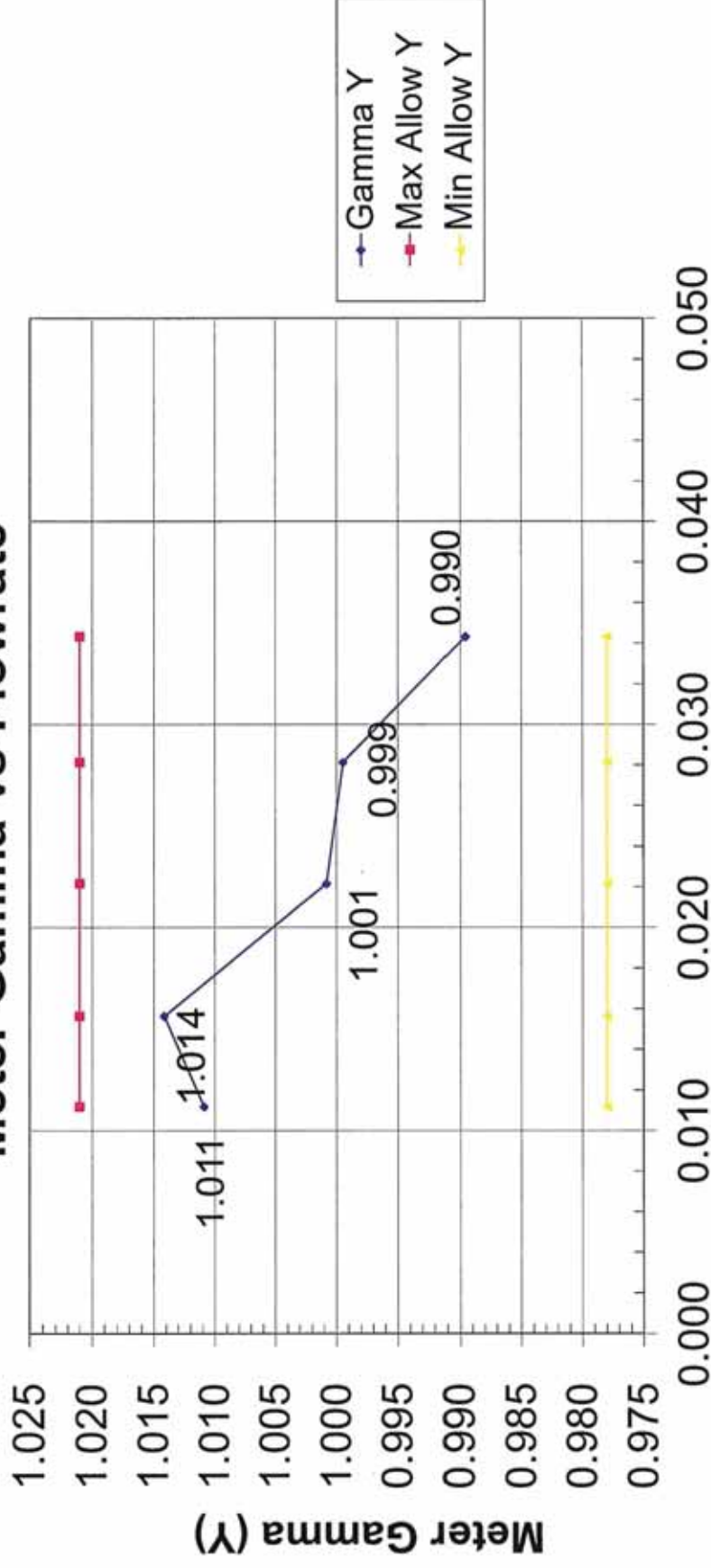
Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ± 0.02 .

Note: For ΔH_{10} , office pressure differential that equates to $0.75 \text{ cfm } (0.0212 \text{ m}^3/\text{min})$ at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 0.2 inches (5.1 mm) H_{sep} .

Signature _____
(Mr. Wichok Ekpongpradit)
Service Engineer

Date 28/11/2022

Meter Gamma vs Flowrate



Flowrate Standardized & Corrected (m³/min)

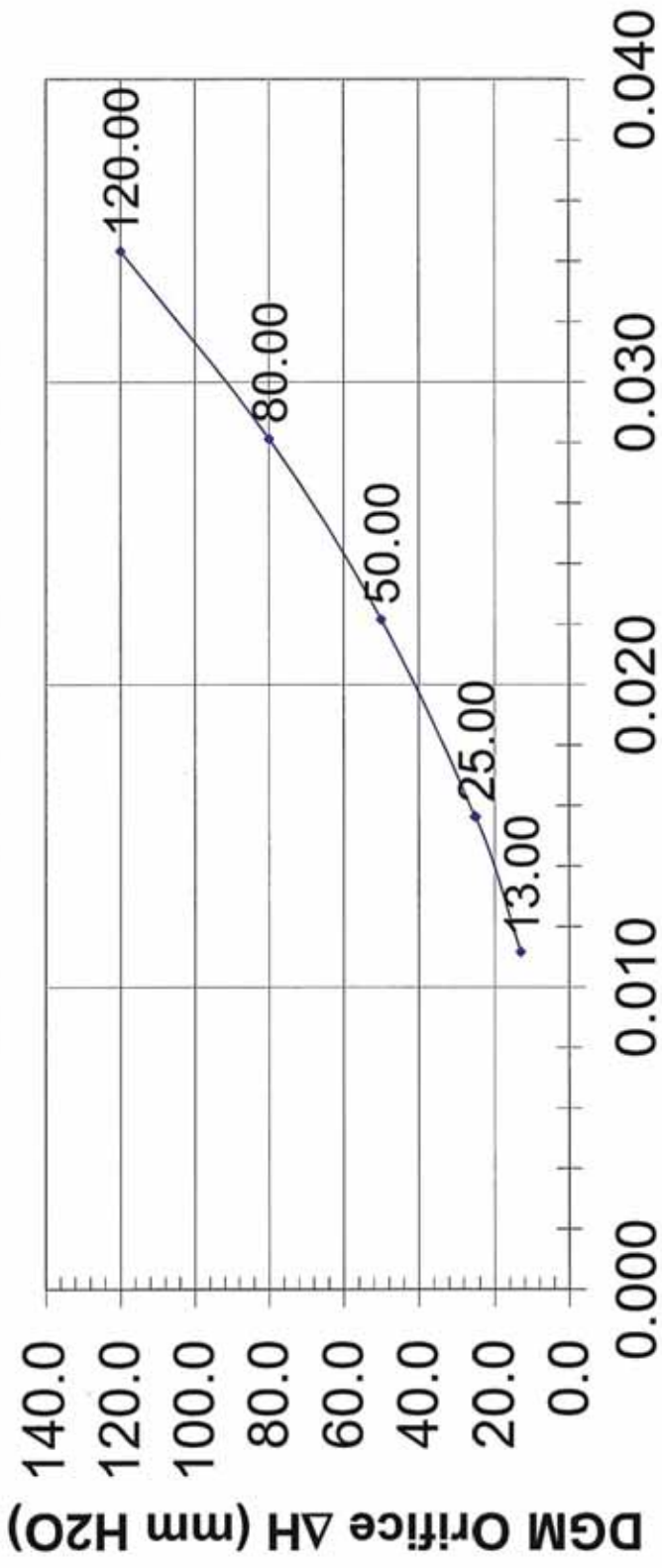
Calibration Date:

28-11-2022

Calibration Reference No:

2APE60010

Meter Pressure vs Flowrate



Flowrate Standardized & Corrected (m³/min)

Console Serial:

605186

Console Model:

MC 572

HEATER SYSTEM CALIBRATION

Sampling System Equipment Information	
Console Model Number	MC 572
Console Serial Number	605186
DGM Model Number	SK25EX
DGM Serial Number	0005288
Probe Heater	Standard Method 5 Assemblies
Heated Filter Box Model	SB-2M

Calibration Conditions			
Date	Time	28-Nov-22	9:30 AM
Calibration Reference No.	2APE660010		
Barometric Pressure	760	mm Hg	

Results				
System Heat	Control Acceptance	Reference thermometer temperature	Thermocouple potentiometer temperature	Temperature difference
	°C	°C	°C	°C
Probe Heater System for Probe 6 Ft.	120 °C \pm 14 °C	120	124	-1.02
Heated Filter Box	120 °C \pm 14 °C	120	125	-1.27

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

Signature _____



Service Engineer

THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information	
Console Model Number	MC-572
Console Serial Number	605186
DGM Model Number	SK25EX
DGM Serial Number	0005288
Meter Box Model Number	JENCO 765-KF
Meter Box Serial Number	JC 10225

Calibration Conditions			
Date	Time	28-Nov-22	9:30 AM
Calibration Reference No.		2APE660010	
Barometric Pressure		760	mm Hg
Reference Thermometer		FLUKE 714	
Serial Number		9038005	

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	-16	25	38	94	151	261	373	485	596	820	1045	
Probe	-16	25	38	94	151							
Filter	-16	25	38	94	151							
Aux	-16	25	38	94	151							
Exit	-16	25	38									

Tolerance Range

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

Aux + 3.0 °C
Exit + 2.0 °C

Temperature difference ≤ 1.5%

Signature _____



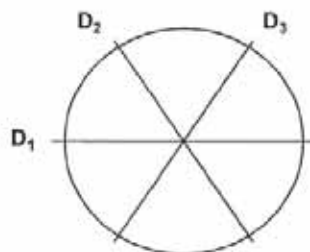
Service Engineer

NOZZLE CALIBRATION

Sampling System Equipment Information		Calibration Conditions			
Console Model Number	MC 572	Date	Time	28-Nov-22	9:30 AM
Console Serial Number	605186	Calibration Reference No.		2APE860010	
DGM Model Number	SK25EX	Barometric Pressure		760	mm Hg
DGM Serial Number	0005288	Calibration		Vernier ,0-150mm	0.01 mm increments
		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	3.18	3.23	3.20	0.025	3.203
6	4.8	4.46	4.45	4.49	0.021	4.467
8	6.4	6.26	6.23	6.28	0.025	6.257
10	8.0	7.75	7.71	7.78	0.035	7.747
12	9.5	9.42	9.46	9.43	0.021	9.437
14	11.1	10.94	10.89	10.95	0.032	10.927
16	12.7	12.61	12.74	12.79	0.093	12.713

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 = (D₁ + D₂ + D₃) / 3



Signature

Service Engineer

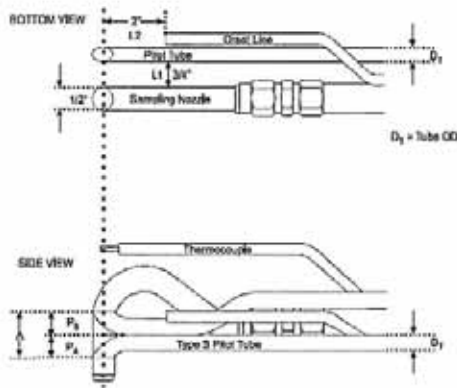
Sampling Probe and Pitot validation

Sampling System Equipment Information	
Probe Sheat	Apex 1 in. , 3 ft.
Probe Number	n/a
Pitot tube Number	A4776
Pitot tube Type	S Type 3/8 inc.
Validation method	Standard Probe validation. with pitot tubs (S)

Calibration Conditions and Equipment	
Reference No.	
Digital Calipers	Mitutoyo 11400118
Digital Inclinator	Laserliner ADJ21L0270
Temperature	25.0 °C
Relative Humidity	60.0 % RH
Validation Date	

Sampling Probe Validation with Tune up

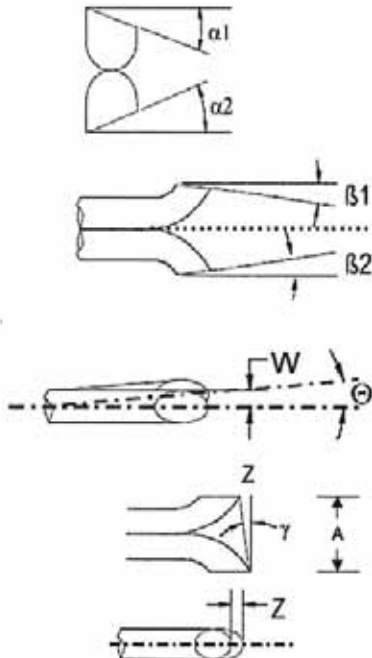
☑ : Measure and Alignment with 1/2" Sampling Nozzle(12.7 mm)



Measured	Standard Range	
L1 =	19.16 mm.	(19.05 mm. or 3/4 in.)
L2 =	50.23 mm.	(50.8 mm. or 2.0 in.)
DT =	9.57 mm.	(9.525 mm., 3/8 in.)
A =	22.32 mm	(2.1 DT ≤ A ≤ 3DT)
A/2DT =	1.166 mm.	(1.05 PA / DT ≤ A ≤ 1.5)

Pitot Tube Validations and Engles measurement Result

☑ : Measure Result after Maintenance and Adjustable



	PB Size	Standard Range	
α1 =	1.45 °	≤ 10°	
β1 =	1.75 °	≤ 5°	
	PA Size		
α2 =	0.80 °	≤ 10°	
β2 =	2.45 °	≤ 5°	
Engles measurement	Calculated Result	Standard Range	
W = 0.05 °	0.019 mm	W < 0.794 mm (1/32 in.)	
Z = 3.25 °	1.267 mm	Z < 3.175 mm (1/8 in.)	

Can be use 0.84 for Cp(s) if the type of face-opening misalignmnet show above with not affect the base line value of Cp(s)
Solong as standard range.

Signature

Service Engineer

METHOD 6 PRE-TEST CONSOLE CALIBRATION
USING REFERENCE METER # WET TEST METER W-NK5A No. 540961
5-POINT METRIC UNIT

Preventive Maintenance & Check

Meter Console Information	
Console Model Number	MC 572
Console Serial Number	505186
DGM Model Number	SK25EX
DGM Serial Number	0005288

Calibration Conditions	
Date	28/11/2022
Time	13:00:00 AM
Calibration Reference No.	2APE660010
Barometric Pressure	755
Calibration Meter Gamma	1.0010
	mm Hg
	Average

Factors/Conversions	
Std Temp	293
Std Press	760
K ₁	0.386
	unitless
	K
	mm Hg
	unitless

Calibration Data									
Metering Console					Reference Meter				
Run Time	Dwyer R Meter P/N VFB-55-SSV Air 4 lpm	Volume Initial (V _{mi})	Volume Final (V _{mf})	Outlet Temp Initial (T _{mi})	Outlet Temp Final (T _{mf})	Volume Initial (V _{ri})	Volume Final (V _{rf})	Outlet Temp Initial (T _{ri})	Outlet Temp Final (T _{rf})
1 (t)	litre/min.	litre/min.	litre/min.	°C	°C	litre/min.	litre/min.	°C	°C
15.00	1.0	387998.20	388012.00	26	26	330445.38	330460.56	26	26
10.00	2.0	388012.00	388033.20	26	26	330460.56	330482.30	26	26
8.00	2.5	388096.00	388117.20	26	26	330545.42	330567.09	26	26
7.00	3.0	388054.40	388075.50	26	26	330503.34	330525.00	26	26
5.00	4.0	388075.50	388096.00	26	26	330525.00	330545.62	26	26

Results of Gas Meter									
Standardized Data					Dry Gas Meter				
Dry Gas Meter		Reference Meter			Calibration Factor				
(V _{std}) Litre	(Q _{std}) litre/min.	(V _{ref}) Litre	(Q _{ref}) litre/min.	(C _{ref}) litre/min.	Value (Y)	Variation (ΔY)			
13.427	0.895	14.785	0.986	0.986	1.101	0.094			
20.628	2.063	21.174	2.117	2.117	1.026	-0.011			
20.628	2.578	21.106	2.638	2.638	1.023	-0.014			
20.530	2.933	21.096	3.014	3.014	1.026	-0.009			
19.946	3.989	20.083	4.017	4.017	1.007	-0.030			
					1.037	Y Average			

Result of Flow Control				
Reference Meter	Flowrate	Flow Meter	Console RotaMeter	Variation
(Q _{std}) litre/min.	litre/min.	litre per min. half ball indicate litre/min.	litre/min.	drift litre/min.
1.0	1.0	1.0	0.014	0.014
2.1	2.1	2.0	-0.117	-0.117
2.6	2.6	2.5	-0.138	-0.138
3.0	3.0	3.0	-0.014	-0.014
4.0	4.0	4.0	-0.017	-0.017
Drift Average				-0.054

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.

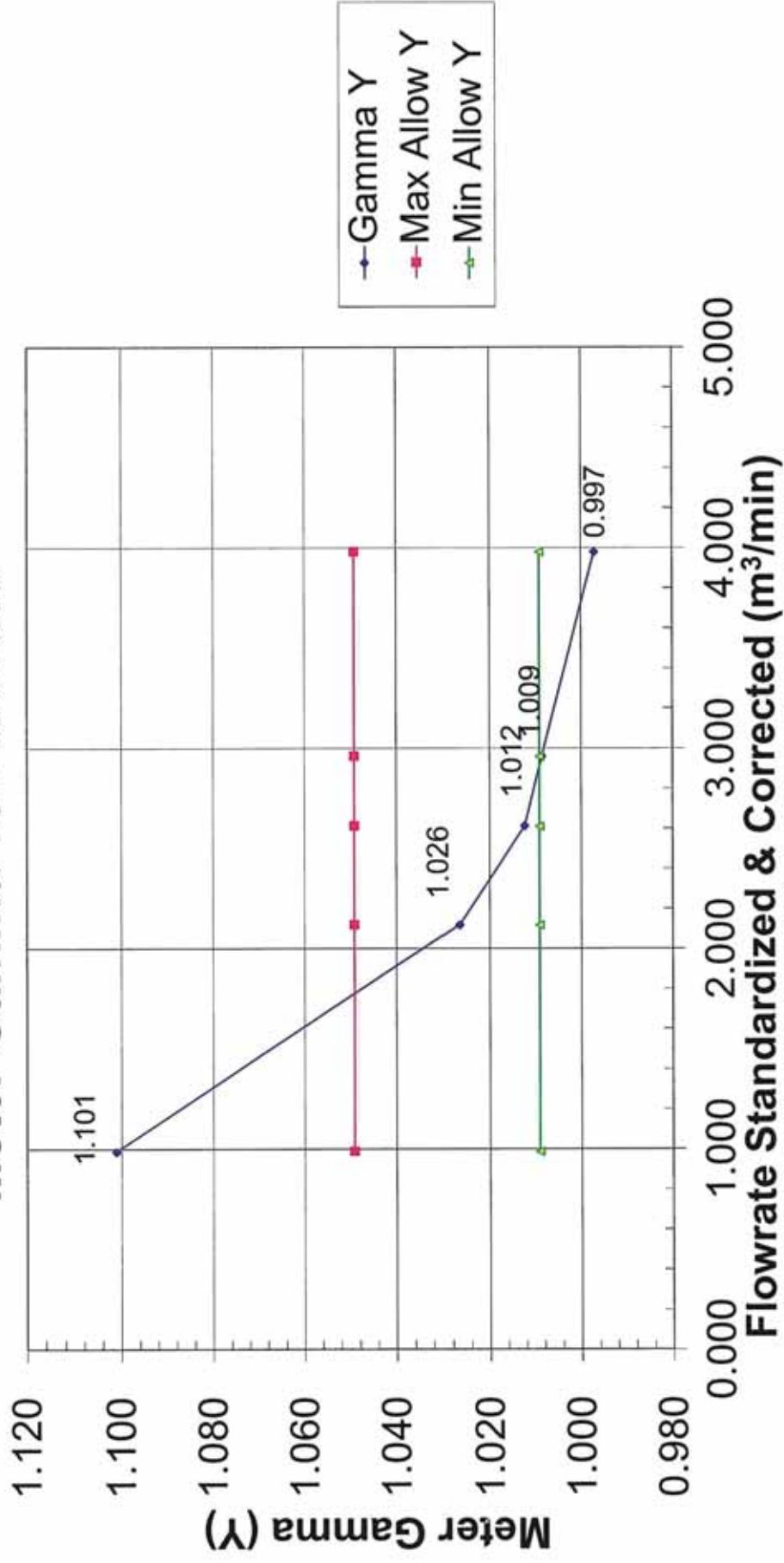
Signature _____

Date 28/11/2022

Calibration Date:

28-11-2022

Meter Gamma vs Flowrate



Console Serial:

605186

Console Model:

MC 572

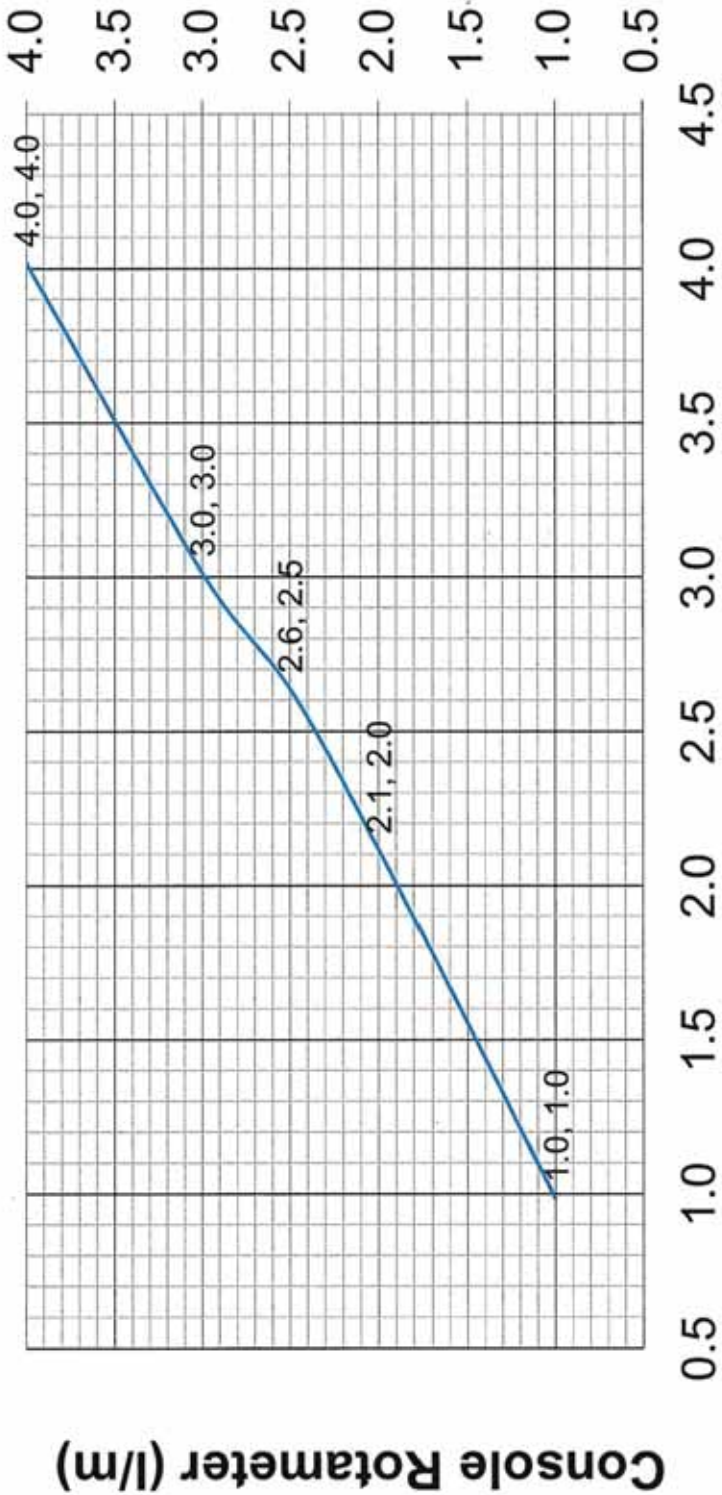
Calibration Reference :

2APE660010

Calibration Date:

28-11-2022

Rotameter , Flow Calibration



Flowrate Standardized & Corrected (l/m)

Console Serial:

605186

Console Model:

MC 572

Calibration Reference :

2APE660010

TEMPERATURE SYSTEM CALIBRATION

Samplig System Equipment Information

Console Model No.	MC 572
Console Serial No.	605186
Meter Box Model No.	JENCO 765-KF
Meter Box Serial No.	JC 13490
Control Temp.Model No.	WATLOW_EZ-ZONE
Control Temp.Model No.	PM3C1CC

Calibration Conditions

Date	Time	28/11/2022	13:00:00 AM
Calibration Reference No.	EO60000		
Barometric Pressure	755	mm Hg	

Reference Thermometer	MASTECH MS7220
Serial Number	12010008857

Results

Console Thermocouple Simulator

Channal and test point	Meter Box Channal Temperature Reading (°C)											
	-18.0	0.0	10.0	20.0	50.0	100.0	150.0	200.0	250.0	350.0	450.0	550.0
Aux	-16	0	10	20	50	101	152	201	250	351	452	553
Stack	-16	0	11	20	50	101	152	201	250	351	452	553
Filter	-16	0	10	20	50	101	152	201	250			
Exit	-16	0	10	20	50	101	152	201	250			
Meter												

Temperature Controller

Thermocouple Simulator (°C)

Probe Temperature	-16	0	10	20	50	101	152	201	250	351	452	553
-------------------	-----	---	----	----	----	-----	-----	-----	-----	-----	-----	-----

Tolerance Range

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

Meter ± 3.0 °C
Exit ± 2.0 °C

Signature

Service Engineer



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



Certificate of Calibration

Certificate No. : 23P137

Page : 1 of 2

Equipment : Barometer

Manufacturer: Barigo

Model : -

Serial No.: -

ID No.: BM-06

Condition As-Received: Used Item

Received Date: 17 January 2023

Calibration Date: 19 January 2023

Reference: 2301-0533WN

Submitted by: LIFE & ENVIRONMENT CO., LTD.

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

Atmospheric Pressure: 1012 mbar

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

90, 92, 94 Soi On-Nuch 64, Srinakarin Road,
On-Nuch, Suanluang, Bangkok 10250

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P10, using " DKD-R 6-1 ; Calibration of Pressure Gauges, Edition 03/2014 " as a guidelines.

Condition of this result of calibration

1.Reference standards instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Standard Barometer	DPI142	1422505046	MP-0076-22	02 May 2023

2.This instrument was installed in vertical orientation and center of the dial was used as the reference level.

3.This result of calibration was made on requested at the point specified by customer.

4.Scale and conversion factor is 1 kPa = 7.50062 mmHg

5.This result of calibration instrument was in absolute pressure.

6.This instrument was used clean air as pressure media.

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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suwit Aussarree

Issue Date : 20 January 2023

Approved Signatory :

[] Pratinnee Pradapalai

[] Sura Suwannasri

✓ Attapol Panurach

B 0306396



Cert.No.: 23P137

Page: 2 of 2

Result of calibration:- Without adjustment

Range : 730 mmHg to 770 mmHg

Function:- Absolute Pressure Measurement

Scale Interval : 1 mmHg (The Fifth Estimate)

Increasing Pressure

Applied Pressure (mmHg)	733.35	742.21	751.56	759.89	769.02
UUC* Indication (mmHg)	730.0	740.0	750.0	760.0	770.0
Error (mmHg)	-3.35	-2.21	-1.58	0.11	0.98

Decreasing Pressure

Applied Pressure (mmHg)	769.01	759.90	751.57	742.23	733.37
UUC* Indication (mmHg)	770.0	760.0	750.0	740.0	730.0
Error (mmHg)	0.99	0.10	-1.57	-2.23	-3.37

The uncertainty of measurement was ± 0.24 mmHg

* UUC = Unit Under Calibration

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

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Certificate No: G 660057

Date of issue : 01-Feb-23

Instrument description : Gas Analyzer
Instrument model : EC 9832 Series CO
Instrument serial no. : 13-1210
ID no. or control no. : -
Manufacturer : Ecotech
Probe description : -
Probe model : -
Probe serial : -
Customer name : Life & Environment Co., Ltd. (Head Office)
Customer address : 90,92,94 Soi On-Nuch 64, Srinakarin Road, Suanluang, Bangkok 10250

Total pages of certificate : 2 Pages
Receiving no. : L-230196
Receiving date. : 24-Jan-23
Parameter of calibration : Gas Calibration (Carbon Monoxide 1003 ppm)

Condition of UUC. : Used
Ambient condition : All of the Measurement were carried out the stabilized laboratory
 Temperature : 23 ± 5 °C
 Humidity : 55 ± 15 %RH

Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210

Calibration procedure no. : WI-CL-19-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.

This certificate is applied only to item under test Environmental condition.

This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature and seal not valid.

This calibration certificate documents are traceability to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 30-Jan-23

M

Calibration Technician

Technical Manager

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Carbon Monoxide (CO) 1003 ppm	2583/22	Linde	09-Aug-24

Measured room conditions

Temperature : 22.3 °C Humidity : 58.5 %RH Pressure : 1012.7 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,500 ml/min Gas pressure : 1020.4 mbar

Calibration Results (without adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
CO (ppm)	1003	1218.61	215.61	12

Remark : 1 $\mu\text{mol/mol}$ = 1 ppm.

End of Report

Certificate No: G 660087

Date of issue : 14-Feb-23

Instrument description : Flue gas Analyzer
Instrument model : Testo 300-M
Instrument serial no. : 00255285
ID no. or control no. : -
Manufacturer : Testo SE & Co. KGaA
Probe description : -
Probe model : -
Probe serial : -
Customer name : Life & Environment Co., Ltd. (Head Office)
Customer address : 90,92,94 Soi On-Nuch 64, Srinakarin Road, Suanluang, Bangkok 10250

Total pages of certificate : 2 Pages
Receiving no. : L-230292
Receiving date. : 13-Feb-23
Parameter of calibration : Gas Calibration(Oxygen 2.498,10.04,21.02 %vol, Carbon Monoxide 80.14,309.9,1003 ppm)

Condition of UUC. : Used
Ambient condition : All of the Measurement were carried out the stabilized laboratory
 Temperature : 23 ± 5 °C
 Humidity : 55 ± 15 %RH

Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210
Calibration procedure no. : WI-CL-28-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%. This certificate is applied only to item under test Environmental condition. This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates without signature and seal not valid. This calibration certificate documents are traceability to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 13-Feb-23



Calibration Technician



Technical Manager

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen (O ₂) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen (O ₂) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide (CO) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide (CO) 1003 ppm	2583/22	Linde	09-Aug-24

Measured room conditions

Temperature : 23.0 °C Humidity : 62.9 %RH Pressure : 1012.5 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,000 ml/min Gas pressure : 1018.2 mbar

Calibration Results Before Adjustment (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O ₂ (%Vol)	2.498	2.6	0.102	0.20
O ₂ (%Vol)	10.04	10.2	0.16	0.40
O ₂ (%Vol)	21.02	21.2	0.18	0.80
CO (ppm)	80.14	75	-5.14	3.0
CO (ppm)	309.9	298	-11.9	6.0
CO (ppm)	1003	972	-31	12

Calibration Results After Adjustment (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O ₂ (%Vol)	2.498	2.6	0.102	0.20
O ₂ (%Vol)	10.04	10.2	0.16	0.40
O ₂ (%Vol)	21.02	21.2	0.18	0.80
CO (ppm)	80.14	79	-1.14	3.0
CO (ppm)	309.9	307	-2.9	6.0
CO (ppm)	1003	996	-7	12

Remark : 1 cmol/mol = 1 %vol. , 1 μmol/mol = 1 ppm.

End of Report



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-27 FAX. 0-2719-9484



Cert.No.: 23CH28
Page.: 1 of 2

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Hanna
Model : HI 3222
Serial No. : 08645111
ID No. : -
Condition As-Received: Used Item
Received Date : 09 January 2023
Calibration Date : 10 January 2023
Reference : 2301-0202WN-1
Submitted by : LIFE & ENVIRONMENT CO., LTD.
90, 92, 94 Soi On-Nuch 64, Srinakarin Road,
On-Nuch, Suanluang, Bangkok 10250
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with standard
voltage calibrator and direct measurement
with certified reference material (CRM)

Calibrated by : Warakorn Lemgagtrakul

Approved by :

Approved Signatory

(✓) Malee Butkrusa
() Saithip Meangmai
() Warakorn Lemgagtrakul

Issue Date : 16 January 2023

The Uncertainties are for a confidence probability of approximately 95%

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

A 0049339



Cert. No.: 23CH28

Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument : -

<u>Instrument</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023

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

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

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

<u>Buffer Solution</u>	<u>Manufacturer</u>	<u>Lot No.</u>	<u>Exp. date</u>
pH 4.008	CPA chem	826588	09 July 2024
pH 6.987	CPA chem	826589	09 July 2023
pH 10.008	CPA chem	826590	09 July 2023

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (\pm mV)	Coverage factor <i>k</i>
	pH	mV	mV	pH		
pH Meter S/N.: 08645111	4.000	177.48	177.2	4.000	0.058	2.00
	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00

Function : pH Measurement

Performing three buffers standard curve by using buffer nominal pH (4,7,10)

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH measurement (\pm)	Coverage factor <i>k</i>
pH Electrode S/N.: 092818FN	4.008	4.010	171.2	0.0045	2.00
	6.987	6.990	0.7	0.0084	2.00
	10.008	10.006	-174.5	0.0065	2.00

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

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Certificate of Calibration

Equipment:	Cooled Incubator	Certificate No.:	C31222140
Model:	i250	Issued Date:	11 November 2022
Serial No.(or ID):	0812-0416 (W-BOD-01/55)	Job No.:	KSPR2214212
Manufacturer:	Accuplus	Page:	1 of 3
Condition:	In Condition	Ventilation Valve:	None
Shelves(pc.):	2		

Customer: LIFE & ENVIRONMENT CO., LTD.
90, 92, 94 Soi On-nuch 64, Srinakarin Road, On-nuch,
Suanluang, Bangkok 10250 Thailand

Environment Condition:

Temperature:	24 °C	±	1.7 °C
Humidity:	53 %RH	±	5.5 %RH
Voltage:	230 VAC	±	3.3 VAC

Calibration Place: LIFE & ENVIRONMENT CO., LTD. (Water & Soil Testing Laboratory)
90, 92, 94 Soi On-nuch 64, Srinakarin Road, On-nuch,
Suanluang, Bangkok 10250 Thailand

Calibration By: Mr. Suphanimit Khamnonphoem

Calibration Date: 08 November 2022

The Method used: In house method, CAL-WI-16, base on TLAS-G20

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through SPC RT Co., Ltd. Certificate No. C10220009



(Mr. Suphanimit Khamnonphoe)

Person in charge



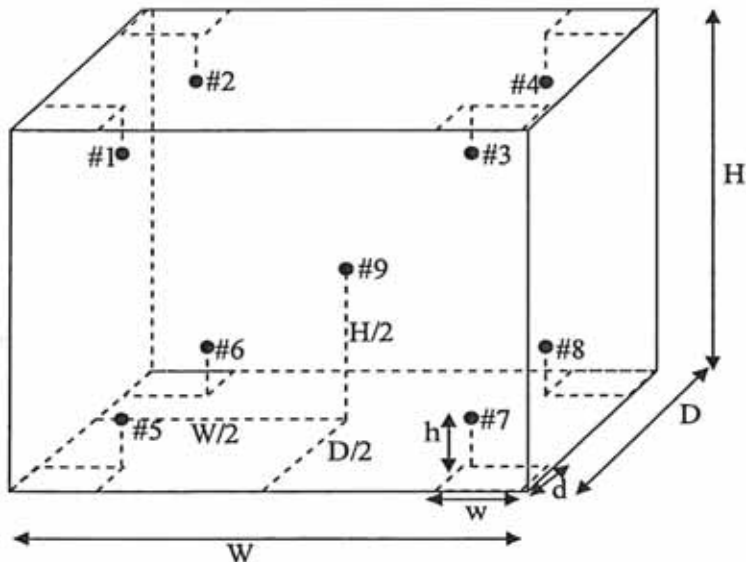
(Mr. Udon Srichana)

Authorized signatory

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

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

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



Standard Installation Locations

Volume (Calibration Zone)= 102 (Liters)

Inside chamber: $W = 50$ (cm) $D = 50$ (cm) $H = 104$ (cm)

Standard Locations (#1, #2, #3, #4): $w = 5$ (cm) $d = 5$ (cm) $h = 30$ (cm)

Standard Locations (#5, #6, #7, #8): $w = 5$ (cm) $d = 5$ (cm) $h = 10$ (cm)

#9: Geometric center of the chamber

Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Channel of Logger	1	2	3	4	5	6	7	8	9

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.

Measured Temperature: The average reading of standards at any positions or location.

Measured Uniformity: The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the chamber at steady-state. The reference probe is preferably located in the geometric center of the chamber.

Measured Stability: The one-half of greatest maximum difference of measured temperatures at any one probe.

Overall Variation: The difference of maximum and minimum measured temperatures throughout observation time.

Calibration Results:
Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 20.0 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	20.14	0.14	0.32
#2	20.27	0.27	0.29
#3	20.02	0.02	0.34
#4	20.17	0.17	0.30
#5	19.99	-0.01	0.34
#6	20.16	0.16	0.26
#7	19.83	-0.17	0.38
#8	19.93	-0.07	0.26
#9	20.18	0.18	0.27

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
			#1	#2	#3	#4	#5	#6	#7	#8	#9	
20.0	20.0	20.0	20.14	20.27	20.02	20.17	19.99	20.16	19.83	19.93	20.18	0.38

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
20.0	0.51	0.26	0.85

Note: * Maximum uncertainty of the each position

The End of Certificate



Certificate of Calibration

Equipment:	Cooled Incubator	Certificate No.:	C31232288
Model:	i250	Issued Date:	14 November 2023
Serial No.(or ID):	0812-0416 (W-BOD-01/55)	Job No.:	WO-00008954
Manufacturer:	Accuplus	Page:	1 of 3
Condition:	In Condition	Ventilation Valve:	None
Shelves(pc.):	2		

Customer: LIFE & ENVIRONMENT CO., LTD.
90, 92, 94 Soi On-nuch 64, Srinakarin Road, On-nuch,
Suanluang, Bangkok 10250 Thailand

Environment Condition:

Temperature:	21 °C	±	1.4 °C
Humidity:	61 %RH	±	5.2 %RH
Voltage:	229 VAC	±	2.9 VAC

Calibration Place: LIFE & ENVIRONMENT CO., LTD. (Water & Soil Testing Laboratory)
90, 92, 94 Soi On-nuch 64, Srinakarin Road, On-nuch,
Suanluang, Bangkok 10250 Thailand

Calibration By: Mr. Suphanimit Khamnonphoem


Calibration Date: 06 November 2023

The Method used: In house method, CAL-WI-16, base on TLAS-G20

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited.
Certificate No. C10230012


 (Mr. Suphanimit Khamnonphoem)

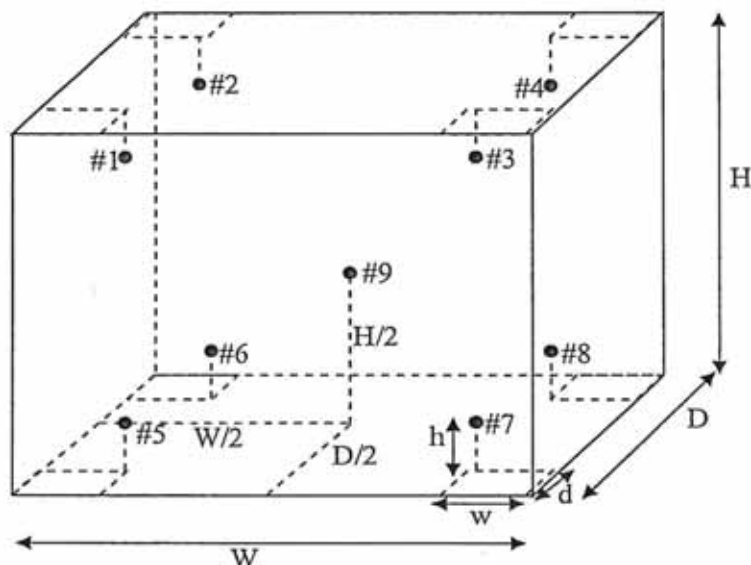
Person in charge


 (Mr. Udon Srichana)
 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).

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Standard Installation Locations

Volume (Calibration Zone)= 102 (Liters)

Inside chamber: $W = 50$ (cm) $D = 50$ (cm) $H = 104$ (cm)

Standard Locations (#1, #2, #3, #4): $w = 5$ (cm) $d = 5$ (cm) $h = 30$ (cm)

Standard Locations (#5, #6, #7, #8): $w = 5$ (cm) $d = 5$ (cm) $h = 10$ (cm)

#9: Geometric center of the chamber

Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Channel of Logger	101	102	103	104	105	106	107	108	109

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.

Measured Temperature: The average reading of standards at any positions or location.

Measured Uniformity: The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the chamber at steady-state. The reference probe is preferably located in the geometric center of the chamber.

Measured Stability: The one-half of greatest maximum difference of measured temperatures at any one probe.

Overall Variation: The difference of maximum and minimum measured temperatures throughout observation time.

Calibration Results:
Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 20.0 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	20.20	0.20	0.23
#2	20.38	0.38	0.24
#3	20.01	0.01	0.23
#4	20.26	0.26	0.23
#5	19.98	-0.02	0.26
#6	20.15	0.15	0.23
#7	20.02	0.02	0.26
#8	19.84	-0.16	0.23
#9	20.26	0.26	0.23

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
			#1	#2	#3	#4	#5	#6	#7	#8	#9	
20.0	20.0	20.0	20.20	20.38	20.01	20.26	19.98	20.15	20.02	19.84	20.26	0.26

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
20.0	0.45	0.13	0.71

Note: * Maximum uncertainty of the each position

The End of Certificate



Certificate of Calibration

Equipment:	Cooled Incubator	Certificate No.:	C31222139
Model:	i250	Issued Date:	15 November 2022
Serial No.(or ID):	0812-0414 (W-RE-01/55)	Job No.:	KSPR2214210
Manufacturer:	Accuplus	Page:	1 of 3
Condition:	In Condition	Ventilation Valve:	None
Shelves(pc.):	2		

Customer: LIFE & ENVIRONMENT CO., LTD.
90, 92, 94 Soi On-nuch 64, Srinakarin Road, On-nuch,
Suanluang, Bangkok 10250 Thailand

Environment Condition:

Temperature:	24 °C	±	0.9 °C
Humidity:	52 %RH	±	4.9 %RH
Voltage:	229 VAC	±	2.7 VAC

Calibration Place: LIFE & ENVIRONMENT CO., LTD. (Water & Soil Testing Laboratory)
90, 92, 94 Soi On-nuch 64, Srinakarin Road, On-nuch,
Suanluang, Bangkok 10250 Thailand

Calibration By: Mr. Suphanimit Khamnonphoem

Calibration Date: 08 November 2022

The Method used: In house method, CAL-WI-16, base on TLAS-G20

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through SPC RT Co., Ltd. Certificate No. C10220009



(Mr. Suphanimit Khamnonphoe)

Person in charge



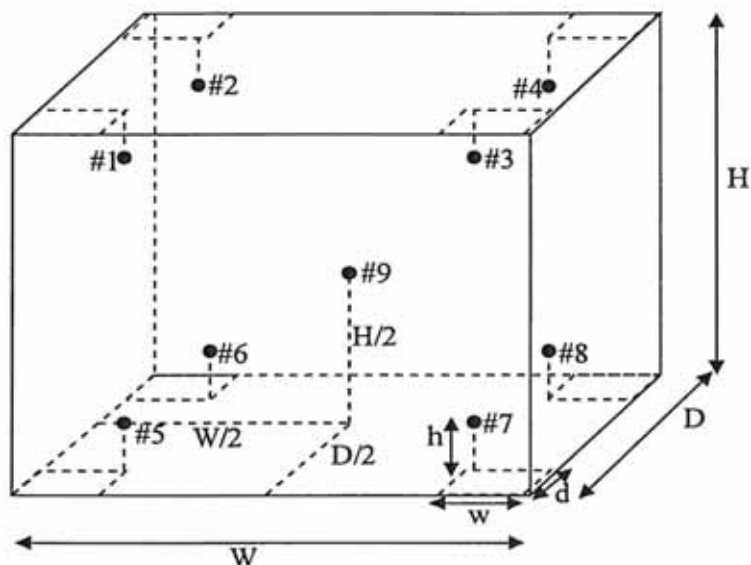
(Mr. Udon Srichana)

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).

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Standard Installation Locations

Volume (Calibration Zone)= 102 (Liters)

Inside chamber: $W = 50$ (cm) $D = 50$ (cm) $H = 104$ (cm)

Standard Locations (#1, #2, #3, #4): $w = 5$ (cm) $d = 5$ (cm) $h = 30$ (cm)

Standard Locations (#5, #6, #7, #8): $w = 5$ (cm) $d = 5$ (cm) $h = 10$ (cm)

#9: Geometric center of the chamber

Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Channel of Logger	1	2	3	4	5	6	7	8	9

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.

Measured Temperature: The average reading of standards at any positions or location.

Measured Uniformity: The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the chamber at steady-state. The reference probe is preferably located in the geometric center of the chamber.

Measured Stability: The one-half of greatest maximum difference of measured temperatures at any one probe.

Overall Variation: The difference of maximum and minimum measured temperatures throughout observation time.

Calibration Results:

Before adjustment

Setting:	Indicating:	#1:	#2:	#3:	#4:	#5:	#6:	#7:	#8:	#9:
4.0	4.0	3.96	3.76	4.35	3.84	5.62	4.65	4.41	4.51	4.32

After adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 4.0 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	3.59	-0.41	0.98
#2	3.39	-0.61	0.98
#3	3.79	-0.21	0.76
#4	3.39	-0.61	1.2
#5	5.12	1.12	0.72
#6	4.07	0.07	0.82
#7	4.00	0.00	0.71
#8	3.89	-0.11	0.74
#9	3.80	-0.20	0.79

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
			#1	#2	#3	#4	#5	#6	#7	#8	#9	
4.0	4.0	4.0	3.59	3.39	3.79	3.39	5.12	4.07	4.00	3.89	3.80	1.2

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
4.0	1.76	0.94	2.96

Note: * Maximum uncertainty of the each position

The End of Certificate



Certificate of Calibration

Equipment:	Cooled Incubator	Certificate No.:	C31232287
Model:	i250	Issued Date:	14 November 2023
Serial No.(or ID):	0812-0414 (W-RE-01/55)	Job No.:	WO-00008954
Manufacturer:	Accuplus	Page:	1 of 3
Condition:	In Condition	Ventilation Valve:	None
Shelves(pc.):	2		

Customer: LIFE & ENVIRONMENT CO., LTD.
90, 92, 94 Soi On-nuch 64, Srinakarin Road, On-nuch,
Suanluang, Bangkok 10250 Thailand

Environment Condition:

Temperature:	21 °C	±	1.4 °C
Humidity:	61 %RH	±	5.2 %RH
Voltage:	229 VAC	±	2.9 VAC

Calibration Place: LIFE & ENVIRONMENT CO., LTD. (Water & Soil Testing Laboratory)
90, 92, 94 Soi On-nuch 64, Srinakarin Road, On-nuch,
Suanluang, Bangkok 10250 Thailand

Calibration By: Mr. Suphanimit Khamnonphoem

Calibration Date: 06 November 2023

The Method used: In house method, CAL-WI-16, base on TLAS-G20

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited.
Certificate No. C10230012


(Mr. Suphanimit Khamnonphoem)

Person in charge

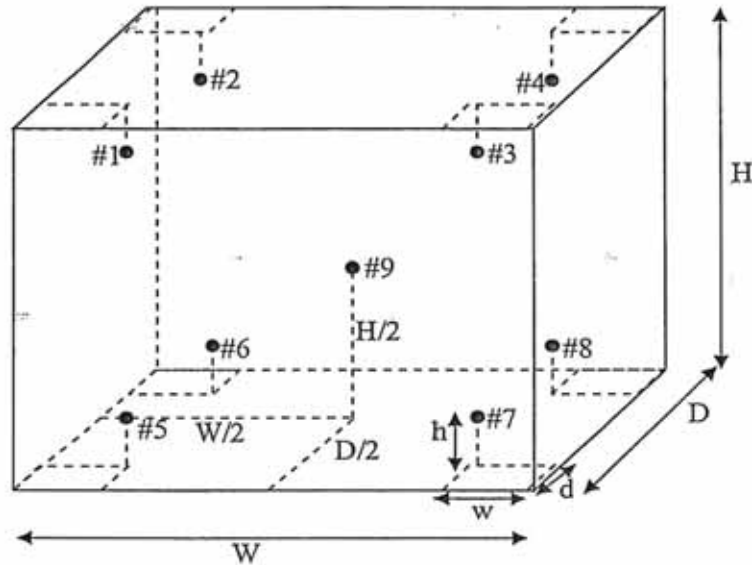

(Mr. Udon Srichana)

Authorized signatory

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Standard Installation Locations

Volume (Calibration Zone)= 102 (Liters)

Inside chamber: $W = 50$ (cm) $D = 50$ (cm) $H = 104$ (cm)

Standard Locations (#1, #2, #3, #4): $w = 5$ (cm) $d = 5$ (cm) $h = 30$ (cm)

Standard Locations (#5, #6, #7, #8): $w = 5$ (cm) $d = 5$ (cm) $h = 10$ (cm)

#9: Geometric center of the chamber

Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Channel of Logger	201	202	203	204	205	206	207	208	209

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.

Measured Temperature: The average reading of standards at any positions or location.

Measured Uniformity: The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the chamber at steady-state. The reference probe is preferably located in the geometric center of the chamber.

Measured Stability: The one-half of greatest maximum difference of measured temperatures at any one probe.

Overall Variation: The difference of maximum and minimum measured temperatures throughout observation time.

Calibration Results:

Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 4.0 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	3.79	-0.21	0.79
#2	3.56	-0.44	0.92
#3	4.05	0.05	0.67
#4	3.84	-0.16	0.84
#5	4.12	0.12	0.45
#6	3.80	-0.20	0.74
#7	3.99	-0.01	0.52
#8	4.09	0.09	0.51
#9	3.69	-0.31	0.75

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
			#1	#2	#3	#4	#5	#6	#7	#8	#9	
4.0	4.0	4.0	3.79	3.56	4.05	3.84	4.12	3.80	3.99	4.09	3.69	0.92

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
4.0	0.75	0.75	1.72

Note: * Maximum uncertainty of the each position

The End of Certificate



Certificate of Calibration

Equipment:	Hot Air Oven	Certificate No.:	C31231015
Model:	UFE 400	Issued Date:	16 May 2023
Serial No.(or ID):	G412.0022	Job No.:	KSPR2307253
Manufacturer:	Memmert	Page:	1 of 5
Condition:	In Condition	Ventilation Valve:	Closed
Shelves(pc.):	1		

Customer: LIFE & ENVIRONMENT CO., LTD.
90, 92, 94 Soi On-nuch 64, Srinakarin Road,
On-nuch, Bangkok 10250 Thailand

Environment Condition:

Temperature:	27 °C	±	1.1 °C
Humidity:	58 %RH	±	5.2 %RH
Voltage:	224 VAC	±	1.4 VAC

Calibration Place: LIFE & ENVIRONMENT CO., LTD.(Water & Soil Testing Laboratory)
90, 92, 94 Soi On-nuch 64, Srinakarin Road,
On-nuch, Bangkok 10250 Thailand

Calibration By: Mr. Bovon Jannantha
Calibration Date: 16 May 2023
The Method used: In house method, CAL-WI-16, base on TLAS-G20

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited.
Certificate No. C10230015



(Mr. Bovon Jannantha)
Person in charge

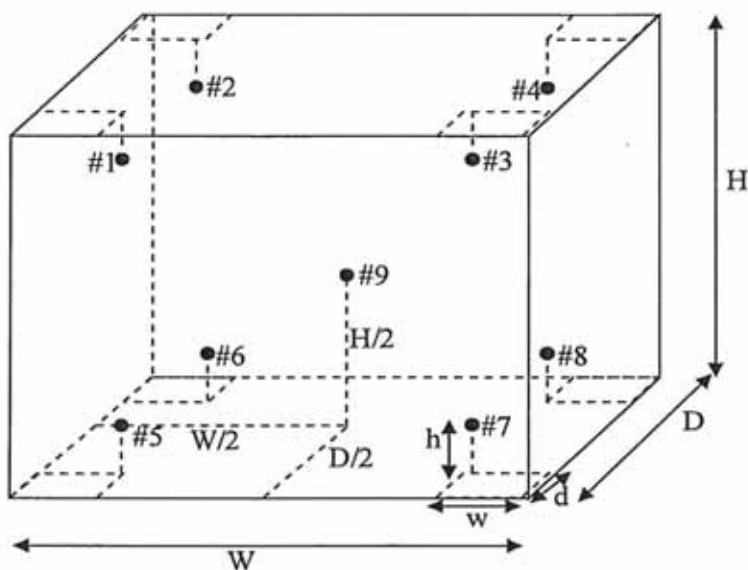


(Mr. Udon Srichana)
Authorized signatory

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Standard Installation Locations

Volume (Calibration Zone)= 21 (Liters)

Inside chamber: $W = 40$ (cm) $D = 33$ (cm) $H = 40$ (cm)

Standard Locations (#1, #2, #3, #4): $w = 5$ (cm) $d = 5$ (cm) $h = 5$ (cm)

Standard Locations (#5, #6, #7, #8): $w = 5$ (cm) $d = 5$ (cm) $h = 5$ (cm)

#9: Geometric center of the chamber

Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Channel of Logger	1	2	3	4	5	6	7	8	9

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.

Measured Temperature: The average reading of standards at any positions or location.

Measured Uniformity: The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the chamber at steady-state. The reference probe is preferably located in the geometric center of the chamber.

Measured Stability: The one-half of greatest maximum difference of measured temperatures at any one probe.

Overall Variation: The difference of maximum and minimum measured temperatures throughout observation time.

Calibration Results:
Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 104.0 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	104.26	0.26	0.39
#2	104.22	0.22	0.39
#3	103.67	-0.33	0.39
#4	103.89	-0.11	0.39
#5	104.09	0.09	0.39
#6	103.69	-0.31	0.39
#7	103.98	-0.02	0.39
#8	104.11	0.11	0.39
#9	103.82	-0.18	0.39

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
			#1	#2	#3	#4	#5	#6	#7	#8	#9	
104.0	104.0	104.0	104.26	104.22	103.67	103.89	104.09	103.69	103.98	104.11	103.82	0.39

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
104.0	0.48	0.09	0.70

Note: * Maximum uncertainty of the each position

Without adjustment (Cont.)

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 150.0 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	150.43	0.43	0.39
#2	150.43	0.43	0.39
#3	149.54	-0.46	0.39
#4	149.78	-0.22	0.39
#5	150.30	0.30	0.39
#6	149.56	-0.44	0.39
#7	149.86	-0.14	0.39
#8	150.05	0.05	0.39
#9	149.86	-0.14	0.39

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
			#1	#2	#3	#4	#5	#6	#7	#8	#9	
150.0	150.0	150.0	150.43	150.43	149.54	149.78	150.30	149.56	149.86	150.05	149.86	0.39

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
150.0	0.61	0.10	1.05

Note: * Maximum uncertainty of the each position

Without adjustment (Cont.)

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 180.0 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	180.53	0.53	0.42
#2	180.59	0.59	0.42
#3	179.43	-0.57	0.42
#4	179.66	-0.34	0.42
#5	180.53	0.53	0.42
#6	179.48	-0.52	0.42
#7	179.93	-0.07	0.42
#8	180.10	0.10	0.42
#9	180.00	0.00	0.42

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
			#1	#2	#3	#4	#5	#6	#7	#8	#9	
180.0	180.0	180.0	180.53	180.59	179.43	179.66	180.53	179.48	179.93	180.10	180.00	0.42

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
180.0	0.67	0.08	1.30

Note: * Maximum uncertainty of the each position

The End of Certificate



Certificate of Calibration

Equipment:	Balance	Certificate No.:	C01231653
Model:	40SM-200A	Issued Date:	17 May 2023
Serial No. (or ID.):	40294	Job No.:	KSPR2307254
Manufacturer:	Precisa	Page:	1 of 5
Condition:	In condition		

Customer: LIFE & ENVIRONMENT CO., LTD.
90, 92, 94 Soi On-nuch 64, Srinakarin Road,
On-nuch, Bangkok 10250 Thailand

Environment Condition: Temperature 25 °C ± 0.7 °C
Humidity 57 %RH ± 2.8 %RH

Calibration Place: LIFE & ENVIRONMENT CO., LTD. (Air Testing Laboratory)
90, 92, 94 Soi On-nuch 64, Srinakarin Road,
On-nuch, Bangkok 10250 Thailand

Calibration By: Mr. Bovon Jannantha

Calibration Date: 16 May 2023

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

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Co., Ltd. Certificate No. C02230532



(Mr. Bovon Jannantha)
Person in charge



(Mr. Rungrod Jenkitrakulchai)
Authorized signatory

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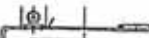
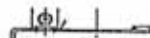
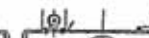
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Calibration Results:

Before Adjustment

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

			Nominal Test Value 100 (g)				
Reference Points (g)							
A	B	C	D	E			
-	0.0001	0.0001	-0.0001	-0.0001			

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.00001 (g)

Nominal test value (g)	Standard Deviation
5	0.000004
40	0.000004

Error of Indication from nominal or conventional mass value., Readability 0.00001 (g)

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
0.1	0.100004	0.10000	0.00000	0.000012	2.01
0.2	0.200001	0.20000	0.00000	0.000013	2.01
0.3	0.300005	0.30001	0.00000	0.000019	2.00
0.4	0.399997	0.40000	0.00000	0.000021	2.00
0.5	0.500006	0.50001	0.00000	0.000015	2.00
1	1.000015	0.99999	-0.00003	0.000018	2.00
2	2.000018	1.99997	-0.00005	0.000021	2.00
5	5.000020	4.99983	-0.00019	0.000027	2.00
10	10.000018	9.99970	-0.00032	0.000034	2.00
20	20.000018	19.99937	-0.00065	0.000048	2.00
30	30.000036	29.99907	-0.00097	0.000080	2.00
40	40.000036	39.99887	-0.00117	0.000090	2.00

Before Adjustment (Cont.)

Repeatability: Determination of the standard deviation of weighing balance., Readability

0.0001 (g)

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

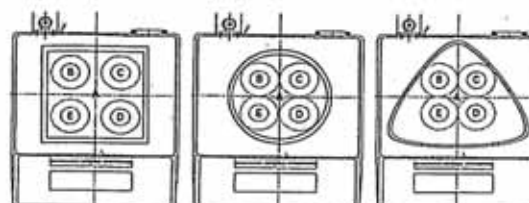
Error of Indication from nominal or conventional mass value., Readability

0.0001 (g)

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
0.01	0.01000	0.0100	0.0000	0.000096	2.02
0.05	0.05000	0.0500	0.0000	0.000096	2.02
0.1	0.10000	0.1000	0.0000	0.000096	2.02
0.5	0.50001	0.5000	0.0000	0.000097	2.02
1	1.00002	1.0000	0.0000	0.000097	2.02
2	2.00002	2.0000	0.0000	0.000098	2.02
5	5.00002	4.9999	-0.0001	0.000099	2.02
10	10.00002	9.9998	-0.0002	0.00010	2.02
50	50.00003	49.9986	-0.0014	0.00012	2.01
100	100.00002	99.9973	-0.0027	0.00017	2.00
150	150.00005	149.9963	-0.0038	0.00023	2.00
200	200.00000	199.9950	-0.0050	0.00029	2.00

After Adjustment

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

			Nominal Test Value		100	(g)
Reference Points (g)						
A		B		C		D
-		0.0001		0.0001		-0.0001
						-0.0001

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.00001 (g)

Nominal test value (g)	Standard Deviation
5	0.000004
40	0.000004

Error of Indication from nominal or conventional mass value., Readability 0.00001 (g)

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
0.1	0.100004	0.10000	0.00000	0.000012	2.01
0.2	0.200001	0.20000	0.00000	0.000013	2.01
0.3	0.300005	0.30001	0.00000	0.000019	2.00
0.4	0.399997	0.40000	0.00000	0.000021	2.00
0.5	0.500006	0.50001	0.00000	0.000015	2.00
1	1.000015	1.00002	0.00000	0.000018	2.00
2	2.000018	2.00002	0.00000	0.000021	2.00
5	5.000020	5.00001	-0.00001	0.000027	2.00
10	10.000018	9.99999	-0.00003	0.000034	2.00
20	20.000018	19.99999	-0.00003	0.000048	2.00
30	30.000036	29.99999	-0.00005	0.000080	2.00
40	40.000036	39.99998	-0.00006	0.000090	2.00

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

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

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

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
0.01	0.01000	0.0100	0.0000	0.000096	2.02
0.05	0.05000	0.0500	0.0000	0.000096	2.02
0.1	0.10000	0.1000	0.0000	0.000096	2.02
0.5	0.50001	0.5000	0.0000	0.000097	2.02
1	1.00002	1.0000	0.0000	0.000097	2.02
2	2.00002	2.0000	0.0000	0.000098	2.02
5	5.00002	5.0000	0.0000	0.000099	2.02
10	10.00002	10.0000	0.0000	0.00010	2.02
50	50.00003	50.0000	0.0000	0.00012	2.01
100	100.00002	100.0000	0.0000	0.00017	2.00
150	150.00005	150.0001	0.0000	0.00023	2.00
200	200.00000	200.0001	0.0001	0.00029	2.00

The End of Certificate



Certificate of Calibration

Equipment:	Incubator	Certificate No.:	C31222126
Model:	INE 400	Issued Date:	09 November 2022
Serial No.(or ID):	E407.1277 (WM-IB-02/51)	Job No.:	KSPR2214211
Manufacturer:	Memmert	Page:	1 of 3
Condition:	In Condition	Ventilation Valve:	Closed
Shelves(pc.):	1		

Customer: LIFE & ENVIRONMENT CO., LTD.
90, 92, 94 Soi On-nuch 64, Srinakarin Road, On-nuch,
Suanluang, Bangkok 10250 Thailand

Environment Condition:

Temperature:	26 °C	±	1.2 °C
Humidity:	51 %RH	±	5.7 %RH
Voltage:	226 VAC	±	3.7 VAC

Calibration Place: LIFE & ENVIRONMENT CO., LTD. (Microbiological Laboratory)
90, 92, 94 Soi On-nuch 64, Srinakarin Road, On-nuch,
Suanluang, Bangkok 10250 Thailand

Calibration By: Mr. Nakarin Ruenros
Calibration Date: 08 November 2022
The Method used: In house method, CAL-WI-16, base on TLAS-G20
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through SPC RT Co., Ltd. Certificate No. C10220001



(Mr. Nakarin Ruenros)
Person in charge

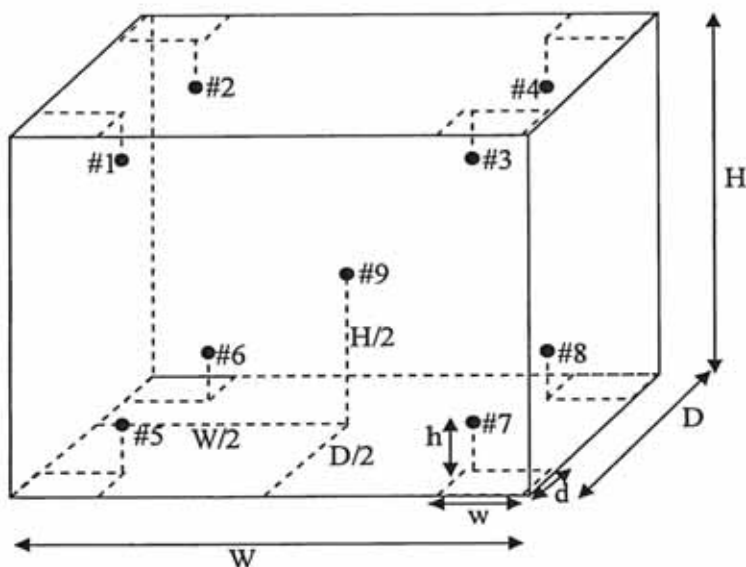


(Mr. Udon Srichana)
Authorized signatory

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

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

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



Standard Installation Locations

Volume (Calibration Zone)= 21 (Liters)

Inside chamber: $W = 40$ (cm) $D = 33$ (cm) $H = 40$ (cm)

Standard Locations (#1, #2, #3, #4): $w = 5$ (cm) $d = 5$ (cm) $h = 5$ (cm)

Standard Locations (#5, #6, #7, #8): $w = 5$ (cm) $d = 5$ (cm) $h = 5$ (cm)

#9: Geometric center of the chamber

Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Channel of Logger	1	2	3	4	5	6	7	8	9

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.

Measured Temperature: The average reading of standards at any positions or location.

Measured Uniformity: The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the chamber at steady-state. The reference probe is preferably located in the geometric center of the chamber.

Measured Stability: The one-half of greatest maximum difference of measured temperatures at any one probe.

Overall Variation: The difference of maximum and minimum measured temperatures throughout observation time.

Calibration Results:
Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 35.0 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	34.99	-0.01	0.25
#2	34.81	-0.19	0.25
#3	34.80	-0.20	0.25
#4	34.97	-0.03	0.25
#5	34.78	-0.22	0.29
#6	35.35	0.35	0.27
#7	34.97	-0.03	0.28
#8	35.16	0.16	0.30
#9	35.32	0.32	0.27

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
			#1	#2	#3	#4	#5	#6	#7	#8	#9	
35.0	35.0	35.0	34.99	34.81	34.80	34.97	34.78	35.35	34.97	35.16	35.32	0.30

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
35.0	0.68	0.15	0.76

Note: * Maximum uncertainty of the each position

The End of Certificate



Certificate of Calibration

Equipment:	Incubator	Certificate No.:	C31232289
Model:	INE 400	Issued Date:	14 November 2023
Serial No.(or ID):	E407.1277 (WM-IB-02/51)	Job No.:	WO-00008954
Manufacturer:	Memmert	Page:	1 of 3
Condition:	In Condition	Ventilation Valve:	Closed
Shelves(pc.):	1		

Customer: LIFE & ENVIRONMENT CO., LTD.
90, 92, 94 Soi On-nuch 64, Srinakarin Road,
Suanluang, Bangkok 10250 Thailand

Environment Condition:

Temperature:	24 °C	±	0.6 °C
Humidity:	50 %RH	±	4.4 %RH
Voltage:	224 VAC	±	2.5 VAC

Calibration Place: LIFE & ENVIRONMENT CO., LTD. (Microbiological Laboratory)
90, 92, 94 Soi On-nuch 64, Srinakarin Road,
Suanluang, Bangkok 10250 Thailand

Calibration By: Mr. Suphakorn Sookmee

Calibration Date: 06 November 2023

The Method used: In house method, CAL-WI-16, base on TLAS-G20

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited.
Certificate No. C10230019

(Mr. Suphakorn Sookmee)

Person in charge

(Mr. Udon Srichana)

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).

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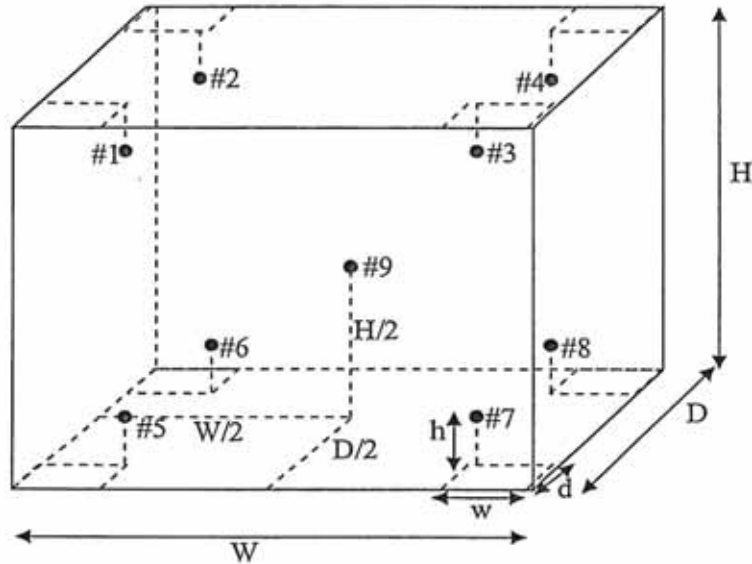
บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด

DKSH Technology Limited

2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260

2533 Sukhumvit Road, Bangchak, Phraekhanong, Bangkok 10260

Phone: +66 2839 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand



Standard Installation Locations

Volume (Calibration Zone)= 21 (Liters)

Inside chamber: $W = 40$ (cm) $D = 33$ (cm) $H = 40$ (cm)

Standard Locations (#1, #2, #3, #4): $w = 5$ (cm) $d = 5$ (cm) $h = 5$ (cm)

Standard Locations (#5, #6, #7, #8): $w = 5$ (cm) $d = 5$ (cm) $h = 5$ (cm)

#9: Geometric center of the chamber

Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Channel of Logger	101	102	103	104	105	106	107	108	109

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.

Measured Temperature: The average reading of standards at any positions or location.

Measured Uniformity: The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the chamber at steady-state. The reference probe is preferably located in the geometric center of the chamber.

Measured Stability: The one-half of greatest maximum difference of measured temperatures at any one probe.

Overall Variation: The difference of maximum and minimum measured temperatures throughout observation time.

Calibration Results:

Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 35.0 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	35.16	0.16	0.27
#2	34.98	-0.02	0.29
#3	35.13	0.13	0.33
#4	34.98	-0.02	0.27
#5	35.51	0.51	0.33
#6	35.58	0.58	0.35
#7	35.63	0.63	0.30
#8	35.70	0.70	0.33
#9	35.00	0.00	0.28

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
			#1	#2	#3	#4	#5	#6	#7	#8	#9	
35.0	35.0	35.0	35.16	34.98	35.13	34.98	35.51	35.58	35.63	35.70	35.00	0.35

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
35.0	0.85	0.11	0.90

Note: * Maximum uncertainty of the each position

The End of Certificate



Certificate of Calibration

Equipment:	Liquid Bath	Certificate No.:	C13220385
Model:	1013	Issued Date:	09 November 2022
Serial No. (or ID.):	10637804J (WM-WB-01/50)	Job No.:	KSPR2214213
Manufacturer:	GFL	Page:	1 of 3
Condition:	In Condition		
Forced Circulation:	None		

Customer: LIFE & ENVIRONMENT CO., LTD.
90, 92, 94 Soi On-nuch 64, Srinakarin Road, On-nuch,
Suanluang, Bangkok 10250 Thailand

Environment Condition:

Temperature:	26 °C	±	0.9 °C
Humidity:	51 %RH	±	5.3 %RH
Voltage:	226 VAC	±	3.7 VAC

Calibration Place: LIFE & ENVIRONMENT CO., LTD. (Microbiological Laboratory)
90, 92, 94 Soi On-nuch 64, Srinakarin Road, On-nuch,
Suanluang, Bangkok 10250 Thailand

Calibration By: Mr. Chaiwat Srisanguan

Calibration Date: 08 November 2022

The Method used: In house method, CAL-WI-17, base on ASTM E715-80

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through SPC RT Co., Ltd. Certificate No. C10220001



(Mr. Chaiwat Srisanguan)
Person in charge

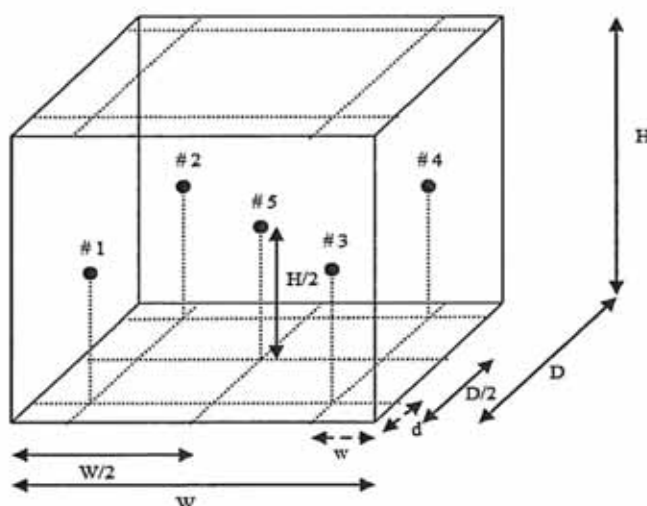


(Mr. Udon Srichana)
Authorized signatory

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).

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Standard Installation Locations

Midway between the diffuser plate and the water surface

Inside bath: W = 40 (cm) D = 25 (cm) H = 17 (cm) Volume = 17 (Liters)

Standard Locations #1: w = 5 (cm) d = 5 (cm)

Standard Locations #2: w = 5 (cm) d = 5 (cm)

Standard Locations #3: w = 5 (cm) d = 5 (cm)

Standard Locations #4: w = 5 (cm) d = 5 (cm)

Standard Locations #5: Center of any probes. (#1 - #4)

Position of Std	#1	#2	#3	#4	#5
Channel of Logger	1	2	3	4	5

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the bath.

Measured Temperature: The average reading of standards at any positions or location.

Measured Uniformity: The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the bath at steady-state. The reference probe is preferably located in the geometric center of the bath.

Measured Stability: The one-half of greatest maximum difference of measured temperatures at any one probe.

Overall Variation: The difference of maximum and minimum measured temperatures throughout observation time.

Calibration Results:
Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 44.5 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (\pm °C)
#1	44.42	-0.08	0.15
#2	44.44	-0.06	0.15
#3	44.42	-0.08	0.15
#4	44.43	-0.07	0.15
#5	44.43	-0.07	0.15

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)					Uncertainty (\pm °C)*
			#1	#2	#3	#4	#5	
44.5	44.5	44.5	44.42	44.44	44.42	44.43	44.43	0.15

Bath Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (\pm °C)	Overall Variation (°C)
44.5	0.03	0.01	0.04

Note: * Maximum uncertainty of the each position

The End of Certificate



Certificate of Calibration

Equipment:	Liquid Bath	Certificate No.:	C13230368
Model:	1013	Issued Date:	06 November 2023
Serial No. (or ID.):	10637804J (WM-WB-01/05)	Job No.:	WO-00008954
Manufacturer:	GFL	Page:	1 of 3
Condition:	In Condition		
Forced Circulation:	None		

Customer: LIFE & ENVIRONMENT CO., LTD.
90, 92, 94 Soi On-nuch 64, Srinakarin Road,
Suanluang, Bangkok 10250 Thailand

Environment Condition:

Temperature:	24 °C	±	0.6 °C
Humidity:	50 %RH	±	4.4 %RH
Voltage:	224 VAC	±	2.5 VAC

Calibration Place: LIFE & ENVIRONMENT CO., LTD. (Microbiological Laboratory)
90, 92, 94 Soi On-nuch 64, Srinakarin Road,
Suanluang, Bangkok 10250 Thailand

Calibration By: Mr. Suphakorn Sookmee
Calibration Date: 06 November 2023
The Method used: In house method, CAL-WI-17, base on ASTM E715-80
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited.
Certificate No. C10230019

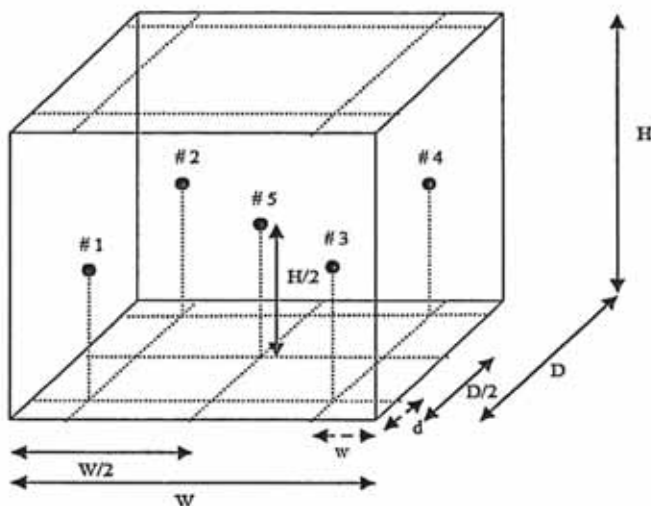
(Mr. Suphakorn Sookmee)
Person in charge

(Mr. Udon Srichana)
Authorized signatory

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Standard Installation Locations

Midway between the diffuser plate and the water surface

Inside bath: $W = 40$ (cm) $D = 25$ (cm) $H = 17$ (cm) Volume = 17 (Liters)

Standard Locations #1: $w = 5$ (cm) $d = 5$ (cm)

Standard Locations #2: $w = 5$ (cm) $d = 5$ (cm)

Standard Locations #3: $w = 5$ (cm) $d = 5$ (cm)

Standard Locations #4: $w = 5$ (cm) $d = 5$ (cm)

Standard Locations #5: Center of any probes. (#1 - #4)

Position of Std	#1	#2	#3	#4	#5
Channel of Logger	301	302	303	304	309

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the bath.

Measured Temperature: The average reading of standards at any positions or location.

Measured Uniformity: The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the bath at steady-state. The reference probe is preferably located in the geometric center of the bath.

Measured Stability: The one-half of greatest maximum difference of measured temperatures at any one probe.

Overall Variation: The difference of maximum and minimum measured temperatures throughout observation time.

Calibration Results:
Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 44.5 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (\pm °C)
#1	44.50	0.00	0.15
#2	44.49	-0.01	0.16
#3	44.46	-0.04	0.15
#4	44.48	-0.02	0.15
#5	44.49	-0.01	0.15

Temperature Distribution

Desired (°C)	Setting (°C)	Indicating (°C)	Measured Temperature at Spread Locations (°C)					Uncertainty (\pm °C)*
			#1	#2	#3	#4	#5	
44.5	44.5	44.5	44.50	44.49	44.46	44.48	44.49	0.16

Bath Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (\pm °C)	Overall Variation (°C)
44.5	0.04	0.03	0.07

Note: * Maximum uncertainty of the each position

The End of Certificate



Certificate of Calibration

Equipment:	Autoclave	Certificate No.:	C11220233
Model:	88	Issued Date:	14 December 2022
Serial No. (or ID.):	105611	Job No.:	KSPR2215651
Manufacturer:	ALP	Page:	1 of 3
Condition:	In Condition		

Customer: LIFE & ENVIRONMENT CO., LTD.
90, 92, 94 Soi On-nuch 64, Srinakarin Road, On-nuch,
Suanluang, Bangkok 10250 Thailand

Environment Condition:

Temperature:	27 °C	±	0.7 °C
Humidity:	56 %RH	±	4.3 %RH
Voltage:	226 VAC	±	1.4 VAC

Calibration Place: LIFE & ENVIRONMENT CO., LTD. (Microbiogy Testing Laboratory)
90, 92, 94 Soi On-nuch 64, Srinakarin Road, On-nuch,
Suanluang, Bangkok 10250 Thailand

Calibration By: Mr. Siwapan Srijan

Calibration Date: 14 December 2022

The Method used: In house method, CAL-WI-18, base on BS 2646 : Part 5

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through Quality reborn Co., Ltd.
Certificate No.QR22-0176



(Mr. Siwapan Srijan)
Person in charge

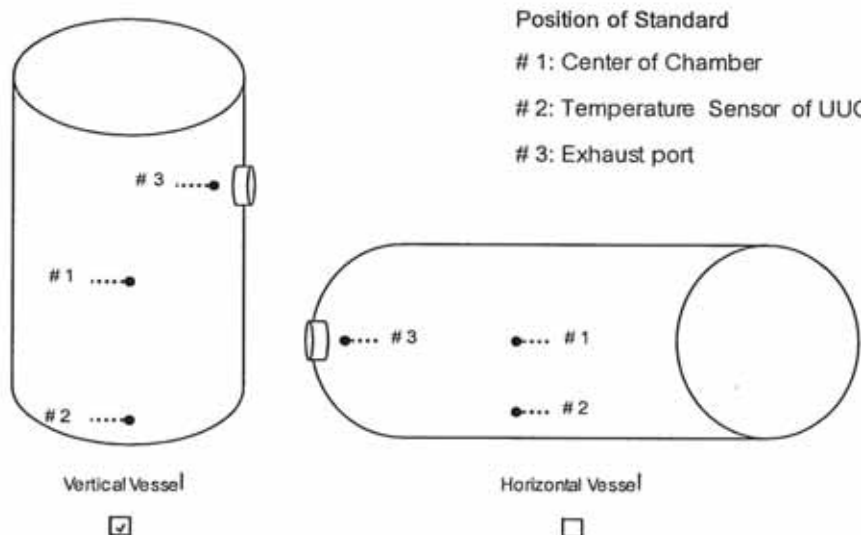


(Mr. Udon Srichana)
Authorized signatory

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Standard Installation Locations

- Standard Locations (#1): Geometric center of the chamber
- Standard Locations (#2): Distance from temperature sensor of UUC 2 (cm.)
- Standard Locations (#3): Distance from the wall 5 (cm.)

Position of Std	#1	#2	#3
Channel of Logger	4	5	6

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.

Measured Temperature: The average reading of standards at any positions or location.

Measured Stability: The one-half of greatest maximum difference of measured temperatures at any one probe.

Calibration Results:

Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 121 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	121.05	0.05	2.0
#2	121.06	0.06	1.9
#3	121.03	0.03	2.0

Temperature Distribution

Temperature			Pressure	Measured Temperature at Spread Locations			Uncertainty
Desired (°C)	Setting (°C)	Indicating (°C)	Indicating kg/cm ²	#1 (°C)	#2 (°C)	#3 (°C)	
121	121	121	1.2	121.05	121.06	121.03	2.0

Chamber Characterization

Indicating Temperature (°C)	Indicating Pressure kg/cm ²	Measured Stability (± °C)
121	1.2	1.61

Note: * Maximum uncertainty of the each position

Record every 10 seconds after reaching steady state or after one achieved complete cycle.

The End of Certificate



Certificate of Calibration

Equipment:	Autoclave	Certificate No.:	C11230236
Model:	88	Issued Date:	13 December 2023
Serial No. (or ID.):	105611	Job No.:	WO-00011851
Manufacturer:	ALP	Page:	1 of 3
Condition:	In Condition		

Customer: LIFE & ENVIRONMENT CO., LTD.
90, 92, 94 Soi On-nuch 64, Srinakarin Road,
On-nuch, Suanluang, Bangkok 10250 Thailand.

Environment Condition: Temperature: 26 °C ± 0.6 °C
Humidity: 51 %RH ± 4.0 %RH
Voltage: 226 VAC ± 1.5 VAC

Calibration Place: LIFE & ENVIRONMENT CO., LTD. (Microbiogy Testing Laboratory)
90, 92, 94 Soi On-nuch 64, Srinakarin Road,
On-nuch, Suanluang, Bangkok 10250 Thailand.

Calibration By: Mr. Siwapan Srijan

Calibration Date: 13 December 2023

The Method used: In house method, CAL-WI-18, base on BS 2646 : Part 5

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through Quality reborn Co., Ltd.
Certificate No.QR23-0487



(Mr. Siwapan Srijan)
Person in charge

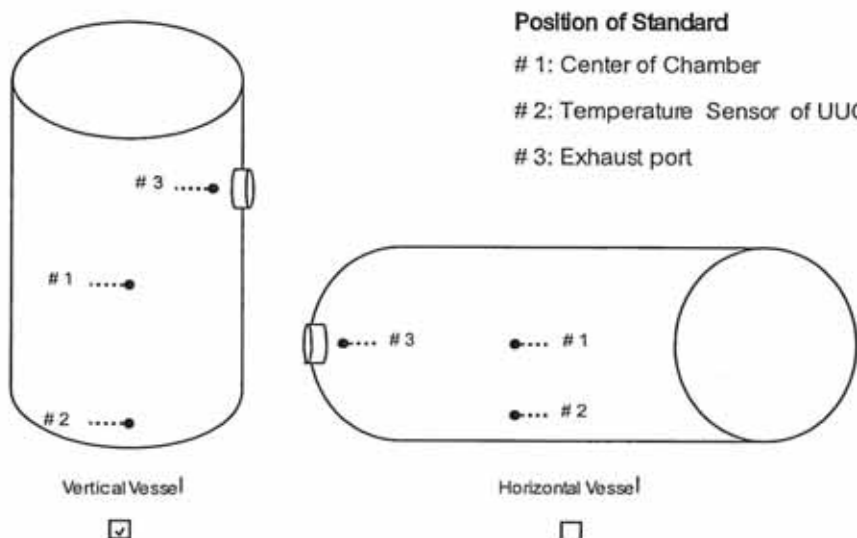


(Mr. Udon Srichana)
Authorized signatory

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



Standard Installation Locations

- Standard Locations (#1): Geometric center of the chamber
- Standard Locations (#2): Distance from temperature sensor of UUC 2 (cm.)
- Standard Locations (#3): Distance from the wall 5 (cm.)

Position of Std	#1	#2	#3
Channel of Logger	10	11	12

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.

Measured Temperature: The average reading of standards at any positions or location.

Measured Stability: The one-half of greatest maximum difference of measured temperatures at any one probe.

Calibration Results:
Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 121 °C

Locations	Measured Temperature (°C)	Correction of UUC. (°C)	Uncertainty (± °C)
#1	121.02	0.02	1.8
#2	121.02	0.02	1.9
#3	121.05	0.05	2.0

Temperature Distribution

Temperature			Pressure	Measured Temperature at Spread Locations			Uncertainty
Desired (°C)	Setting (°C)	Indicating (°C)	Indicating kg/cm ²	#1 (°C)	#2 (°C)	#3 (°C)	
121	121	121	1.2	121.02	121.02	121.05	2.0

Chamber Characterization

Indicating Temperature (°C)	Indicating Pressure kg/cm ²	Measured Stability (± °C)
121	1.2	1.63

Note: * Maximum uncertainty of the each position

Record every 10 seconds after reaching steady state or after one achieved complete cycle.

The End of Certificate