

ภาคผนวก ง

ใบรับรองการสอบเทียบเครื่องมือ



ALS Laboratory Group (Thailand) Co., Ltd.
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Khwaeng Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand
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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

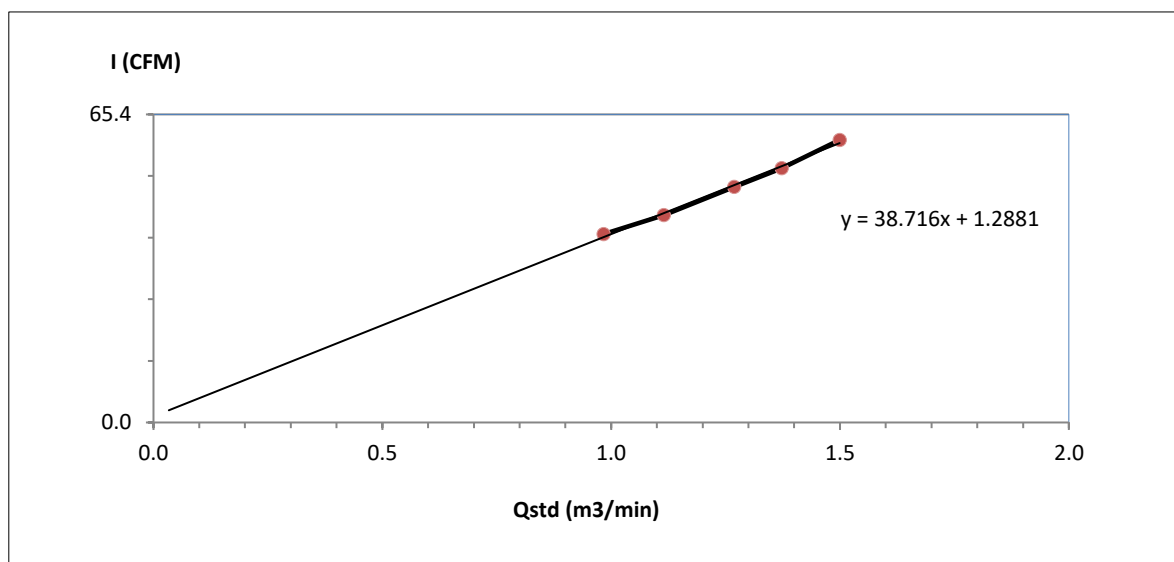
Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Total Suspended Particulate	High Volume	RYG_FS0178	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0182	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0180	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RYG_EN0001	23-Mar-22	23-Mar-23	12
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0188	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0186	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0184	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	RYG_EN0001	23-Mar-22	23-Mar-23	12
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0413	29-Jul-21	27-Jan-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0143	23-Feb-21	24-Aug-22	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0414	29-Jul-21	27-Jan-23	18
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0518	12-Jan-22	12-Jul-22	6
Stack	Total Suspended Particulate	Digital Balance	RYG_EN0003	23-Mar-22	23-Mar-23	12
Stack	Total VOCs as Propane	Console Control Unit	BKK_FS0518	12-Jan-22	12-Jul-22	6
Stack	Total VOCs as Propane	FID Analyzer	BKK_FS0758	4-Jan-22	4-Jul-22	6
Stack	Butyl Acrylate	Console Control Unit	RYG_FS0315	12-Jan-22	12-Jul-22	6
Stack	Butyl Acrylate	Field Rotameter	BKK_FS1042	1-Apr-22	1-Jul-22	3
Stack	Butyl Acrylate	GC-MSD	BKK_EN0119	1-Oct-21	1-Apr-23	18
Stack	Methyl Methacrylate	Console Control Unit	RYG_FS0315	12-Jan-22	12-Jul-22	6
Stack	Methyl Methacrylate	Field Rotameter	BKK_FS1042	1-Apr-22	1-Jul-22	3
Stack	Methyl Methacrylate	GC-MSD	BKK_EN0119	1-Oct-21	1-Apr-23	18
Noise	Leq 24 hrs	Sound Calibrator	RYG_FS0215	9-Aug-21	9-Aug-22	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0024	4-Oct-21	4-Oct-22	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0493	10-Jan-22	10-Jan-23	12
Workplace	Total Dust	Field Rotameter	RYG_FS0197	4-Jan-22	4-Apr-22	3
Workplace	Total Dust	Field Rotameter	RYG_FS0198	1-Apr-22	1-Jul-22	3
Workplace	Total Dust	Digital Balance	RYG_EN0004	23-Mar-22	23-Mar-23	12
Workplace	Total VOC	TVOC Analyzer	BKK_FS0819	4-Feb-22	5-Aug-23	18
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0213	24-Mar-21	24-Mar-22	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0020	10-Jan-22	10-Jan-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0021	21-Jan-22	21-Jan-23	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0215	9-Aug-21	9-Aug-22	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0381	7-Jul-21	7-Jul-22	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0300	4-Jun-21	4-Jun-22	12
Rayong Lab	pH at 25 °C	pH meter	RYG_EN0183	17-Mar-22	17-Mar-23	12
Rayong Lab	BOD (5 days at 20°C)	DO meter with Sensor	RYG_EN0140	2-Feb-21	3-Aug-22	18
Rayong Lab	BOD (5 days at 20°C)	Incubator	RYG_EN0154	22-Apr-22	21-Oct-23	18
Rayong Lab	COD	SPECTROPHOTOMETER	RYG_EN0037	1-Apr-21	1-Oct-22	18
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG_EN0002	23-Mar-22	23-Mar-23	12
Rayong Lab	Total Suspended Solids	Chamber Oven	RYG_EN0010	5-May-21	3-Nov-22	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RYG_EN0002	23-Mar-22	23-Mar-23	12
Rayong Lab	Total Dissolved Solids 180°C	Chamber Oven	RYG_EN0010	5-May-21	3-Nov-22	18
Rayong Lab	Oil & Grease	Electronic Balance	RYG_EN0002	23-Mar-22	23-Mar-23	12
Rayong Lab	Oil & Grease	Hot Air Oven	RYG_EN0006	5-May-21	3-Nov-22	18
Rayong Lab	Oil & Grease	Water Bath	RYG_EN0061	5-May-21	3-Nov-22	18
Rayong Lab	Temperature	Digital Thermometer	RYG_FS0467	7-Jul-21	7-Jul-22	18





High Volume Air Sampler Calibration Worksheet

Project Site :	THAI MMA Co., Ltd.	Barometric Pressure (mm Hg) :	758
Calibrate Location :	บ้านบน	Temperature (°C) :	32
Calibrate Date :	19-Apr-22	High Volume ID :	RYG_FS0178
CalibrationSheet No.:	C-190422-RYG_FS0178	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0206	High Volume S/N :	4804
Calibrator Model :	TE-5028A	Calibrator Slope :	1.4867
Calibrator S/N :	1543	Calibrator Intercept :	-0.0445

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.0	0.9835	40	Slope : 38.7164 Intercept : 1.2881 Correlation Coefficient : 0.9972
2	2.6	1.1151	44	
3	3.4	1.2688	50	
4	4.0	1.3725	54	
5	4.8	1.4992	60	



Calibrated by 
 (Mr.Anurak Tongkhajonsakda)
 Field Scientist(1)

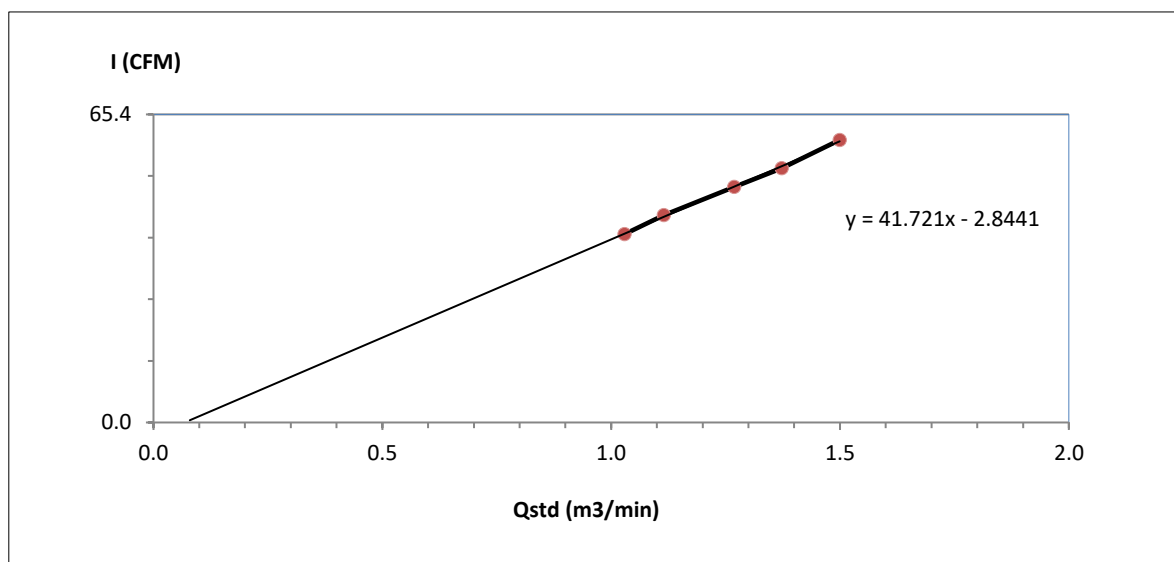
Approved by : 
 (Mr. Noppong Juntarupan)
 Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site :	THAI MMA Co., Ltd.	Barometric Pressure (mm Hg) :	758
Calibrate Location :	บ้านมณเฑียร	Temperature (°C) :	32
Calibrate Date :	19-Apr-22	High Volume ID :	RYG_FS0182
CalibrationSheet No.:	C-190422-RYG_FS0182	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0206	High Volume S/N :	5335
Calibrator Model :	TE-5028A	Calibrator Slope :	1.4867
Calibrator S/N :	1543	Calibrator Intercept :	-0.0445

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.2	1.0294	40	Slope : 41.7215 Intercept : -2.8441 Correlation Coefficient : 0.9992
2	2.6	1.1151	44	
3	3.4	1.2688	50	
4	4.0	1.3725	54	
5	4.8	1.4992	60	



Calibrated by

(Mr.Anurak Tongkhajonsakda)
Field Scientist(1)

Approved by :

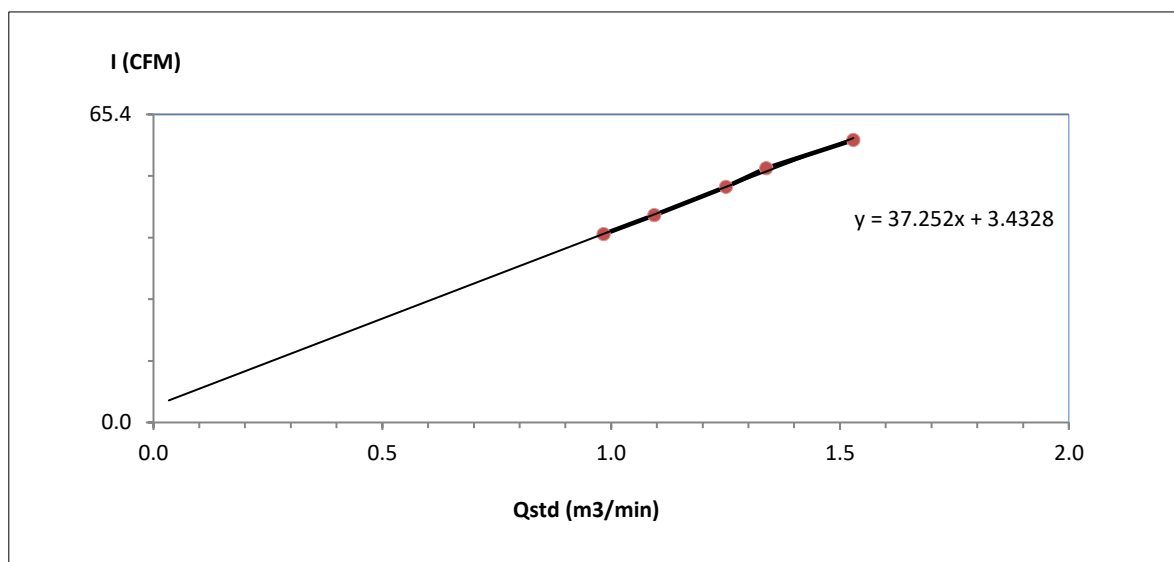
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)



High Volume Air Sampler Calibration Worksheet

Project Site :	THAI MMA Co., Ltd.	Barometric Pressure (mm Hg) :	758
Calibrate Location :	บ้านเนินพยอม	Temperature (°C) :	32
Calibrate Date :	19-Apr-22	High Volume ID :	RYG_FS0180
CalibrationSheet No.:	C-190422-RYG_FS0180	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0206	High Volume S/N :	1328
Calibrator Model :	TE-5028A	Calibrator Slope :	1.4867
Calibrator S/N :	1543	Calibrator Intercept :	-0.0445

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	2.0	0.9835	40	Slope : 37.2518 Intercept : 3.4328 Correlation Coefficient : 0.9986
2	2.5	1.0944	44	
3	3.3	1.2507	50	
4	3.8	1.3388	54	
5	5.0	1.5292	60	



Calibrated by

(Mr.Anurak Tongkhajonsakda)
Field Scientist(1)

Approved by :

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



PENTA
CALIBRATION

PENTA CALIBRATION CO., LTD.

66/124 The Connect 33 Village Kanchanaphisek Road
Dokmai Prawet Bangkok 10250
Tel: +66 (0) 2069-9773
www.pentacal.com

Certificate of Calibration

Represent to Certificate of Calibration ,PTC/07/22102

Certificate No.:	PTC/07/22102	Page:	1 of 2
Equipment:	Digital Balance	Condition:	Normal
Manufacturer:	Sartorius	Serial No:	25409664
Model:	LA130S-F	ID No:	RYG_EN0001
Type of Balance:	Single interval		



Customer: ALS Laboratory Group (Thailand) Co.,Ltd.
616/10 Moo 5 T.Maenamkoo, A.Pluakdaeng,
Rayong 21140, Thailand



Environment Condition: Temperature 23.9 °C ± 0.3 °C
Humidity 58.1 %RH ± 4.4 %RH
Air density 1.17 kg/m³

Calibration Place: ALS Laboratory Group (Thailand) Co.,Ltd.
616/10 Moo 5 T.Maenamkoo, A.Pluakdaeng,
Rayong 21140, Thailand

The Method used: In house method, PTC-WI-07, base on Euramet cg. 18

Traceability: This certificate is traceable to the SI Units through Thai Calibration Service Co.,Ltd.
, NSC-ONSC Accreditation No.: Calibration 0189

Date Received: March 23, 2022

Calibration Date: March 23, 2022

Issued Date: March 25, 2022

Calibration By: Mr. Rungroje Metakul



PENTA CALIBRATION CO.,LTD

(Signature)

(Mr.Kriangsak Kalasri)

Reviewed by

Approved By :

(Signature)

(Mr. Keattisak Kerdto)

Laboratory Manager

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 recognised 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). The effect that the results relate only to the items calibrated.

This calibration certificate shall not be reproduced except in full only, without written approval from penta calibration co., ltd



Represent to Certificate of Calibration ,PTC/07/22102

Certificate No.: PTC/07/22102

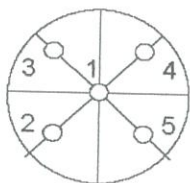
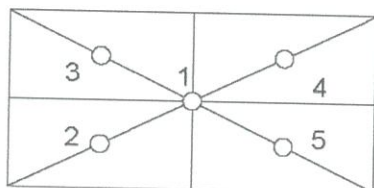
Page: 2 of 2

Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

Eccentric Error: Weight to be 1/3 ,1/2 or of Maximum capacity



Eccentricity test 50 (g)

Position (g)				
1	2	3	4	5
0.0000	0.0000	-0.0001	0.0000	0.0001
Maximum deviation:			0.0001	

Repeatability Test : Weight to be $1/2 \leq L_1 \leq$ Maximum capacity

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

Nominal test value (g)	Standard Deviation
100	0.00009

Error of indication : from nominal value., Readability 0.0001 (g)

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
0	0.00000	0.0000	0.0000	0.00026	2.87
0.01	0.01000	0.0100	0.0000	0.00026	2.65
0.05	0.05000	0.0500	0.0000	0.00026	2.65
0.1	0.10000	0.1000	0.0000	0.00026	2.65
0.5	0.50000	0.4999	0.0001	0.00026	2.65
1	1.00000	0.9999	0.0001	0.00026	2.65
2	2.00000	1.9999	0.0001	0.00026	2.65
5	5.00001	5.0000	0.0000	0.00026	2.65
10	10.00000	10.0001	-0.0001	0.00026	2.65
20	20.00003	20.0001	-0.0001	0.00026	2.52
100	100.00004	100.0001	-0.0001	0.00027	2.18

Note: Weight of adjust - (g)

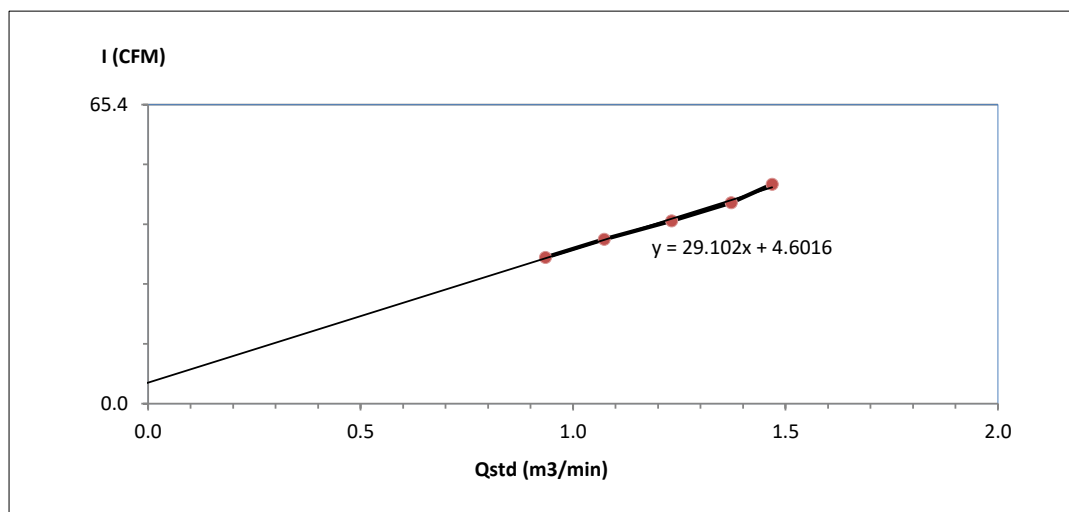
The End of Certificate



High Volume Air Sampler Calibration Worksheet

Project Site :	THAI MMA Co., Ltd.	Barometric Pressure (mm Hg) :	758
Calibrate Location :	บมบ	Temperature (°C) :	32
Calibrate Date :	19-Apr-22	High Volume ID :	RYG_FS0188
Calibration Sheet No.:	C-190422-RYG_FS0188	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0206	High Volume S/N :	4796
Calibrator Model :	TE-5028A	Calibrator Slope :	1.4867
Calibrator S/N :	1543	Calibrator Intercept :	-0.0445

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	1.8	0.9353	32	Slope : 29.1018 Intercept : 4.6016 Correlation Coefficient : 0.9969
2	2.4	1.0731	36	
3	3.2	1.2323	40	
4	4.0	1.3725	44	
5	4.6	1.4686	48	



Calibrated by

(Mr.Anurak Tongkhajonsakda)
Field Scientist(1)

Approved by :

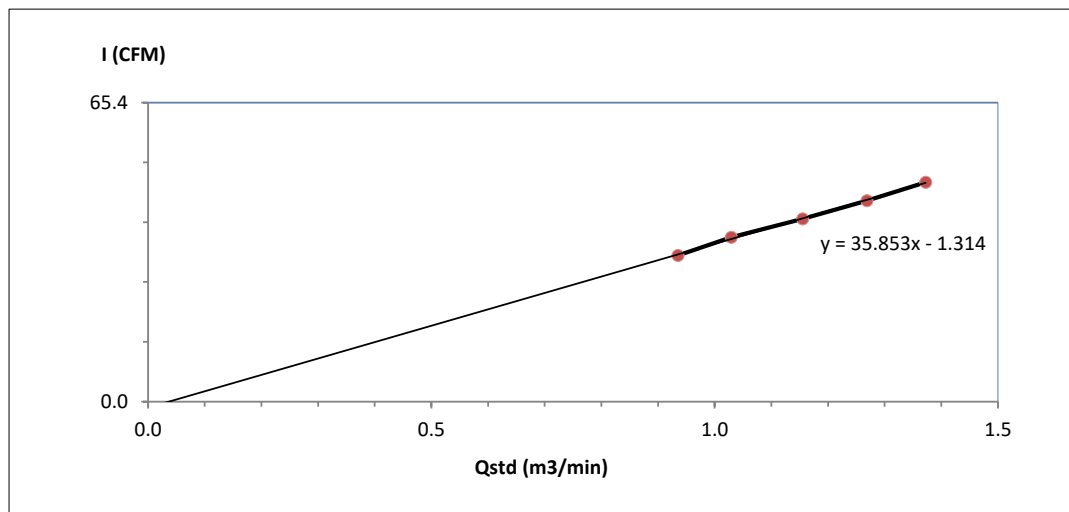
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)




High Volume Air Sampler Calibration Worksheet

Project Site :	THAI MMA Co., Ltd.	Barometric Pressure (mm Hg) :	758
Calibrate Location :	บ้านนาทราย	Temperature (°C) :	32
Calibrate Date :	19-Apr-22	High Volume ID :	RYG_FS0186
Calibration Sheet No.:	C-190422-RYG_FS0186	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0206	High Volume S/N :	4794
Calibrator Model :	TE-5028A	Calibrator Slope :	1.4867
Calibrator S/N :	1543	Calibrator Intercept :	-0.0445

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	1.8	0.9353	32	Slope : 35.8532 Intercept : -1.3140 Correlation Coefficient : 0.9991
2	2.2	1.0294	36	
3	2.8	1.1556	40	
4	3.4	1.2688	44	
5	4.0	1.3725	48	



Calibrated by 

(Mr.Anurak Tongkhajonsakda)
Field Scientist(1)

Approved by : 

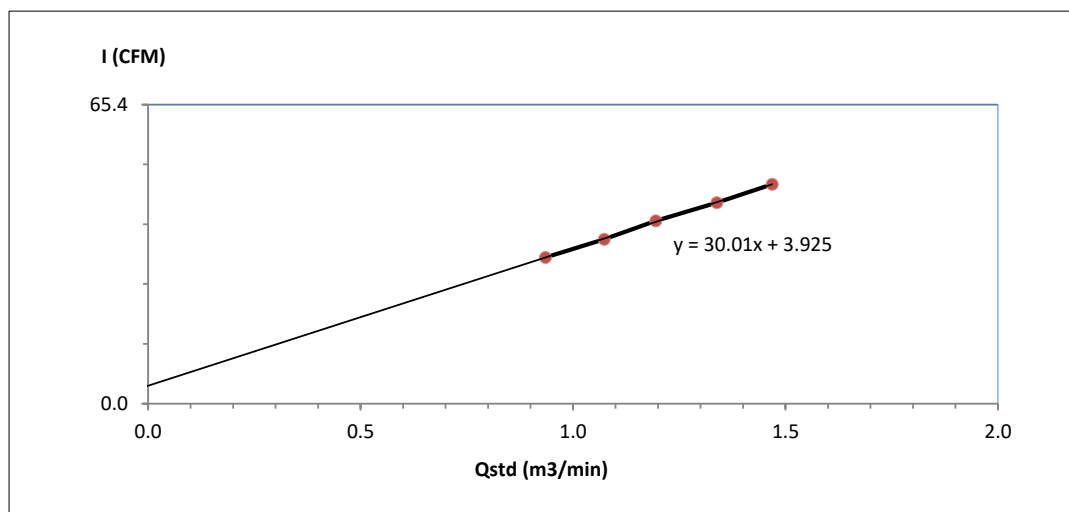
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)





High Volume Air Sampler Calibration Worksheet

Project Site :	THAI MMA Co., Ltd.	Barometric Pressure (mm Hg) :	758
Calibrate Location :	บ้านเนินพยอม	Temperature (°C) :	32
Calibrate Date :	19-Apr-22	High Volume ID :	RYG_FS0184
Calibration Sheet No.:	C-190422-RYG_FS0184	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0206	High Volume S/N :	4792
Calibrator Model :	TE-5028A	Calibrator Slope :	1.4867
Calibrator S/N :	1543	Calibrator Intercept :	-0.0445

Test No.	Delta H ₂ O (inch)	Q _{std} (m ³ /min)	I : Chart (CFM)	Linear Regression
1	1.8	0.9353	32	Slope : 30.0101 Intercept : 3.9250 Correlation Coefficient : 0.9998
2	2.4	1.0731	36	
3	3.0	1.1946	40	
4	3.8	1.3388	44	
5	4.6	1.4686	48	



Calibrated by 
(Mr.Anurak Tongkhajonsakda)
Field Scientist(1)

Approved by : 
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

CERTIFICATE OF CALIBRATION

Certificate No: WS-13072021

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx.
: Cup anemometer: Novalynx.

Model/Type : Data logger: 200-WS-25LB.
: Cup anemometer: WS-02F.

Serial Number : Data logger: A5375.
: Cup anemometer: -.

ID No : Data logger: RYG_FS0413.
: Cup anemometer: -.

Customer : ALS laboratory group (Thailand) co., ltd.
: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Test Conditions : Wind tunnel cross test section area 900 cm²
: Anemometer frontal area 100 cm²
: Diameter of mounting pipe - mm
: Blockage ratio of test object 0.111 [-]

Test Conditions : Air temperature 24.8 ±0.8 °C
: Air pressure 1007.4 ±0.4 hPa
: Relative air humidity 52.4 ±3.5 %RH

Calibration Procedure : Calibration was carried out base on;
IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines;
MCASNET Anemometer Calibration Procedure - Version 2: 2009;

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

Measurement Date : Jul 29, 2021.

Issued Date : Jul 29, 2021.



Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:

[Signature]
Mr. Parinya Booncharoen
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WS-13072021

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

Calibration in the range of 1 – 16 m/s at a calibration interval of 1 m/s.

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

V _{STD} Reading m/s	V _{UUC} * Reading m/s	Error (m/s)	Uncertainty (%)
2.067	2.0	-0.1	2.4
4.138	4.1	0.0	1.2
6.03	6.1	0.1	0.97
7.99	8.0	0.0	0.84
10.00	10.1	0.1	0.59
12.03	12.2	0.2	0.72
13.99	14.3	0.3	0.47
15.98	16.4	0.4	0.35
15.03	15.3	0.3	0.38
12.99	13.1	0.1	0.69
11.01	11.1	0.1	0.57
9.01	9.0	0.0	0.87
6.99	7.1	0.1	0.81
5.177	5.1	-0.1	0.97
2.972	3.1	0.1	1.6
1.044	0.9	-0.1	5.3

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TESTO INC.	06352145	July 16, 2020	MW-0035-20	5 – 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2500	July 16, 2020	MW-0035-20	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	July 20, 2020	MW-0036AA-20	0 – 5 m/s
4	Temperature	Zoglab	DSR-THP	March 30, 2021	CL-027-64	-30 – 70°C
5	Relative humidity	Zoglab	DSR-THP	March 30, 2021	RH-03032021	0 – 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 30, 2021	BP-01032021	500 – 1100 hPa
7	Wind tunnel	ESSOM	MP330D	-	-	0 – 50 Hz

End of certificate of calibration



CERTIFICATE OF CALIBRATION

Certificate No.: WD-13072021

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

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

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

Serial Number : Data logger: A5375.
: Wind direction sensor: -.

ID No : Data logger: RYG_FS0413.
: Wind direction sensor: -.

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

Environmental Condition:

The measurement was carried out in an ambient temperature of $(23\pm3)^{\circ}\text{C}$, and relative humidity of $(40\pm10)\%$.

Measurement Method:

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

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

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: CC563-07-0045, Certificate No.: KWS63/0044.

Measurement Date : Jul 29, 2021.

Issued Date : Jul 29, 2021.

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....



Mr. Parinya Booncharoen.
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-13072021

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

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

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	42	-3	3.0
3		90	90	87	-3	3.0
4		135	135	134	-1	3.0
5		180	180	181	1	3.0
6		225	225	228	3	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	42	-3	3.0
11		90	90	87	-3	3.0
12		135	135	134	-1	3.0
13		180	180	181	1	3.0
14		225	225	228	3	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

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

End of Certificate of Calibration





63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
 Watthapra, Bangkokyai,Bangkok 10600 Thailand.
 Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

CERTIFICATE OF CALIBRATION

Certificate No.: WD-01032021

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

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

Model/Type : Data logger: WS-25DL.
 : Wind direction sensor: WS-02F.

Serial Number : Data logger: A4562.
 : Wind direction sensor: -

Customer : ALS laboratory group (thailand) Co.,Ltd.
 104 Phatthanakan 40, Phatthanakan Rd.,Khwaeng Suan Luang, Khet Suan Luang,Bangkok 10250
 Thailand.

Environmental Condition:

The measurement was carried out in an ambient temperature of $(23 \pm 3)^{\circ}\text{C}$, and relative humidity of $(40 \pm 10)\%$.

Measurement Method:

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

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

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: CC563-07-0045.
 Certificate No.: KWS63/0044.

Measurement Date : March 02, 2021.

Issued Date : March 03, 2021.

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Mr. Bongkorn Malithong



Approved Signatory:.....

Mr. Parinya Booncharoen.
 Technical Support
 and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-01032021

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

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

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	43	-2	3.0
3		90	90	90	0	3.0
4		135	135	130	-5	3.0
5		180	180	177	-3	3.0
6		225	225	228	3	3.0
7		270	270	272	2	3.0
8		315	315	319	4	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	43	-2	3.0
11		90	90	90	0	3.0
12		135	135	130	-5	3.0
13		180	180	177	-3	3.0
14		225	225	228	3	3.0
15		270	270	272	2	3.0
16		315	315	319	4	3.0

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

End of Certificate of Calibration



CERTIFICATE OF CALIBRATION

Certificate No: WS-01032021

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx.
: Cup anemometer: Novalynx.

Model/Type : Data logger: Vantage: WS-25DL.
: Cup anemometer: WS-02F.

Serial Number : Data logger: A4562.
: Cup anemometer:-

Customer : ALS laboratory group (Thailand) co., ltd.
: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250
Thailand.

Test Conditions : Wind tunnel cross test section area 900 cm²
: Anemometer frontal area 100 cm²
: Diameter of mounting pipe - mm
: Blockage ratio of test object 0.111 [-]

Test Conditions : Air temperature 24.1 ±0.8 °C
: Air pressure 1014.4 ±0.4 hPa
: Relative air humidity 60.1 ±3.5 %RH

Calibration Procedure Calibration was carried out base on:
IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind
Turbines;
MEASNET Anemometer Calibration Procedure - Version 2: 2009;

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

Measurement Date : Feb 23, 2021.

Issued Date : Mar 03, 2021.

Calibrated by

- ☐ Mr. Sorawit Thachalad
☒ Mr. Bongkoch Malitrong



Approved Signatory:

[Signature]

Mr. Parinya Booncharoen
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No. : WS-01032021

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

Calibration in the range of 1 - 16 m/s at a calibration interval of 1 m/s.

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

V _{sin} Reading m/s	V _{uuc} * Reading m/s	Error (m/s)	Uncertainty (%)
2.035	1.9	-0.1	2.8
4.098	4.0	-0.1	1.3
6.04	6.1	0.1	0.97
7.97	8.1	0.1	0.84
10.01	10.2	0.2	0.69
12.00	12.3	0.3	0.50
14.02	14.5	0.5	0.57
15.98	16.7	0.7	0.87
15.01	15.6	0.6	0.71
13.00	13.3	0.3	0.76
11.01	11.3	0.3	0.97
8.97	9.1	0.1	0.76
6.98	7.1	0.1	1.2
5.137	5.1	0.0	1.1
2.990	3.0	0.0	1.7
1.038	0.9	-0.1	6.9

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TCSTO INC.	06352145	July 16, 2020	MW-0035-20	5 - 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2500	July 16, 2020	MW-0035-20	5 - 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	July 20, 2020	MW-0036AA-20	0 - 5 m/s
4	Temperature	Zoglab	DSR-THP	March 3, 2020	HZ202003301001	-30 - 70°C
5	Relative humidity	Zoglab	DSR-THP	March 3, 2020	HZ202003301001	0 - 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 3, 2020	HZ202003301001	500 - 1100 hPa
7	Wind tunnel	CSSOM	MP330D			0 - 50 Hz

End of certificate of calibration

CERTIFICATE OF CALIBRATION

Certificate No: WS-14072021

Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx.
: Cup anemometer: Novalynx.

Model/Type : Data logger: 200-WS-25LB.
: Cup anemometer: WS-02F.

Serial Number : Data logger: A5376.
: Cup anemometer: -.

ID No : Data logger: RYG_FS0414.
: Cup anemometer: -.

Customer : ALS laboratory group (Thailand) co., ltd.
: 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

Test Conditions : Wind tunnel cross test section area 900 cm²
: Anemometer frontal area 100 cm²
: Diameter of mounting pipe - mm
: Blockage ratio of test object 0.111 [-]

Test Conditions : Air temperature 25.2 ±0.8 °C
: Air pressure 1006.6 ±0.4 hPa
: Relative air humidity 51.4 ±3.5 %RH

Calibration Procedure Calibration was carried out base on;
IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines;
MGASNET Anemometer Calibration Procedure - Version 2: 2009;

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

Measurement Date : Jul 29, 2021.

Issued Date : Jul 29, 2021.

Calibrated by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:

[Signature]

Mr. Parinya Booncharoen
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WS-14072021

Page 2 of 2 Pages

Result of calibration: ☒ Without adjustment ☐ With adjustment

Calibration in the range of 1 – 16 m/s at a calibration interval of 1 m/s.

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

V _{STD} Reading m/s	V _{UUC} * Reading m/s	Error (m/s)	Uncertainty (%)
2.057	1.8	-0.3	3.1
4.135	4.0	-0.1	1.3
6.02	6.0	0.0	2.1
7.99	8.0	0.0	0.74
10.00	10.1	0.1	0.69
11.99	12.0	0.0	0.72
13.98	14.2	0.2	0.48
15.98	16.2	0.2	0.77
14.99	15.2	0.2	0.49
13.00	13.1	0.1	0.52
11.01	11.0	0.0	0.94
9.01	9.0	0.0	0.81
6.99	7.0	0.0	2.0
5.189	5.1	-0.1	0.96
2.987	3.0	0.0	2.0
1.034	0.8	-0.2	5.3

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TESTO INC.	06352145	July 16, 2020	MW-0035-20	5 – 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2500	July 16, 2020	MW-0035-20	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	July 20, 2020	MW-0036AA-20	0 – 5 m/s
4	Temperature	Zoglab	DSR-THP	March 30, 2021	CL-027-64	-30 – 70°C
5	Relative humidity	Zoglab	DSR-THP	March 30, 2021	RH-03032021	0 – 100 %RH
6	Atmospheric pressure	Zoglab	DSR-THP	March 30, 2021	BP-01032021	500 – 1100 hPa
7	Wind tunnel	ESSOM	MP330D	-	-	0 – 50 Hz

End of certificate of calibration



CERTIFICATE OF CALIBRATION

Certificate No.: WD-14072021

Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

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

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

Serial Number : Data logger: A5376.
: Wind direction sensor: -.

ID No : Data logger: RYG_FS0414.
: Wind direction sensor: -.

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

Environmental Condition:

The measurement was carried out in an ambient temperature of $(23 \pm 3)^{\circ}\text{C}$, and relative humidity of $(40 \pm 10)\%$.

Measurement Method:

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

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

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No.: CC563-07-0045, Certificate No.: KWS63/0044.

Measurement Date : Jul 29, 2021.

Issued Date : Jul 29, 2021.

Performed by

- ☒ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya



Approved Signatory:.....



Mr. Parinya Booncharoen.
Technical Support
and Calibration Manager

Continuation of Certificate of Calibration Number

Certificate No: WD-14072021

Pages 2 of 2 pages

Result of calibration: ☐ Without adjustment ☒ With adjustment.

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

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	43	-2	3.0
3		90	90	87	-3	3.0
4		135	135	132	-3	3.0
5		180	180	179	-1	3.0
6		225	225	228	3	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	43	-2	3.0
11		90	90	87	-3	3.0
12		135	135	132	-3	3.0
13		180	180	179	-1	3.0
14		225	225	228	3	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

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

End of Certificate of Calibration





CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 12 Jan 22
Next Cal. Date : 12 Jul 22

Barometric Pressure (mm.Hg) : 760
Relative Humidity (%) : 58.0
Temperature (°C) : 25.0

Console Control Meter Data

Calibration No. : C-120122-BKK_FS0518
Dry Gas Meter No. : BKK_FS0518
Console Serial No. : 1504025
Console Model No. : XC-572-V

Reference Dry Gas Meter Data

Serial No. : 1607009
Model No. : SK25EXSR-QC6
Correction Factor (Yr) : 1.0060
Next Calibration Date : 8 Apr 22

ΔH (mm.H ₂ O)	Θ Minutes	Reference Dry Gas Meter Calibration				Console Control ; Drygas Meter						Dry Gas Meter Correction	Orifice Calibration
		Vr (Liters)			Tr (°C)	Vm (Liters)			Ti (°C)	To (°C)	Avg.Tm (°C)	Factor (Y)	Factor $\Delta H@$
		Final	Initial	Total		Final	Initial	Total					
15	12.75	150.00	0.00	150.00	31.0	49103.0	48950.0	153.00	29.0	29.0	29.0	0.9784	50.2263
25	9.55	150.00	0.00	150.00	30.0	49263.0	49110.0	153.00	29.0	29.0	29.0	0.9806	46.6557
50	6.75	150.00	0.00	150.00	30.0	49603.0	49450.0	153.00	29.0	29.0	29.0	0.9783	46.6160
80	5.22	150.00	0.00	150.00	30.0	49773.0	49620.0	153.00	30.0	30.0	30.0	0.9787	44.4583
120	4.25	150.00	0.00	150.00	30.0	49933.0	49780.0	153.00	30.0	30.0	30.0	0.9750	44.2060
											Avg.	0.9782	46.4324

Y : Ratio of reading of reference to dry gas meter : tolerance for individual values ± 0.02 from average .

$\Delta H@$: Orifice pressure differential that equates to 21.24 lm of air @ 25 C and 760 mm of mercury , mmH₂O ; tolerance for individual values ± 5.08 from average .

Procedure; 40 CFR 60,APP A,METH ,SEC 5.3 & 7

Calibrated by:

Saksit Phaisanphisut

(Mr.Saksit Phaisanphisut)

Field Scientist (4)

Approved by:

Wichan Choonharat

(Mr.Wichan Choonharat)

Manager



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	12 Jan 22	Ambient Temperature (°C) :	25
Calibration sheet No. :	C-120122-BKK_FS0519	Relative Humidity (%) :	58
Digital Temperature ID	BKK_FS0519	Reference Temperature ID. :	BKK_FS0609
Console Serial No. :	1504025	Serial No. :	7688004
Console Model :	XC-572-V	Model :	FLUKE 714
		Next Calibrate :	13 Jan 22

Location	Reference Temperature °C	Digital Temperature °C	Error °C	Remark
Stack	0	0	0	
	25	25	0	
	50	50	0	
	100	101	1	
	150	153	3	
	200	202	2	
	250	252	2	
	300	302	2	
	500	503	3	
	1000	1004	4	
	1200	1205	5	
Probe	100	101	1	
	125	127	2	
	150	153	3	
Oven	100	101	1	
	125	127	2	
	150	153	3	
Filter	100	101	1	
	125	127	2	
	150	153	3	
Exit	0	0	0	
	10	9	-1	
	20	19	-1	
Meter	0	0	0	
	25	24	-1	
	50	50	0	
AUX	0	0	0	
	25	25	0	
	50	50	0	

Calibrated by

Saksit Phaisanphisut

(Mr.Saksit Phaisanphisut)

Field Scientist (4)

Approved by :

Wichan Chonharat

Mr.Wichan Choonharat

Manager



Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK_FS0522

Calibration Date : 12 Jan 22

Lab test duct Number : 258-1-13-01

Standard Pitot ID : BKK_FS0441

Calibration Sheet No. : C-120122-BKK_FS0522

Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube (ΔP , mm.H ₂ O)	Type s pitot tube (ΔP , mm.H ₂ O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
			\bar{C}_p	0.842	0.842

$$Cp(S) = Cp_{(std)} \sqrt{\frac{\Delta P(std)}{\Delta P(s)}}$$

$$\left| \bar{C}_{p(A)} - \bar{C}_{p(B)} \right| \text{ must BE } \leq 0.01$$

$$\text{Average deviation(A or B)} = \frac{\sum_i [Cp(s) - Cp(A \text{ or } B)]}{3} \text{ must BE } \leq 0.01$$

Calibrated by : Saksit Phaisanphisut

(Mr.Saksit Phaisanphisut)

Field Scientist (4)

Approved by : Wichan Choonharat

(Mr.Wichan Choonharat)

Manager



Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK_FS0523 Calibration Date : 12 Jan 22
 Lab test duct Number : 258-1-13-01 Standard Pitot ID : BKK_FS0441
 Calibration Sheet No. : C-120122-BKK_FS0523 Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube (ΔP , mm.H ₂ O)	Type s pitot tube (ΔP , mm.H ₂ O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
			\bar{C}_p	0.842	0.842

$$Cp(S) = Cp_{(std)} \sqrt{\frac{\Delta P(std)}{\Delta P(s)}}$$

$$\left| \bar{C}_{p(A)} - \bar{C}_{p(B)} \right| \text{ must BE } \leq 0.01$$

$$\text{Average deviation(A or B)} = \frac{\sum_i [Cp(s) - Cp(A \text{ or } B)]}{3} \text{ must BE } \leq 0.01$$

Calibrated by : Saksit Phaisanphisut

(Mr.Saksit Phaisanphisut)

Field Scientist (4)

Approved by : Wichan Choonharat

(Mr.Wichan Choonharat)

Manager



PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date	12 Jan 22	Nozzle Set ID. :	BKK_FS0524
Calibration Sheet No. :	C-120122-BKK_FS0524	Vernier Caliper ID. :	BKK_FS0626

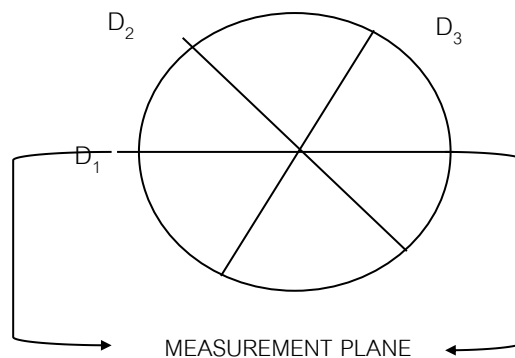
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo ΔD	$(D_1 + D_2 + D_3) / 3$ D_{avg}
	D_1	D_2	D_3		
1	0.318	0.318	0.318	0.000	0.318
2	0.475	0.475	0.475	0.000	0.475
3	0.635	0.635	0.635	0.000	0.635
4	0.792	0.792	0.792	0.000	0.792
5	0.952	0.952	0.952	0.000	0.952
6	1.110	1.110	1.110	0.000	1.110
7	1.270	1.270	1.270	0.000	1.270

Where :

D_1, D_2, D_3 = Three different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm.

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

D_{avg} = $(D_1 + D_2 + D_3) / 3$



Calibrated by : Saksit Phaisanphisut Approved by : Wichan Choonharat

(Mr.Saksit Phaisanphisut)

(Mr.Wichan Choonharat)

Field Scientist (4)

Manager



PENTA
CALIBRATION

PENTA CALIBRATION CO., LTD.

66/124 The Connect 33 Village Kanchanaphisek Road
Dokmai Prawet Bangkok 10250
Tel: +66 (0) 2069-9773
www.pentacal.com

Certificate of Calibration

Represent to Certificate of Calibration ,PTC/07/22099

Certificate No.:	PTC/07/22099	Page:	1 of 2
Equipment:	Digital Balance	Condition:	Normal
Manufacturer:	Sartorius	Serial No:	31709552
Model:	MSU224S-100-DU	ID No:	RYG_EN0003
Type of Balance:	Single interval		



Customer: ALS Laboratory Group (Thailand) Co.,Ltd.
616/10 Moo 5 T.Maenamkoo, A.Pluakdaeng,
Rayong 21140, Thailand

REVIEW BY Thanitall.
APPROVED BY D. [Signature]
NEXT CAL. DATE 23/03/23

Environment Condition: Temperature 23.9 °C ± 0.3 °C
Humidity 58.1 %RH ± 4.4 %RH
Air density 1.17 kg/m³

Calibration Place: ALS Laboratory Group (Thailand) Co.,Ltd.
616/10 Moo 5 T.Maenamkoo, A.Pluakdaeng,
Rayong 21140, Thailand

The Method used: In house method, PTC-WI-07, base on Euramet cg. 18

Traceability: This certificate is traceable to the SI Units through Thai Calibration Service Co.,Ltd.
, NSC-ONSC Accreditation No.: Calibration 0189

Date Received: March 23, 2022

Calibration Date: March 23, 2022

Issued Date: March 25, 2022

Calibration By: Mr. Rungroje Metakul



PENTA CALIBRATION CO.,LTD

[Signature]

(Mr.Kriangsak Kalasri)

Reviewed by

Approved By :

[Signature]

(Mr. Keattisak Kerdto)

Laboratory Manager

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 recognised 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). The effect that the results relate only to the items calibrated.

This calibration certificate shall not be reproduced except in full only, without written approval from penta calibration co., ltd



Represent to Certificate of Calibration ,PTC/07/22099

Certificate No.: PTC/07/22099

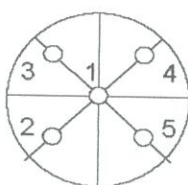
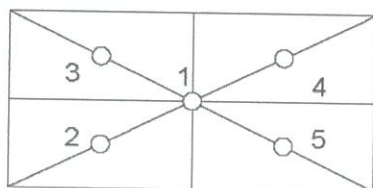
Page: 2 of 2

Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

Eccentric Error: Weight to be 1/3 ,1/2 or of Maximum capacity



Eccentricity test 100 (g)

Position (g)				
1	2	3	4	5
0.0000	0.0000	-0.0001	-0.0001	0.0001
Maximum deviation:				0.0001

Repeatability Test : Weight to be $1/2 \leq L_1 \leq$ Maximum capacity

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

Nominal test value (g)	Standard Deviation
200	0.00007

Error of indication : from nominal value., Readability 0.0001 (g)

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
0	0.00000	0.0000	0.0000	0.00020	2.65
0.01	0.01000	0.0099	0.0001	0.00020	2.43
0.1	0.10000	0.1000	0.0000	0.00020	2.43
0.5	0.50000	0.5000	0.0000	0.00020	2.43
1	1.00000	1.0000	0.0000	0.00020	2.43
5	5.00001	5.0000	0.0000	0.00020	2.43
10	10.00000	10.0000	0.0000	0.00020	2.43
20	20.00003	20.0000	0.0000	0.00020	2.43
50	50.00004	50.0000	0.0000	0.00021	2.32
100	100.00004	99.9999	0.0001	0.00022	2.17
200	200.00011	200.0000	0.0001	0.00027	2.05

Note: Weight of adjust - (g)

The End of Certificate

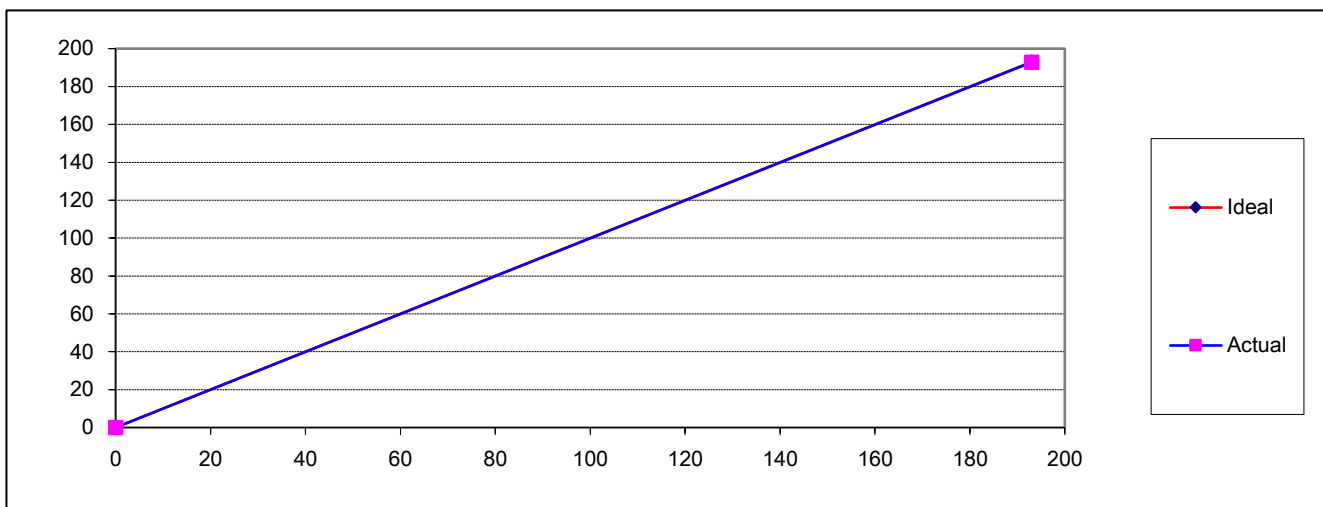


CALIBRATION REPORT

Calibration Date	4-Jan-22	Equipment ID	BKK_FS0758
Equipment Name	FID Analyzer	Manufacturer	Baseline Mocon
Model	9000H	Serial No.	0315EF0047
Std.Gas Conc.(ppm)	193	Cylinder No.	D619622
Certified Date	17-Sep-14	Expired Date	17-Sep-22

CALIBRATION RESULTS

Point	CALIBRATION RESULTS			
	Ideal	Actual	Error	%Error
ZERO	0.00	0.04	0.04	0.04
SPAN	193.00	192.80	-0.20	-0.10
AVERAGE (%)				-0.03



Calibrated By

(Mr. Apisit Sing-ha)
Field Environmental Scientist (4)

Approved By

(Mr. Sarayuth Jittrantont)
Assistant General Manager



CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 12 Jan 22
Next Cal. Date : 12 Jul 22

Barometric Pressure (mm.Hg) : 760
Relative Humidity (%) : 58.3
Temperature (°C) : 25.0

Console Control Meter Data

Calibration No. : C-120122-RYG_FS0315
Dry Gas Meter No. : RYG_FS0315
Console Serial No. : 1706091
Console Model No. : XC-572-V

Reference Dry Gas Meter Data

Serial No. : 1607009
Model No. : DGM-SK25RM-QS8
Correction Factor (Yr) : 1.0060
Next Calibration Date : 8 Apr 22

ΔH (mm.H ₂ O)	\ominus Minutes	Reference Dry Gas Meter Calibration				Console Control ; Drygas Meter						Dry Gas Meter	Orifice
		Vr (Liters)			Tr (°C)	Vm (Liters)			Ti (°C)	To (°C)	Avg.Tm (°C)	Correction	Calibration
		Final	Initial	Total		Final	Initial	Total				Factor (Y)	Factor $\Delta H@$
15	12.30	150.00	0.00	150.00	27.0	1274534.0	1274390.0	144.00	27.0	27.0	27.0	1.0464	45.8249
25	9.45	150.00	0.00	150.00	30.0	1274689.0	1274545.0	144.00	28.0	28.0	28.0	1.0385	45.8355
50	6.73	150.00	0.00	150.00	30.0	1274843.0	1274700.0	143.00	28.0	28.0	28.0	1.0432	46.4941
80	5.22	150.00	0.00	150.00	30.0	1275003.0	1274860.0	143.00	30.0	30.0	30.0	1.0471	44.4583
120	4.27	150.00	0.00	150.00	30.0	1275163.0	1275020.0	143.00	30.0	30.0	30.0	1.0431	44.6230
											Avg.	1.0437	45.4472

Y : Ratio of reading of reference to dry gas meter : tolerance for individual values ± 0.02 from average .

$\Delta H@$: Orifice pressure differential that equates to 21.24 lm of air @ 25 C and 760 mm of mercury , mmH₂O ; tolerance for individual values ± 5.08 from average .

Procedure; 40 CFR 60,APP A,METH ,SEC 5.3 & 7

Calibrated by:

(Mr.Warawut Pubpa)

Field Scientist(3)

Approved by:

(Mr.Wichan Choonharat)

Manager



DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	12-Jan-22	Ambient Temperature (°C) :	24
Calibration sheet No. :	C-120122-RYG_FS0316	Relative Humidity (%) :	58.4

Digital Temperature ID	RYG_FS0316	Reference Temperature ID .	BKK_FS0609
Console Serial No. :	1706091	Serial No. :	7688004
Console Model :	XC-572-V	Model :	FLUKE 714
		Next Calibrate :	13 Jan 22

Location	Reference Temperature °C	Digital Temperature °C	Error °C	Remark
Stack	0	0	0	
	25	27	2	
	50	53	3	
	100	104	4	
	150	154	4	
	200	202	2	
	250	253	3	
	300	304	4	
	500	505	5	
	1000	1003	3	
	1200	1202	2	
Probe	100	104	4	
	125	129	4	
	150	154	4	
Oven	100	104	4	
	125	129	4	
	150	154	4	
Filter	100	104	4	
	125	129	4	
	150	154	4	
Exit	0	0	0	
	10	11	1	
	20	22	2	
Meter	0	0	0	
	25	27	2	
	50	52	2	
AUX	0	0	0	
	25	27	2	
	50	53	3	

Calibrated by :

(Mr.Warawut Pubpa)

Field Scientist (3)

Approved by :

Mr.Wichan Choonharat

Manager



PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date	12 Jan 22	Nozzle Set ID. :	RYG_FS0319
Calibration Sheet No. :	C-120122-RYG_FS0319	Vernier Caliper ID. :	BKK_FS0626

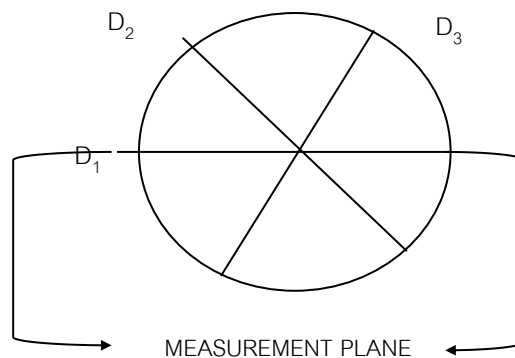
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo ΔD	$(D_1 + D_2 + D_3) / 3$ D_{avg}
	D_1	D_2	D_3		
1	0.300	0.300	0.300	0.000	0.300
2	0.470	0.465	0.465	0.005	0.467
3	0.600	0.600	0.600	0.000	0.600
4	0.770	0.760	0.755	0.015	0.762
5	0.920	0.930	0.930	0.010	0.927
6	1.080	1.080	1.085	0.005	1.082
7	1.240	1.220	1.235	0.020	1.232
8	1.550	1.570	1.540	0.030	1.553

Where :

D_1, D_2, D_3 = Three different nozzle diameters at 60 degrees to each other, each measured the nearest 0.025 mm.

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

D_{avg} = $(D_1 + D_2 + D_3) / 3$



Calibrated by

(Mr. Warawut Pubpa)

Field Scientist (3)

Approved by

(Mr. Wichan Choonharat)

Manager



Pitot Tube Calibration Data

Pitot Tube Identification Number : RYG_FS0320

Calibration Date : 12 Jan 22

Lab test duct Number : 258-1-13-01

Standard Pitot ID : BKK_FS0441

Calibration Sheet No. : C-120122-RYG_FS0320

Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube (ΔP , mm.H ₂ O)	Type s pitot tube (ΔP , mm.H ₂ O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
			\bar{C}_p	0.842	0.842

$$Cp(S) = Cp_{(std)} \sqrt{\frac{\Delta P(std)}{\Delta P(s)}}$$

$$\left| \bar{C}_{p(A)} - \bar{C}_{p(B)} \right| \text{ must BE } \leq 0.01$$

$$\text{Average deviation(A or B)} = \frac{\sum_i [Cp(s) - Cp(A \text{ or } B)]}{3} \text{ must BE } \leq 0.01$$

Calibrated by

(Mr.Warawut Pubpa)

Field Scientist (3)

Approved by

Mr.Wichan Choonharat

Manager



Pitot Tube Calibration Data

Pitot Tube Identification Number : RYG_FS0321 Calibration Date : 12 Jan 22
 Lab test duct Number : 258-1-13-01 Standard Pitot ID : BKK_FS0441
 Calibration Sheet No. : C-120122-RYG_FS0321 Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube (ΔP , mm.H ₂ O)	Type s pitot tube (ΔP , mm.H ₂ O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
			\bar{C}_p	0.842	0.842

$$Cp(S) = Cp_{(std)} \sqrt{\frac{\Delta P(std)}{\Delta P(s)}}$$

$$\left| \bar{C}_{p(A)} - \bar{C}_{p(B)} \right| \text{ must BE } \leq 0.01$$

$$\text{Average deviation}(A \text{ or } B) = \frac{\sum_i [Cp(s) - Cp(A \text{ or } B)]}{3} \text{ must BE } \leq 0.01$$

Calibrated by

(Mr. Warawut Pubpa)

Field Scientist (3)

Approved by

Mr. Wichan Choonharat

Manager



ROTA METER CALIBRATION RESULT APRIL 2022

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R ²)
BKK_FS0577	01 Apr 22	$Y = 1.0202x + 0.1976$	1.0000
BKK_FS0579	01 Apr 22	$Y = 1.0078x + 0.4789$	0.9998
BKK_FS0583	01 Apr 22	$Y = 1.016x + 0.3922$	1.0000
BKK_FS0584	01 Apr 22	$Y = 1.0036x + 2.2262$	0.9997
BKK_FS0585	01 Apr 22	$Y = 1.0189x - 5.6476$	0.9997
BKK_FS0586	01 Apr 22	$Y = 1.0095x - 1.1524$	0.9995
BKK_FS0587	01 Apr 22	$Y = 1.013x - 3.6619$	0.9996
BKK_FS0588	01 Apr 22	$Y = 1.0154x + 4.8357$	0.9999
BKK_FS0589	01 Apr 22	$Y = 0.9918x + 4.8069$	0.9999
BKK_FS0590	01 Apr 22	$Y = 1.0038x - 0.4857$	0.9996
BKK_FS0591	01 Apr 22	$Y = 0.9705x - 52.174$	0.9986
BKK_FS0592	01 Apr 22	$Y = 0.9646x - 37.642$	0.9985
BKK_FS0593	01 Apr 22	$Y = 0.9767x - 58.445$	0.9988
BKK_FS0594	01 Apr 22	$Y = 0.9902x - 62.87$	0.9999
BKK_FS0595	01 Apr 22	$Y = 1.0249x - 98.162$	0.9999
BKK_FS0596	01 Apr 22	$Y = 0.9843x - 26.806$	0.9991
BKK_FS0597	01 Apr 22	$Y = 0.9802x - 61.653$	0.9978
BKK_FS1004	01 Apr 22	$Y = 0.9696x + 17.69$	0.9990
BKK_FS1005	01 Apr 22	$Y = 1.0065x + 5.6786$	0.9997
BKK_FS1006	01 Apr 22	$Y = 1.2142x - 7.1037$	0.9993
BKK_FS1007	01 Apr 22	$Y = 0.9917x + 1.6592$	1.0000
BKK_FS1008	01 Apr 22	$Y = 1.0132x + 0.7207$	1.0000
BKK_FS1009	01 Apr 22	$Y = 1.0132x + 1.1633$	0.9960
BKK_FS1010	01 Apr 22	$Y = 1.0033x + 0.5758$	0.9999
BKK_FS1011	01 Apr 22	$Y = 1.0234x + 0.1759$	0.9996
BKK_FS1012	01 Apr 22	$Y = 1.0106x - 2.0048$	0.9997
BKK_FS1013	01 Apr 22	$Y = 0.9677x - 35.851$	0.9997
BKK_FS1014	01 Apr 22	$Y = 1.0021x + 0.3148$	0.9998
BKK_FS1015	01 Apr 22	$Y = 0.9994x + 1.786$	1.0000
BKK_FS1016	01 Apr 22	$Y = 1.0105x - 80.256$	0.9998
BKK_FS1017	01 Apr 22	$Y = 0.9995x + 0.649$	1.0000
BKK_FS1018	01 Apr 22	$Y = 1.0011x + 1.1786$	1.0000
BKK_FS1019	01 Apr 22	$Y = 1.0023x - 68.424$	0.9996
BKK_FS1020	01 Apr 22	$Y = 1.0547x - 0.666$	0.9998
BKK_FS1021	01 Apr 22	$Y = 1.018x - 3.3286$	0.9998
BKK_FS1022	01 Apr 22	$Y = 0.9932x - 57.035$	0.9986
BKK_FS1023	01 Apr 22	$Y = 1.0094x + 0.0717$	0.9999
BKK_FS1024	01 Apr 22	$Y = 1.0042x + 0.4086$	0.9997



ROTA METER CALIBRATION RESULT APRIL 2022

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R ²)
BKK_FS1025	01 Apr 22	$Y = 1.0132x - 88.507$	0.9996
BKK_FS1026	01 Apr 22	$Y = 1.0018x + 1.0776$	0.9997
BKK_FS1027	01 Apr 22	$Y = 1.0053x + 0.231$	0.9995
BKK_FS1028	01 Apr 22	$Y = 0.9792x - 60.312$	0.9982
BKK_FS1029	01 Apr 22	$Y = 0.9935x + 0.8234$	1.0000
BKK_FS1030	01 Apr 22	$Y = 1.0039x + 0.515$	0.9999
BKK_FS1031	01 Apr 22	$Y = 1.009x - 79.295$	0.9998
BKK_FS1039	01 Apr 22	$Y = 0.9868x + 7.8119$	0.9993
BKK_FS1040	01 Apr 22	$Y = 1.0096x - 7.2905$	0.9990
BKK_FS1041	01 Apr 22	$Y = 1.076x - 2.0503$	0.9999
BKK_FS1042	01 Apr 22	$Y = 1.0054x + 1.6095$	0.9995
BKK_FS1043	01 Apr 22	$Y = 1.0108x - 11.048$	0.9999
BKK_FS1044	01 Apr 22	$Y = 1.0468x - 0.9391$	0.9997
BKK_FS1161	01 Apr 22	$Y = 1.0126x + 0.7738$	0.9999
BKK_FS1162	01 Apr 22	$Y = 0.9994x + 2.6357$	0.9995
BKK_FS1163	01 Apr 22	$Y = 0.977x - 55.03$	0.9987
BKK_FS1164	01 Apr 22	$Y = 0.9914x + 0.8427$	0.9997
BKK_FS1165	01 Apr 22	$Y = 0.9893x + 6.5919$	0.9998
BKK_FS1166	01 Apr 22	$Y = 1.0031x - 77.881$	0.9996
RYG_FS0197	01 Apr 22	$Y = 1.0055x + 1.1914$	0.9998
RYG_FS0198	01 Apr 22	$Y = 0.996x + 23.788$	0.9996
RYG_FS0199	01 Apr 22	$Y = 1.1166x - 3.3942$	0.9998

Review By :

(Mr. Wichan Choonharat)

Enviro Field Services Manager

Approved By :

(Mr. Sarayuth Jittrantont)

Assistant General Manager

Certificate of System Qualification

GC-OQ + GCMS-OQ

REVIEW BY	Sarat M.
APPROVED BY	Ch
NEXT CAL. DATE	1 April 23

System ID: GM-2
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Phatthanakan 40, Phattanakan Rd., Kheiwang Suan Luang, Khet Suan Luang, Bangkok 10250
Date: October 1, 2021 1:10:17 PM
EQP Name: AgilentRecommended , AgilentRecommended
EQP Revision: GC.02.51, GCMS.02.51
Overall Qualification Status: Pass

System Inspection and Basic Safety and Operation

Name: 7890
Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Accuracy

Name: 7890
Front MMI
Setpoint Status: Pass

	Setpoint	Actual
Inlet Pressure:	25.0 psi	24.9 psi
Accuracy:		0.1 psi
Agilent Recommended:	<=	1.2

Overall Inlet Pressure Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

Date: October 1, 2021 1:10:17 PM
System ID: GM-2

Setpoint Status:	Pass			
Zone:	Oven			
	Setpoint/Actual			
Temperature:	230.0	230.5	°C	
Accuracy:		0.5	°C	
Agilent Recommended:	>=	-1.0	% setpoint in K	(-5.0 °C)
	<=	1.0	% setpoint in K	(5.0 °C)

Setpoint Status:	Pass			
Zone:	Oven			
	Setpoint/Actual			
Temperature:	100.0	101.5	°C	
Accuracy:		1.5	°C	
Agilent Recommended:	>=	-1.0	% setpoint in K	(-3.7 °C)
	<=	1.0	% setpoint in K	(3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name:	7890			
Setpoint Status:	Pass			
	Setpoint/Average			
Temperature:	100.0	101.5	°C	
Stability:		0.0	°C	
Agilent Recommended:	<=	0.5		

Overall GC Oven Temperature Stability Test Status

Pass

Log Amp

Tested Combination1	Front	MMI	/ External	SQ
Name:	5975C inert XL with TAD			
Setpoint Status:	Pass			

Date: October 1, 2021 1:10:17 PM
System ID: GM-2

Overall Log Amp Test Status

Pass

RFPA

Tested Combination1

Front

MMI

/ External

SQ

Name:

5975C inert XL with TAD

Setpoint Status:

Pass

Amu:

1050

m/z

Drift After Five Minutes:

6

mV

RFPA Voltage:

461

mV

Agilent Recommended:

>=

-100

and

<=

100

<=

1100

Overall RFPA Test Status

Pass

Tune EI

Tested Combination1

Front

MMI

/ External

SQ

Name:

5975C inert XL with TAD

Setpoint Status:

Pass

Filament:

1

Setpoint Status:

Pass

Filament:

2

Overall Tune EI Test Status

Pass

Scouting Run

Tested Combination1

Front

MMI

/ External

SQ

Injection Tower

Name:

7693A

Source:

EI - Inert

Date:

October 1, 2021 1:10:17 PM

System ID:

GM-2

Setpoint Status:

Completed

Injection Volume on Column:

1.0 μ L

Overall Scouting Run Status

Completed

Signal to Noise EI

Tested Combination1

Front

MMI

/ External

SQ

Name:

5975C Inert XL with TAD

Source:

EI - Inert

Filament:

1

Setpoint Status:

Pass

Signal to Noise:

619

Agilent Recommended:

 \geq

320

Source:

EI - Inert

Filament:

2

Setpoint Status:

Pass

Signal to Noise:

647

Agilent Recommended:

 \geq

320

Overall Signal to Noise EI Test Status

Pass

Injection Precision

Tested Combination1

Front

MMI

/ External

SQ

Name:

7693A

Source:

EI - Inert

Setpoint Status:

Pass

Injection Volume on Column:

1.0 μ L

Area RSD:

4.75

%

Retention Time RSD:

0.02

%

Agilent Recommended:

 \leq

5.00

 \leq

1.00

Overall Injection Precision Test Status

Pass

Date:

October 1, 2021 1:10:17 PM

System ID:

GM-2

Mass Ratio Precision

Tested Combination1	Front	MMI	/ External	SQ
Injection Tower				
Name:	7693A			
Source:	EI - Inert			
Setpoint Status:	Pass			
Injection Volume on Column:	1.0	uL		
	Area Mass 1	Mass Ratio		
	Abundance*s			
RSD:	4.75	%	0.81	%
Agilent Recommended:	<= 5.00		<= 5.00	
	Pass		Pass	

Overall Mass Ratio Precision Test Status

Pass

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

System ID	GM-2
Manufacturer	Agilent Technologies
Name	7890
Flow Data Input	Manual Data
Temperature Data Input	Manual Data or Other Data Logging

Tested Combination1

Injection Technique	Injection Tower
Inlet	Front
Detector	External
LTM Included?	No

Sampler 1

Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7693A
Model Number	G4513A
Serial Number	CN10120123
Firmware Revision	A.10.08
Usage	Sample Injection
Location	Front
Syringe Volume (µL)	10

Sampler 2

Manufacturer	Agilent Technologies
Type	Tray
Name	7693A
Model Number	G4514A
Serial Number	CN10060099
Firmware Revision	A.10.16
Vial Heater	Not installed

Mainframe 1

Manufacturer	Agilent Technologies
Name	7890
Model Number	G3440A
Serial Number	CN10141049
Firmware Revision	A.01.16
Oven Type	Standard

Inlet 1

Manufacturer	Agilent Technologies
Name	7890
Type	MMI
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes

Detector 1

Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External

Mass Spectrometer 1

Manufacturer	Agilent Technologies
Type	SQ
Name	5975C inert XL with TAD
Serial Number	US10153217
Firmware Revision	5.02.12
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN Std

MS EI Source 1

Manufacturer	Agilent Technologies
Source Type	EI - Inert
Number of filaments	2

Electronic Signature

Purpose

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

Details

Full Name of Signer:	Supasak Nimsongtham
Logged On User Name:	supasak.nimsongtham@agilent.com
Signature Creation Date:	October 1, 2021
Reason for Signature:	Executed protocol and published this original version of document

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User Name: supasak.nimsongtham
 Hostname: 5CG1115HKC

System Id: GM-2
 Print Date: October 1, 2021 1:10:19 PM

ALS_GM2 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 1, 2021 12:42:37 PM	Audit	SessionCreated	Session	None
October 1, 2021 12:42:37 PM	Start	Configuration	Session	None
October 1, 2021 12:42:37 PM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
October 1, 2021 12:44:21 PM	Audit	EqpLoaded	Session	EQP details for primary technique [Gc] - File path: [ProtocolPacks/Gc/Configurations/02.51/Gc.02.51.eqp], EQP File Name: [Gc.02.51.eqp], EQP Name: [AgilentRecommended] EQP details for hyphenated technique [GcMs] - File path: [ProtocolPacks/GcMs/Configurations/02.51/GcMs.02.51.eqp], EQP File Name: [GcMs.02.51.eqp], EQP Name: [AgilentRecommended]
October 1, 2021 12:44:24 PM	End	Configuration	Session	None
October 1, 2021 12:44:28 PM	Start	Qualification	Session	OQ
October 1, 2021 12:44:28 PM	Start	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	None

Page 1 / 7

User Name: supasak.nimsongtham
 Hostname: 5CG1115HKC

System Id: GM-2
 Print Date: October 1, 2021 1:10:19 PM

ALS_GM2 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 1, 2021 12:47:35 PM	End	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	Run Count : 1
October 1, 2021 12:47:37 PM	Start	Execution	Inlet Pressure Accuracy - Front MMI: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
October 1, 2021 12:47:42 PM	End	Execution	Inlet Pressure Accuracy - Front MMI: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count : 1
October 1, 2021 12:47:44 PM	Start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
October 1, 2021 12:48:04 PM	Audit	Data	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
October 1, 2021 12:48:05 PM	End	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count : 1
October 1, 2021 12:48:07 PM	Start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
October 1, 2021 12:48:34 PM	Audit	Data	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
October 1, 2021 12:48:36 PM	End	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count : 1

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User Name: supasak.nimsongtham
 Hostname: 5CG1115HKC

System id: GM-2
 Print Date: October 1, 2021 1:10:19 PM

ALS_GM2 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 1, 2021 12:48:38 PM	Start	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
October 1, 2021 12:49:34 PM	Audit	Data	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
October 1, 2021 12:49:36 PM	End	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count : 1
October 1, 2021 12:49:37 PM	Start	Execution	Log Amp - 5975C inert XL with TAD SQ: - Source: EI - Inert	None
October 1, 2021 12:49:47 PM	End	Execution	Log Amp - 5975C inert XL with TAD SQ: - Source: EI - Inert	Run Count : 1
October 1, 2021 12:49:48 PM	Start	Execution	RFPA - 5975C inert XL with TAD SQ: - Source: EI - Inert	None
October 1, 2021 12:50:23 PM	End	Execution	RFPA - 5975C inert XL with TAD SQ: - Source: EI - Inert	Run Count : 1
October 1, 2021 12:50:25 PM	Start	Execution	Tune EI - 5975C inert XL with TAD SQ: - Source: - EI - Inert Filament 1 (Qualitative - No setpoints associated)	None
October 1, 2021 12:50:49 PM	End	Execution	Tune EI - 5975C inert XL with TAD SQ: - Source: - EI - Inert Filament 1 (Qualitative - No setpoints associated)	Run Count : 1
October 1, 2021 12:50:50 PM	Start	Execution	Tune EI - 5975C inert XL with TAD SQ: - Source: - EI - Inert Filament 2 (Qualitative - No setpoints associated)	None
October 1, 2021 12:50:59 PM	End	Execution	Tune EI - 5975C inert XL with TAD SQ: - Source: - EI - Inert Filament 2 (Qualitative - No setpoints associated)	Run Count : 1

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User Name: supasak.nimsongtham
 Hostname: 5CG1115HKC

System Id: GM-2
 Print Date: October 1, 2021 1:10:19 PM

ALS_GM2 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 1, 2021 12:51:01 PM	Start	Execution	Scouting Run - Injection Tower, Front MMI, SQ: - Source: - EI - Inert- Part of GCMS System Preparation	None
October 1, 2021 12:51:18 PM	Audit	Data	Scouting Run - Injection Tower, Front MMI, SQ: - Source: - EI - Inert- Part of GCMS System Preparation	Data files Path : E:\GM2OQ2021\SCOUTING RUN001.D\DATA.MS
October 1, 2021 12:51:42 PM	Audit	Data	Scouting Run - Injection Tower, Front MMI, SQ: - Source: - EI - Inert- Part of GCMS System Preparation	Data files Path : E:\GM2OQ2021\SCOUTING RUN001.D\DATA.MS
October 1, 2021 12:52:42 PM	Audit	Data	Scouting Run - Injection Tower, Front MMI, SQ: - Source: - EI - Inert- Part of GCMS System Preparation	Data files Path : E:\GM2OQ2021\SCOUTING RUN001.D\DATA.MS
October 1, 2021 12:53:25 PM	End	Execution	Scouting Run - Injection Tower, Front MMI, SQ: - Source: - EI - Inert- Part of GCMS System Preparation	Run Count : 1
October 1, 2021 12:53:27 PM	Start	Execution	Signal to Noise EI - Injection Tower, Front MMI, SQ: - Source: EI - Inert using Filament 1 - L: >= 320	None
October 1, 2021 12:53:40 PM	Audit	Data	Signal to Noise EI - Injection Tower, Front MMI, SQ: - Source: EI - Inert using Filament 1 - L: >= 320	Data files Path : E:\GM2OQ2021\SNF1_001.D\DATA.MS
October 1, 2021 12:53:56 PM	End	Execution	Signal to Noise EI - Injection Tower, Front MMI, SQ: - Source: EI - Inert using Filament 1 - L: >= 320	Run Count : 1

User Name: supasak.nimsongtham
 Hostname: 5CG1115HKC

System Id: GM-2
 Print Date: October 1, 2021 1:10:19 PM

ALS_GM2 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 1, 2021 12:53:59 PM	Start	Execution	Signal to Noise EI - Injection Tower, Front MMI, SQ: - Source: EI - Inert using Filament 2 - L: >= 320	None
October 1, 2021 12:54:04 PM	Audit	Data	Signal to Noise EI - Injection Tower, Front MMI, SQ: - Source: EI - Inert using Filament 2 - L: >= 320	Data files Path : E:\GM2OQ2021\SNF2_001.D D\DATA.MS
October 1, 2021 12:54:22 PM	End	Execution	Signal to Noise EI - Injection Tower, Front MMI, SQ: - Source: EI - Inert using Filament 2 - L: >= 320	Run Count : 1
October 1, 2021 12:54:26 PM	Start	Execution	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	None
October 1, 2021 12:54:37 PM	Audit	Data	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM2OQ2021\IP_MRP003. D\DATA.MS
October 1, 2021 12:54:37 PM	Audit	Data	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM2OQ2021\IP_MRP004. D\DATA.MS
October 1, 2021 12:54:37 PM	Audit	Data	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM2OQ2021\IP_MRP005. D\DATA.MS
October 1, 2021 12:54:37 PM	Audit	Data	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM2OQ2021\IP_MRP006. D\DATA.MS

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Date: October 1, 2021 1:10:17 PM
 System ID: GM-2

User Name: supasak.nimsongtham

System Id: GM-2

Hostname: 5CG1115HKC

Print Date: October 1, 2021 1:10:19 PM

ALS_GM2 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 1, 2021 12:54:37 PM	Audit	Data	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM2OQ2021\IP_MRP007.D\DATA.MS
October 1, 2021 12:54:37 PM	Audit	Data	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM2OQ2021\IP_MRP008.D\DATA.MS
October 1, 2021 12:54:52 PM	End	Execution	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Run Count : 1
October 1, 2021 12:54:55 PM	Start	Execution	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	None
October 1, 2021 12:55:06 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM2OQ2021\IP_MRP003.D\DATA.MS
October 1, 2021 12:55:06 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM2OQ2021\IP_MRP004.D\DATA.MS
October 1, 2021 12:55:06 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM2OQ2021\IP_MRP005.D\DATA.MS
October 1, 2021 12:55:06 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM2OQ2021\IP_MRP006.D\DATA.MS

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User Name: supasak.nimsongtham
Hostname: 5CG1115HKC

System Id: GM-2
Print Date: October 1, 2021 1:10:19 PM

ALS_GM2 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 1, 2021 12:55:06 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM2OQ2021\IP_MRP007. D\DATA.MS
October 1, 2021 12:55:06 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM2OQ2021\IP_MRP008. D\DATA.MS
October 1, 2021 12:55:10 PM	End	Execution	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Run Count : 1
October 1, 2021 12:55:13 PM	End	Qualification	Session	OQ
October 1, 2021 12:55:13 PM	Start	Reporting	Session	None
October 1, 2021 1:09:11 PM	Audit	Reporting	Session	Report Generated : Certificate

SITHIPORN ASSOCIATES CO.,LTD.

CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd.,Bangbunru, Bangplud Bangkok 10700 THAILAND.
Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiphorn.com http://www.sithiphorn.com



NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACC21009

Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No.: 34178123
ID No.: RYG_FS0215

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWAENG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location : -
Ambient Temperature : (23.0 \pm 3) °C
Pressure : (101.3 \pm 3) kPa
Relative Humidity : (50.0 \pm 20) %

Received Date : 05 AUGUST 2021
Calibration Date : 09 AUGUST 2021
Date of Issue : 11 AUGUST 2021

REVIEW BY	<i>Nathakorn</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	9/8/22

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurai
(Thanakul Petchurai)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

Continuation of Calibration Certificate

Cert. No. : ACC21009

Job No. : VC64AC0058

Pages : 2 of 3

Calibration Procedure : CP-AC-03

Calibration Method :

This equipment was calibrated by based on IEC-60942-2003 Standard.

The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference microphone.

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Digital Multimeter	33461A	MY53220116	EEL.BP. 04/0264	10-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22
Audio Analyzer	AVR-3360A	V744B6069	EF-0010-21	10-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

Continuation of Calibration Certificate

Cert. No. : ACC21009

Job No. : VC64AC0058

Pages : 3 of 3

Result of calibration :**1. Sound pressure level**

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	94.06	0.06	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1001.5	0.1	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
1.67	0.10	3.0

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$
or any value following calculation, providing a level of confidence of approximately 95 %

————— End of Calibration Certificate —————

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd.,Bangbumru, Bangplud Bangkok 10700 THAILAND.
Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiphorn.com http://www.sithiphorn.com



NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL21117

Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00233183 / 144835 / 23230
ID No.: RYG_FS0024

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWANG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location : -
Ambient Temperature : (23.0 \pm 3) °C
Pressure : (101.3 \pm 3) kPa
Relative Humidity : (50.0 \pm 20) %

Received Date : 21 SEPTEMBER 2021
Calibration Date : 04-06 OCTOBER 2021
Date of Issue : 11 OCTOBER 2021

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	4/10/22

Calibrated by :

Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

Continuation of Calibration Certificate

Cert. No. : ACL21117

Job No. : VC64AC0070

Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).

The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

Continuation of Calibration Certificate

Cert. No. : ACL21117
Job No. : VC64AC0070
Pages : 3 of 8

Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.2	N/A
2. Self-generated noise	✓	-	0.2	N/A
3. Acoustical signal tests of frequency weightings				
125 Hz	✓	-	0.3	0.6
1000 Hz	✓	-	0.3	0.6
8000 Hz	✓	-	0.4	0.7
4. Electrical signal tests of frequency weightings				
For 10 Hz to 4 kHz	✓	-	0.3	0.6
For > 4 kHz to 10 kHz	✓	-	0.3	0.7
For > 10 kHz to 20 kHz	-	-	-	1.0
5. Frequency and time weightings at 1 kHz	✓	-	0.2	0.2
6. Long - term stability	✓	-	0.1	0.1
7. Level linearity on the reference level range	✓	-	0.2	0.3
8. Level linearity including the level range control	✓	-	0.2	0.3
9. Tone burst response	✓	-	0.2	0.3
10. Peak C sound level	✓	-	0.2	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

Continuation of Calibration Certificate

Cert. No. : ACL21117
Job No. : VC64AC0070
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.96)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
22.9

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

Frequency Weighting	Measured value (dB)
A - weight	13.8
C - weight	19.7
Flat	25.4

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	-0.1	-0.1	-0.1	± 1.5
1000	0.0	-0.1	0.0	± 1.0
8000	0.3	0.4	0.4	±5.0

Continuation of Calibration Certificate

Cert. No. : ACL21117
Job No. : VC64AC0070
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	94.0	0.0	± 0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	94.0	0.0	± 0.1
Leq	94.0	0.0	± 0.1

6. Long - term stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.0	0.0	± 0.3

Continuation of Calibration Certificate

Cert. No. : ACL21117

Job No. : VC64AC0070

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7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.1	0.1	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.2	0.2	± 1.1

Continuation of Calibration Certificate

Cert. No. : ACL21117

Job No. : VC64AC0070

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8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Auto	94.0	94.0	0.0	±1.1

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.2	-0.2	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.1	0.1	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

Continuation of Calibration Certificate

Cert. No. : ACL21117

Job No. : VC64AC0070

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11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.6	89.5	-0.1	±1.5

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	137.0	137.0	0.0	±0.3

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate

SITHIPHORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd.,Bangbumru, Bangplud Bangkok 10700 THAILAND.
Tel.0-2435-8800 Fax.0-2433-1679 e-mail:cal-center@sithiphorn.com http://www.sithiphorn.com



NSC-TISI-TIS 17025
CALIBRATION 0394

Cert. No. : ACL22027

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Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00900072 / 188465 / 01734
ID No.: RYG_FS0493

Condition As Found : GOOD

Customer : ALS LABORATORY GROUP (THAILAND) CO., LTD.
104 PHATTHANAKAN 40, PHATTHANAKAN ROAD,
KHWANG PHATTHANAKAN, KHET SUAN LUANG,
BANGKOK, 10250 THAILAND.

Location : -
Ambient Temperature : (23.0 \pm 3) °C
Pressure : (101.3 \pm 3) kPa
Relative Humidity : (50.0 \pm 20) %

Received Date : 05 JANUARY 2022
Calibration Date : 10-12 JANUARY 2022
Date of Issue : 13 JANUARY 2022

REVIEW BY	<i>Nathakorn P.</i>
APPROVED BY	<i>[Signature]</i>
NEXT CAL. DATE	10/1/23

Calibrated by : Nathakorn Pisutpaisan

Approved by :

[Signature]
(Thanakul Petchurai)

This certificate is issued in accordance with the requirements of ISO/IEC 17025 standard, may not be reproduced other than in full, except with the prior written approval of the head of Calibration Laboratory.

Continuation of Calibration Certificate

Cert. No. : ACL22027

Job No. : VC65AC0040

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Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).

The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.

3. This certificate is traceable to the international system of unit maintained at :

3.1 National Institute of Metrology (Thailand).

3.2 Thailand Institute of Scientific and Technological Research (TISTR).

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Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
1. Absolute sensitivity	✓	-	0.2	N/A
2. Self-generated noise	✓	-	0.2	N/A
3. Acoustical signal tests of frequency weightings				
125 Hz	✓	-	0.3	0.6
1000 Hz	✓	-	0.3	0.6
8000 Hz	✓	-	0.3	0.7
4. Electrical signal tests of frequency weightings				
For 10 Hz to 4 kHz	✓	-	0.3	0.6
For > 4 kHz to 10 kHz	✓	-	0.3	0.7
For > 10 kHz to 20 kHz	-	-	-	1.0
5. Frequency and time weightings at 1 kHz	✓	-	0.2	0.2
6. Long - term stability	✓	-	0.1	0.1
7. Level linearity on the reference level range	✓	-	0.2	0.3
8. Level linearity including the level range control	✓	-	0.2	0.3
9. Tone burst response	✓	-	0.2	0.3
10. Peak C sound level	✓	-	0.2	0.35
11. Overload indication	✓	-	0.2	0.25
12. High level stability	✓	-	0.1	0.1

Continuation of Calibration Certificate

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Result of calibration :**1. Absolute sensitivity**

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.96)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	9.9
C - weight	16.9
Flat	22.6

3. Acoustical signal tests of frequency weightings

Meter free-field acoustic response at a level of 84 dB

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			Acceptance Limits
	Flat	C-weight	A-weight	
125	0.4	0.4	0.4	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.2	-1.1	-1.1	±5.0

Continuation of Calibration Certificate

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4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
63	-0.1	-0.1	-0.1	±2.0
125	0.0	0.0	-0.1	±1.5
250	0.0	0.0	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.0	0.0	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	94.0	0.0	± 0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	94.0	0.0	± 0.1
Leq	94.0	0.0	± 0.1

6. Long - term stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.0	0.0	± 0.3

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7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

Continuation of Calibration Certificate

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8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Auto	94.0	94.0	0.0	±1.1

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	116.9	-0.1	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
SEL	0.25	1	99.0	98.8	-0.2	1.5 ; -5.0
	2	8	108.0	107.9	-0.1	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.0	-0.4	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

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11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.6	89.6	0.0	±1.5

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	137.0	137.0	0.0	±0.3

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation, providing a level of confidence of approximately 95 %

End of Calibration Certificate