ภาคผนวก ง

เอกสารการสอบเทียบเครื่องมือตรวจวิเคราะห์

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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0187	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0294	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0188	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0400	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0191	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0295	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	RYG_EN0001	1-Mar-23	1-Mar-24	12
Ambient	Total Suspended Particulate	High Volume	RYG_FS0177	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0174	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0396	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0173	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0179	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0175	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RYG_EN0001	1-Mar-23	1-Mar-24	12
Ambient	Nitrogen Dioxide	NO_2 Analyzer	RYG_FS0252	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO_2 Analyzer	RYG_FS0264	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO_2 Analyzer	RYG_FS0551	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO_2 Analyzer	RYG_FS0453	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO_2 Analyzer	BKK_FS1064	5-Jan-23	5-Jul-23	6
Ambient	Nitrogen Dioxide	NO_2 Analyzer	RYG_FS0255	5-Jan-23	5-Jul-23	6
Ambient	Sulfur Dioxide	SO_2 Analyzer	RYG_FS0251	4-Jan-23	4-Jul-23	6
Ambient	Sulfur Dioxide	SO_2 Analyzer	RYG_FS0263	4-Jan-23	4-Jul-23	6
Ambient	Sulfur Dioxide	SO_2 Analyzer	RYG_FS0462	4-Jan-23	4-Jul-23	6
Ambient	Sulfur Dioxide	SO_2 Analyzer	RYG_FS0452	4-Jan-23	4-Jul-23	6
Ambient	Sulfur Dioxide	SO_2 Analyzer	RYG_FS0266	4-Jan-23	4-Jul-23	6
Ambient	Sulfur Dioxide	SO_2 Analyzer	RYG_FS0254	4-Jan-23	4-Jul-23	6
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0081	18-Jan-23	18-Jul-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0413	10-Feb-23	10-Aug-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0609	18-Nov-22	18-May-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0608	17-Nov-22	17-May-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0414	10-Feb-23	10-Aug-24	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0141	5-Jan-23	5-Jul-24	18
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0518	13-Jan-23	13-Jul-23	6
Stack	Total Suspended Particulate	Digital Balance	RYG_EN0003	1-Mar-23	1-Mar-24	12
Stack (CEMs)	Oxides of Nitrogen	Analyzer , System calibration, Standard gas	-	-	-	-
Stack (CEMs)	Sulfur Dioxide	Analyzer , System calibration, Standard gas	-	-	-	-
Stack (CEMs)	Carbon Monoxide	Analyzer , System calibration, Standard gas	-	-	-	-
Stack (CEMs)	Oxygen	Analyzer , System calibration, Standard gas	-	-	-	-
Noise	Leq 24 hrs	Sound Calibrator	RYG_FS0213	26-Jan-23	26-Jan-24	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0304	11-Jul-22	11-Jul-23	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0303	11-Jul-22	11-Jul-23	12

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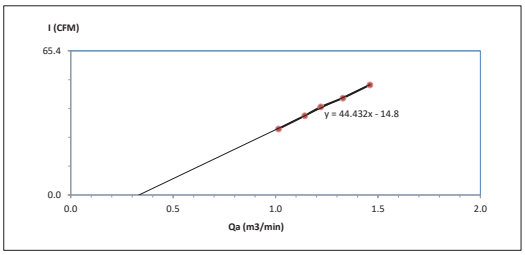
รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Rayong Lab	Temperature	pH meter	RYG_FS0549	18-Aug-22	18-Aug-23	12
Rayong Lab	pH at 25 °C	pH Meter	RYG_EN0152	22-Dec-22	22-Dec-23	12
Rayong Lab	Total Suspended Solids	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Total Suspended Solids	Hot Air Oven	RYG_EN0010	20-Oct-22	20-Apr-24	18
Rayong Lab	Total Dissolved Solids 180°C	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RYG_EN0010	20-Oct-22	20-Apr-24	18
Rayong Lab	BOD	DO meter with Sensor	RYG_EN0032	14-Feb-22	15-Aug-23	18
Rayong Lab	BOD	Incubator	RYG_EN0154	22-Apr-22	21-Oct-23	18
Rayong Lab	Oil & Grease	Electronic Balance	RYG_EN0002	1-Mar-23	1-Mar-24	12
Rayong Lab	Oil & Grease	Hot Air Oven	RYG_EN0006	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Water Bath	RYG_EN0061	20-Oct-22	20-Apr-24	18
Rayong Lab	Dissolved Oxygen	Chamber (Cold Room)	RYG_EN0184	25-Jan-23	25-Jul-24	18
Water Lab	Calcium	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Water Lab	Calcium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Calcium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Magnesium	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Water Lab	Magnesium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Magnesium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Sodium	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Water Lab	Sodium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Sodium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	SAR	ICP-OES	BKK_EL0037	20-Mar-23	19-Sep-24	18
Water Lab	SAR	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	SAR	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Chlorite	Ion Chromatography	BKK_EN0130	11-Jan-23	11-Jan-24	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0215	31-Aug-22	31-Aug-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0006	13-Jan-23	13-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0012	16-Dec-22	16-Dec-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0015	24-May-22	24-May-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0016	11-Jul-22	11-Jul-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0017	3-Jan-23	3-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0018	3-Jan-23	3-Jan-24	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0215	31-Aug-22	31-Aug-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0006	13-Jan-23	13-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0007	13-Jan-23	13-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0012	16-Dec-22	16-Dec-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0019	13-Jan-23	13-Jan-24	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0438	7-Sep-22	7-Sep-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0439	7-Sep-22	7-Sep-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0613	12-Oct-22	12-Oct-23	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0215	31-Aug-22	31-Aug-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0030	25-Jan-23	25-Jan-24	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0223	3-Feb-23	3-Feb-24	12
Illuminance	Illuminance	Lux Meter	RYG_FS0538	2-Sep-22	2-Sep-23	12

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf NC Co.,Ltd.	**Barometric Pressure (mm Hg) :**	753
Calibrate Location :	วัดอ่างศิลา	**Temperature (°C) :**	33
Calibrate Date :	14-Jun-23	**High Volume ID :**	RYG_FS0187
CalibrationSheet No.:	**C-140623-RYG_FS0187**	**High Volume Model :**	TE-5009X
Calibrator ID:	RYG_FS0205	**High Volume S/N :**	4795
Calibrator Model :	TE-5028A	**Calibrator Slope :**	0.94434
Calibrator S/N :	1166	**Calibrator Intercept :**	-0.01292

Test No.	Delta H_2O (inch)	Qa (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.2	1.014	30	Slope : 44.4322
2	2.8	1.142	36	Intercept : -14.8002
3	3.2	1.220	40	Correlation Coefficient : 0.9990
4	3.8	1.329	44	
5	4.6	1.461	50	



Calibrated by _____ (Mr.Nontachai Uppathamp) Field Scientist(1)

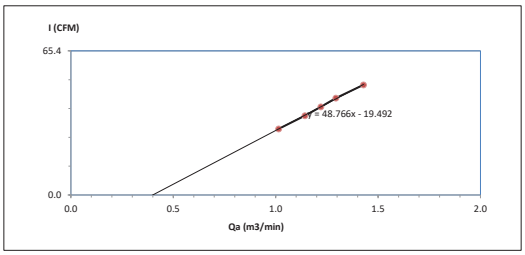
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-074 REVISION NO.: - ISSUE DATE: 14/03/16

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf NC Co.,Ltd.	**Barometric Pressure (mm Hg) :**	753
Calibrate Location :	วัดสระตุ่ศรีทธาฬา	**Temperature (°C) :**	33
Calibrate Date :	14-Jun-23	**High Volume ID :**	RYG_FS0294
CalibrationSheet No.:	**C-140623-RYG_FS0294**	**High Volume Model :**	TE-5009X
Calibrator ID:	RYG_FS0205	**High Volume S/N :**	5501
Calibrator Model :	TE-5028A	**Calibrator Slope :**	0.94434
Calibrator S/N :	1166	**Calibrator Intercept :**	-0.01292

Test No.	Delta H_2O (inch)	Qa (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.2	1.014	30	Slope : 48.7659
2	2.8	1.142	36	Intercept : -19.4924
3	3.2	1.220	40	Correlation Coefficient : 0.9995
4	3.6	1.294	44	
5	4.4	1.429	50	



Calibrated by _____ (Mr.Nontachai Uppathamp) Field Scientist(1)

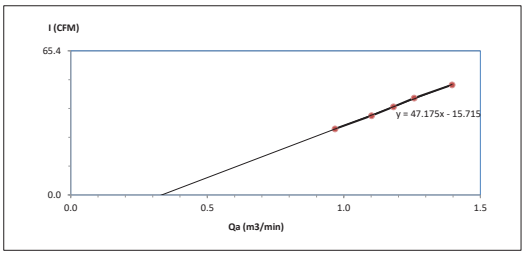
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-074 REVISION NO.: - ISSUE DATE: 14/03/16

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf NC Co.,Ltd.	**Barometric Pressure (mm Hg) :**	753
Calibrate Location :	ชุมชนบ้านนาแขม	**Temperature (°C) :**	33
Calibrate Date :	14-Jun-23	**High Volume ID :**	RYG_FS0188
CalibrationSheet No.:	**C-140623-RYG_FS0188**	**High Volume Model :**	TE-5009X
Calibrator ID:	RYG_FS0205	**High Volume S/N :**	4796
Calibrator Model :	TE-5028A	**Calibrator Slope :**	0.94434
Calibrator S/N :	1166	**Calibrator Intercept :**	-0.01292

Test No.	Delta H_2O (inch)	Qa (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.0	0.968	30	Slope : 47.1753
2	2.6	1.101	36	Intercept : -15.7152
3	3.0	1.182	40	Correlation Coefficient : 0.9995
4	3.4	1.258	44	
5	4.2	1.396	50	



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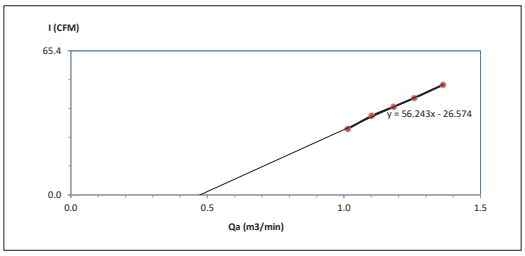
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-074 REVISION NO.: - ISSUE DATE: 14/03/16

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf NC Co.,Ltd.	**Barometric Pressure (mm Hg) :**	753
Calibrate Location :	โรงเรียนบ้านโนนสะอาด	**Temperature (°C) :**	33
Calibrate Date :	14-Jun-23	**High Volume ID :**	RYG_FS0400
CalibrationSheet No.:	**C-140623-RYG_FS0400**	**High Volume Model :**	TE-5009X
Calibrator ID:	RYG_FS0205	**High Volume S/N :**	5691
Calibrator Model :	TE-5028A	**Calibrator Slope :**	0.94434
Calibrator S/N :	1166	**Calibrator Intercept :**	-0.01292

Test No.	Delta H_2O (inch)	Qa (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.2	1.014	30	Slope : 56.2430
2	2.6	1.101	36	Intercept : -26.5735
3	3.0	1.182	40	Correlation Coefficient : 0.9986
4	3.4	1.258	44	
5	4.0	1.363	50	



Calibrated by _____ (Mr.Nontachai Uppathamp) Field Scientist(1)

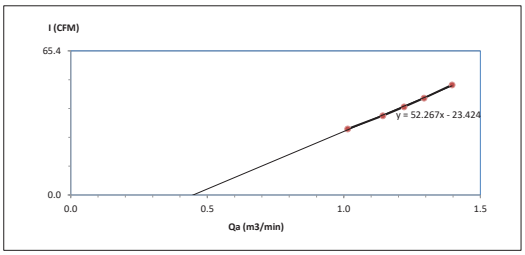
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-074 REVISION NO.: - ISSUE DATE: 14/03/16

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf NC Co.,Ltd.	**Barometric Pressure (mm Hg) :**	753
Calibrate Location :	พื้นที่โครงการ	**Temperature (°C) :**	33
Calibrate Date :	14-Jun-23	**High Volume ID :**	RYG_FS0191
CalibrationSheet No.:	**C-140623-RYG_FS0191**	**High Volume Model :**	TE-5009X
Calibrator ID:	RYG_FS0205	**High Volume S/N :**	5330
Calibrator Model :	TE-5028A	**Calibrator Slope :**	0.94434
Calibrator S/N :	1166	**Calibrator Intercept :**	-0.01292

Test No.	Delta H_2O (inch)	Qa (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.2	1.014	30	Slope : 52.2675
2	2.8	1.142	36	Intercept : -23.4239
3	3.2	1.220	40	Correlation Coefficient : 0.9987
4	3.6	1.294	44	
5	4.2	1.396	50	



Calibrated by _____ Approved by : _____

(Mr.Nontachai Uppathamp)
Field Scientist(1)

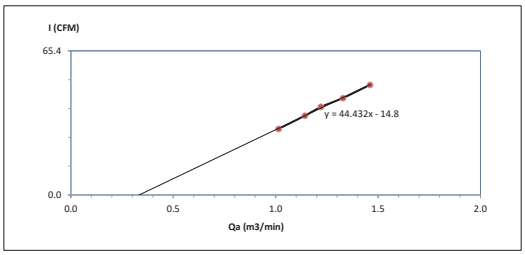
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-074 REVISION NO.: - ISSUE DATE: 14/03/16

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf NC Co.,Ltd.	**Barometric Pressure (mm Hg) :**	753
Calibrate Location :	ชุมชนบ้านเขานางจีน	**Temperature (°C) :**	33
Calibrate Date :	14-Jun-23	**High Volume ID :**	RYG_FS0295
CalibrationSheet No.:	**C-140623-RYG_FS0295**	**High Volume Model :**	TE-5009X
Calibrator ID:	RYG_FS0205	**High Volume S/N :**	5502
Calibrator Model :	TE-5028A	**Calibrator Slope :**	0.94434
Calibrator S/N :	1166	**Calibrator Intercept :**	-0.01292

Test No.	Delta H_2O (inch)	Qa (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.2	1.014	30	Slope : 44.4322
2	2.8	1.142	36	Intercept : -14.8002
3	3.2	1.220	40	Correlation Coefficient : 0.9990
4	3.8	1.329	44	
5	4.6	1.461	50	



Calibrated by _____ Approved by : _____

(Mr.Nontachai Uppathamp)
Field Scientist(1)

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

FORM NO.: F 06-074 REVISION NO.: - ISSUE DATE: 14/03/16

RYG_EN0001

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 , e-mail: service.thailand@sartorius.com

NSC-TISI-TIS 17025
CALIBRATION 0426

SARTORIUS

REVIEW BY Thanitall.
APPROVED BY D.
NEXT CAL. DATE 01/03/24

Certificate of Calibration

Model Number :	LA130S-F	Certificate No. :	23BCI0110
Description :	Analytical Balance	Issued Date :	Friday, March 03, 2023
Serial Number :	25409664	Reference No. :	204833
ID No. :	RYG_EN0001		
Manufacturer :	Sartorius	Page No. :	1 0f 2

Customer Name : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd.(Balance Room)
616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated By : Mr.Chonchai Inthana
Calibration Date : Wednesday, March 01, 2023

Calibration Procedure No. : This calibration was conducted by Using in-house calibration procedure number (WI-003) Based on UKAS LAB 14 : 2019

Metrological data :
Capacity : 150 g Readability : 0.0001 g

Ambients Conditions:
Temperature : 24.2 °C ± 5.0 °C
Humidity : 60.0 % 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 form list of Sartorius Metrological Specifications.

Traceability:

Model Number	Description	Traceability	Cetificate 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	DKSH	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.

Mr.chonchai Inthana(Technical Manager)

STAMP SARTORIUS ISO/IEC 17025:2017

SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 Fax: +66 2643-8367, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number :	LA130S-F	Certificate No. :	23BCI0110
Description :	Analytical Balance	Issued Date :	Friday, March 03, 2023
Serial Number :	25409664	Reference No. :	204833
ID No. :	RYG_EN0001		
Manufacturer :	Sartorius	Page No. :	2 of 2

Calibration Results : Without Adjustment

Repeatability

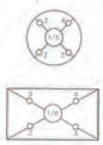
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

Nominal Value : (Low Load) 10 g	10.0000	100.0001
	10.0000	100.0002
Tolerance 0.0001 g	10.0001	100.0001
	10.0000	100.0000
	9.9999	100.0002
Nominal Value : (High Load) 100 g	10.0000	100.0001
	10.0001	100.0001
Tolerance 0.0001 g	10.0000	100.0001
	9.9999	100.0002
	9.9998	100.0001
Standard Deviation	0.00009	0.00006

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 maximim 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 0.0004 g



	Difference
1	–
2	0.0000
3	−0.0001
4	0.0001
5	0.0000
6	-

Linearity

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

Tolerance 0.0002 g

Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
0.01	0.0100	0.0100	0.0000	0.00022
0.05	0.0500	0.0500	0.0000	0.00023
0.1	0.1000	0.1000	0.0000	0.00023
0.5	0.5000	0.5000	0.0000	0.00023
1	1.0000	1.0000	0.0000	0.00023
2	2.0000	2.0000	0.0000	0.00023
5	5.0000	5.0000	0.0000	0.00022
10	10.0000	10.0001	0.0001	0.00024
20	20.0000	20.0001	0.0001	0.00023
100	100.0000	100.0002	0.0002	0.00026

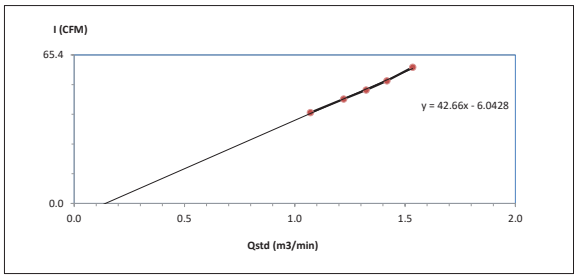
End of Report

SOP FM 33 03 February 2022

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf NC Co.,Ltd.	**Barometric Pressure (mm Hg) :**	753
Calibrate Location :	วัดอ่างศิลา	**Temperature (°C) :**	33
Calibrate Date :	14-Jun-23	**High Volume ID :**	RYG_FS0177
CalibrationSheet No.:	**C-140623-RYG_FS0177**	**High Volume Model :**	TE-5170D
Calibrator ID:	RYG_FS0205	**High Volume S/N :**	4803
Calibrator Model :	TE-5028A	**Calibrator Slope :**	1.50765
Calibrator S/N :	1166	**Calibrator Intercept :**	-0.02043

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.6	1.0710	40	Slope : 42.6601
2	3.4	1.2218	46	Intercept : -6.0428
3	4.0	1.3235	50	Correlation Coefficient : 0.9982
4	4.6	1.4178	54	
5	5.4	1.5344	60	



Calibrated by _____ Approved by : _____

(Mr.Nontchai Uppathamp)
Field Scientist(1)

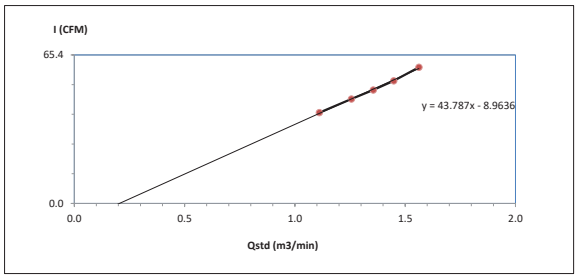
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf NC Co.,Ltd.	**Barometric Pressure (mm Hg) :**	753
Calibrate Location :	วัดสระคูศรัทธาท่า	**Temperature (°C) :**	33
Calibrate Date :	14-Jun-23	**High Volume ID :**	RYG_FS0174
CalibrationSheet No.:	**C-140623-RYG_FS0174**	**High Volume Model :**	TE-5170D
Calibrator ID:	RYG_FS0205	**High Volume S/N :**	4800
Calibrator Model :	TE-5028A	**Calibrator Slope :**	1.50765
Calibrator S/N :	1166	**Calibrator Intercept :**	-0.02043

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.8	1.1106	40	Slope : 43.7868
2	3.6	1.2566	46	Intercept : -8.9636
3	4.2	1.3557	50	Correlation Coefficient : 0.9983
4	4.8	1.4479	54	
5	5.6	1.5622	60	



Calibrated by _____ Approved by : _____

(Mr.Nontchai Uppathamp)
Field Scientist(1)

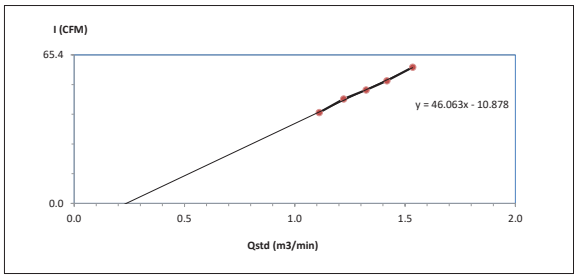
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf NC Co.,Ltd.	**Barometric Pressure (mm Hg) :**	753
Calibrate Location :	ชุมชนบ้านนาแขม	**Temperature (°C) :**	33
Calibrate Date :	14-Jun-23	**High Volume ID :**	RYG_FS0396
CalibrationSheet No.:	**C-140623-RYG_FS0396**	**High Volume Model :**	TE-5170D
Calibrator ID:	RYG_FS0205	**High Volume S/N :**	5688
Calibrator Model :	TE-5028A	**Calibrator Slope :**	1.50765
Calibrator S/N :	1166	**Calibrator Intercept :**	-0.02043

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.8	1.1106	40	Slope : 46.0629
2	3.4	1.2218	46	Intercept : -10.8785
3	4.0	1.3235	50	Correlation Coefficient : 0.9986
4	4.6	1.4178	54	
5	5.4	1.5344	60	



Calibrated by _____ Approved by : _____

(Mr.Nontchai Uppathamp)
Field Scientist(1)

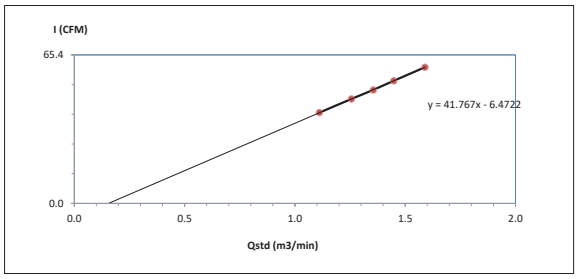
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf NC Co.,Ltd.	**Barometric Pressure (mm Hg) :**	753
Calibrate Location :	โรงเรียนบ้านโนนสะอาด	**Temperature (°C) :**	33
Calibrate Date :	14-Jun-23	**High Volume ID :**	RYG_FS0173
CalibrationSheet No.:	**C-140623-RYG_FS0173**	**High Volume Model :**	TE-5170D
Calibrator ID:	RYG_FS0205	**High Volume S/N :**	4799
Calibrator Model :	TE-5028A	**Calibrator Slope :**	1.50765
Calibrator S/N :	1166	**Calibrator Intercept :**	-0.02043

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.8	1.1106	40	Slope : 41.7674
2	3.6	1.2566	46	Intercept : -6.4722
3	4.2	1.3557	50	Correlation Coefficient : 0.9999
4	4.8	1.4479	54	
5	5.8	1.5895	60	



Calibrated by _____ Approved by : _____

(Mr.Nontchai Uppathamp)
Field Scientist(1)

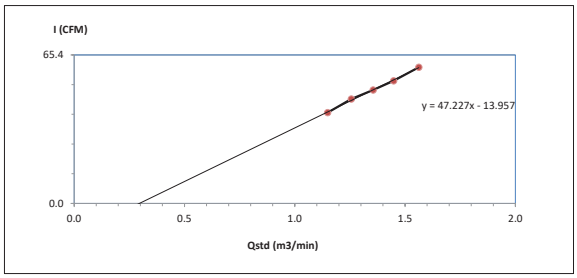
(Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf NC Co.,Ltd.	**Barometric Pressure (mm Hg) :**	753
Calibrate Location :	พื้นที่โครงการ	**Temperature (°C) :**	33
Calibrate Date :	14-Jun-23	**High Volume ID :**	RYG_FS0179
CalibrationSheet No.:	**C-140623-RYG_FS0179**	**High Volume Model :**	TE-5170D
Calibrator ID:	RYG_FS0205	**High Volume S/N :**	4805
Calibrator Model :	TE-5028A	**Calibrator Slope :**	1.50765
Calibrator S/N :	1166	**Calibrator Intercept :**	-0.02043

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	3.0	1.1489	40	Slope : 47.2265
2	3.6	1.2566	46	Intercept : -13.9570
3	4.2	1.3557	50	Correlation Coefficient : 0.9985
4	4.8	1.4479	54	
5	5.6	1.5622	60	



Calibrated by _____ (Mr.Nontchai Uppathamp)
Field Scientist(1)

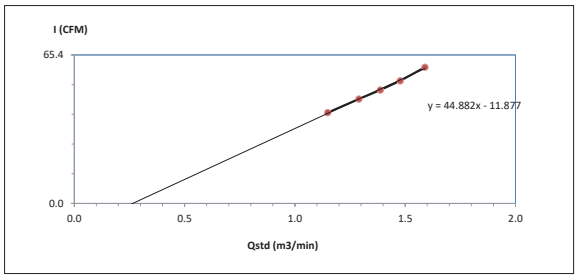
Approved by : _____ (Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

High Volume Air Sampler Calibration Worksheet

Project Site :	Gulf NC Co.,Ltd.	**Barometric Pressure (mm Hg) :**	753
Calibrate Location :	ชุมชนบ้านเขานางจีน	**Temperature (°C) :**	33
Calibrate Date :	14-Jun-23	**High Volume ID :**	RYG_FS0175
CalibrationSheet No.:	**C-140623-RYG_FS0175**	**High Volume Model :**	TE-5170D
Calibrator ID:	RYG_FS0205	**High Volume S/N :**	4801
Calibrator Model :	TE-5028A	**Calibrator Slope :**	1.50765
Calibrator S/N :	1166	**Calibrator Intercept :**	-0.02043

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	3.0	1.1489	40	Slope : 44.8817
2	3.8	1.2905	46	Intercept : -11.8767
3	4.4	1.3871	50	Correlation Coefficient : 0.9985
4	5.0	1.4773	54	
5	5.8	1.5895	60	



Calibrated by _____ (Mr.Nontchai Uppathamp)
Field Scientist(1)

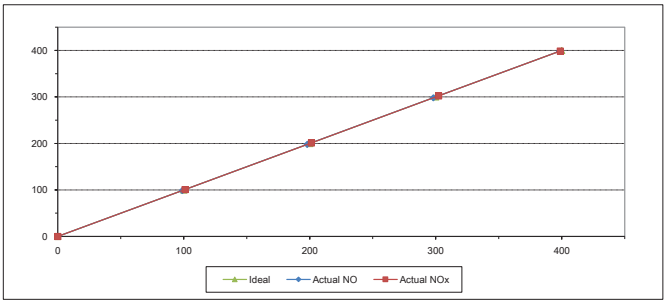
Approved by : _____ (Mr. Noppong Juntarupan)
Enviro Field Coordinator Scientist (3)

FORM NO.: F 06-073 REVISION NO.: - ISSUE DATE: 14/03/16

MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	**Equipment Name**	NOx Analyzer
Manufacturer	Teledyne API	**Model**	T200
Serial No.	2198	**Equipment ID**	RYG_FS0252
Calibrator Manufacturer	Teledyne API	**Model**	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	**Cylinder No.**	GN0027222
Cylinder Pressure (psi)	1800	**Certified By**	Airgas Inc.
Certified Date	9-Feb-22	**Expired Date**	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	98.80	-1.20	-1.20	101.00	1.00	1.00
2	200.00	198.00	-2.00	-1.00	201.30	1.30	0.65
3	300.00	298.10	-1.90	-0.63	302.30	2.30	0.77
4	400.00	398.20	-1.80	-0.45	398.80	-1.20	-0.30
AVERAGE (%)				-0.64			0.44



Calibrated By

(Mr.Jirawut Sakarn)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

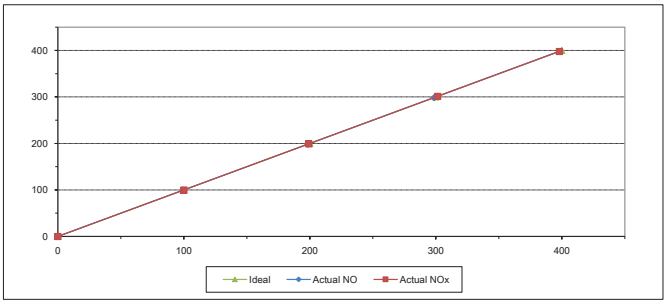
ALS Laboratory Group

FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12

MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	**Equipment Name**	NOx Analyzer
Manufacturer	HORIBA	**Model**	APNA-370
Serial No.	8G314J3K	**Equipment ID**	RYG_FS0264
Calibrator Manufacturer	Teledyne API	**Model**	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	**Cylinder No.**	GN0027222
Cylinder Pressure (psi)	1800	**Certified By**	Airgas Inc.
Certified Date	9-Feb-22	**Expired Date**	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.05	0.05	0.05	0.10	0.10	0.10
1	100.00	99.20	-0.80	-0.80	100.10	0.10	0.10
2	200.00	198.40	-1.60	-0.80	199.10	-0.90	-0.45
3	300.00	298.60	-1.40	-0.47	301.50	1.50	0.50
4	400.00	398.10	-1.90	-0.47	398.00	-2.00	-0.50
AVERAGE (%)				-0.50			-0.05



Calibrated By

(Mr.Jirawut Sakarn)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

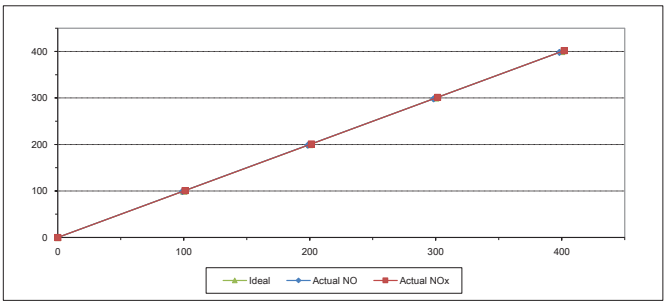
ALS Laboratory Group

FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12

MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	U8AOEAGK	Equipment ID	RYG_FS0551
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.00	-1.00	-1.00	101.00	1.00	1.00
2	200.00	198.50	-1.50	-0.75	201.30	1.30	0.65
3	300.00	298.40	-1.60	-0.53	301.50	1.50	0.50
4	400.00	398.20	-1.80	-0.45	402.00	2.00	0.50
AVERAGE (%)				-0.53			0.55



Calibrated By

(Mr.Jirawut Sakarn)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

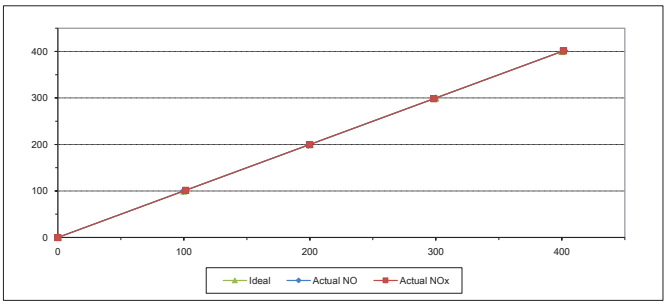
ALS Laboratory Group

FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12

MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	AWXG87CR	Equipment ID	RYG_FS0453
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.60	-0.40	-0.40	101.40	1.40	1.40
2	200.00	198.60	-1.40	-0.70	199.80	-0.20	-0.10
3	300.00	299.00	-1.00	-0.33	298.50	-1.50	-0.50
4	400.00	402.10	2.10	0.53	401.20	1.20	0.30
AVERAGE (%)				-0.16			0.24



Calibrated By

(Mr.Jirawut Sakarn)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

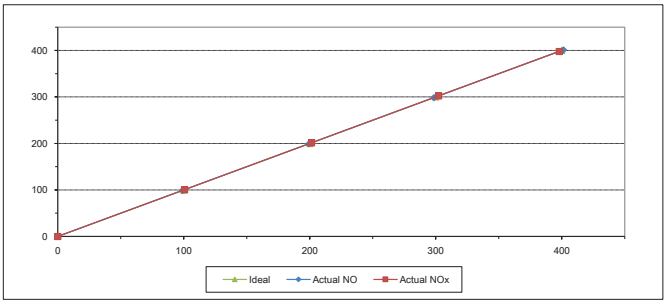
ALS Laboratory Group

FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12

MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	148EH0E0	Equipment ID	BKK_FS1064
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.00	-1.00	-1.00	100.70	0.70	0.70
2	200.00	199.40	-0.60	-0.30	201.50	1.50	0.75
3	300.00	298.60	-1.40	-0.47	302.30	2.30	0.77
4	400.00	401.40	1.40	0.35	398.00	-2.00	-0.50
AVERAGE (%)				-0.26			0.36



Calibrated By

(Mr.Jirawut Sakarn)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

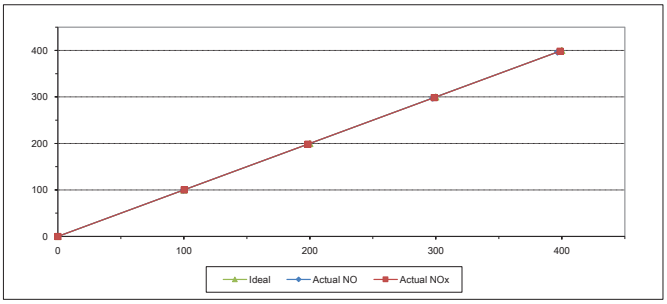
ALS Laboratory Group

FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12

MULTIPOINT CALIBRATION REPORT

Calibration Date	5-Jan-23	Equipment Name	NOx Analyzer
Manufacturer	Teledyne API	Model	T200
Serial No.	2197	Equipment ID	RYG_FS0255
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	55.88	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS						
	Ideal	Actual NO	Error NO	%Error NO	Actual NOx	Error NOx	%Error NOx
ZERO	0.00	0.10	0.10	0.10	0.10	0.10	0.10
1	100.00	99.60	-0.40	-0.40	100.20	0.20	0.20
2	200.00	198.10	-1.90	-0.95	198.50	-1.50	-0.75
3	300.00	297.50	-2.50	-0.83	298.70	-1.30	-0.43
4	400.00	396.50	-3.50	-0.88	398.60	-1.40	-0.35
AVERAGE (%)				-0.59			-0.25



Calibrated By

(Mr.Jirawut Sakarn)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

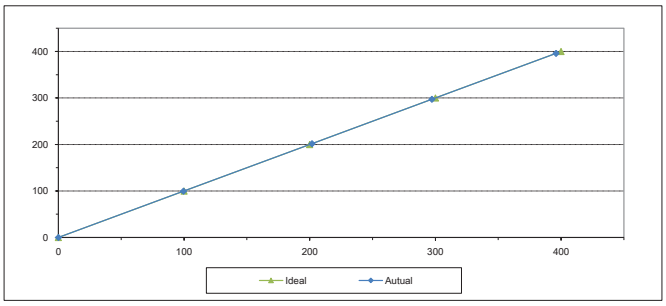
ALS Laboratory Group

FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12

MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-23	Equipment Name	SO2 Analyzer
Manufacturer	Teledyne API	Model	T100
Serial No.	1773	Equipment ID	RYG_FS0251
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Autual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.60	-0.40	-0.40
2	200.00	201.80	1.80	0.90
3	300.00	297.20	-2.80	-0.93
4	400.00	396.00	-4.00	-1.00
AVERAGE (%)				-0.27



Calibrated By

(Mr.Jirawut Sakarn)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

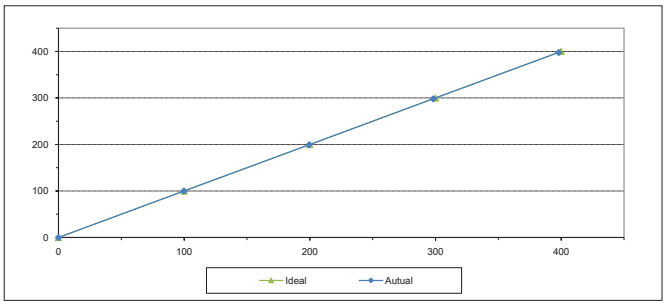
ALS Laboratory Group

FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12

MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-23	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	YPRXJJ20	Equipment ID	RYG_FS0263
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Autual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.80	-0.20	-0.20
2	200.00	199.40	-0.60	-0.30
3	300.00	298.20	-1.80	-0.60
4	400.00	398.00	-2.00	-0.50
AVERAGE (%)				-0.30



Calibrated By

(Mr.Jirawut Sakarn)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

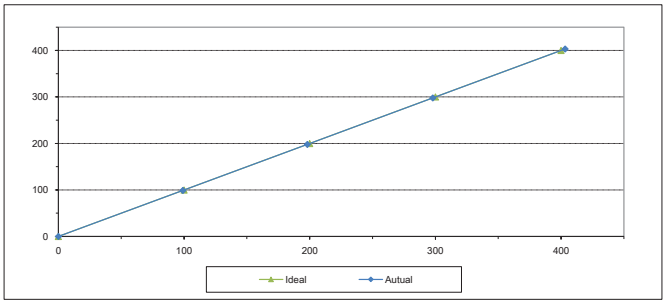
ALS Laboratory Group

FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12

MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-23	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	XL29Y85B	Equipment ID	RYG_FS0462
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Autual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	99.10	-0.90	-0.90
2	200.00	198.10	-1.90	-0.95
3	300.00	297.90	-2.10	-0.70
4	400.00	403.20	3.20	0.80
AVERAGE (%)				-0.33



Calibrated By

(Mr.Jirawut Sakarn)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

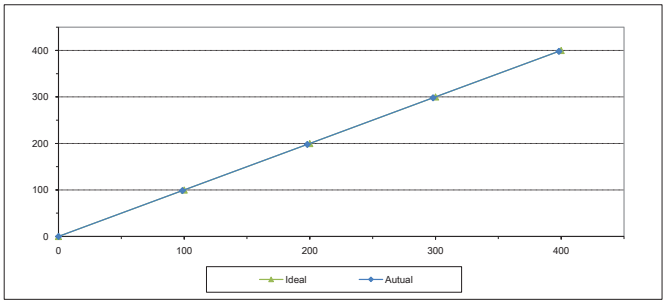
ALS Laboratory Group

FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12

MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-23	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	90U0XJ31	Equipment ID	RYG_FS0452
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Autual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.60	-1.40	-1.40
2	200.00	198.00	-2.00	-1.00
3	300.00	298.10	-1.90	-0.63
4	400.00	398.20	-1.80	-0.45
AVERAGE (%)				-0.68



Calibrated By

(Mr.Jirawut Sakarn)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

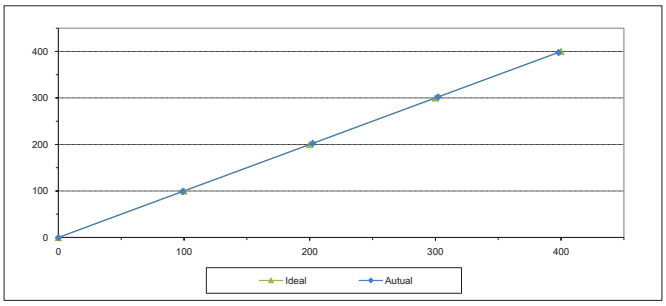
ALS Laboratory Group

FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12

MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-23	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	NM3M2D5M	Equipment ID	RYG_FS0266
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Autual	Error	%Error
ZERO	0.00	0.10	0.10	0.10
1	100.00	98.90	-1.10	-1.10
2	200.00	202.40	2.40	1.20
3	300.00	302.30	2.30	0.77
4	400.00	398.00	-2.00	-0.50
AVERAGE (%)				0.09



Calibrated By

(Mr.Jirawut Sakarn)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

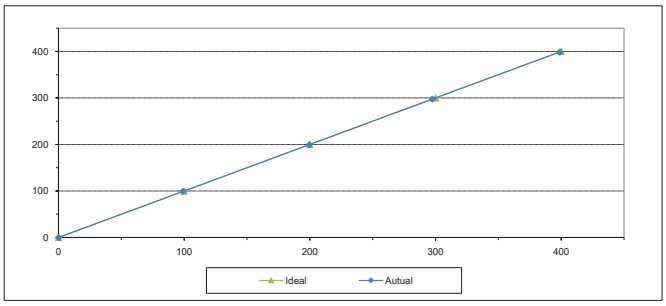
ALS Laboratory Group

FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12

MULTIPOINT CALIBRATION REPORT

Calibration Date	4-Jan-23	Equipment Name	SO2 Analyzer
Manufacturer	Teledyne API	Model	T100
Serial No.	1772	Equipment ID	RYG_FS0254
Calibrator Manufacturer	Teledyne API	Model	700
Serial No.	947		
Std. Gas Concentration (PPM)	56.3	Cylinder No.	GN0027222
Cylinder Pressure (psi)	1800	Certified By	Airgas Inc.
Certified Date	9-Feb-22	Expired Date	9-Feb-30

Point	CALIBRATION RESULTS			
	Ideal	Autual	Error	%Error
ZERO	0.00	0.05	0.05	0.05
1	100.00	99.10	-0.90	-0.90
2	200.00	199.50	-0.50	-0.25
3	300.00	297.50	-2.50	-0.83
4	400.00	398.80	-1.20	-0.30
AVERAGE (%)				-0.45



Calibrated By

(Mr.Jirawut Sakarn)
Field Environmental Scientist (3)

Approved By

(Mr.Sarayuth Jittranont)
Assistant General Manager

ALS Laboratory Group

FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12

JNAC
JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
69/14-15, 67/35-36
Petchkasem 2, 7/1, Rd. Watthapra, Bangkokyai,
Bangkok 10600 (Thailand)
Tel: +6608680812
Mobile: +66861999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TTSI-TIS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department.

REVIEW BY Narakorn P.
APPROVED BY
NEXT CALIBRATE 18/7/24

Certificate Number
CL-009-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02E
Data logger: 110-WS-16N
SERIAL NUMBER : Sensor: -
Data logger: 1159
ID NUMBER : RYG_FS0081
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang,
Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 16 Jan 2023
MEASUREMENT DATE : 18 Jan 2023
ISSUE DATE : 20 Jan 2023

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:

Temperature	: 23.0 ± 3.0	°C
Relative Humidity	: 55.0 ± 15.0	%RH
Atmospheric Pressure	: 1010 ± 10	hPa

PLACE OF CALIBRATION : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS

: Wind tunnel cross-section area[1]	900	cm^2
Win direction frontal area[2]	100	cm^2
Diameter of mounting pipe[3]	-	mm
Blockage ratio of test object[4]	0.111	[-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.5) °C, (52.2) %RH and (1014.5) hPa.

TABULATION OF RESULTS:
The table on next page give the measured values.

Calibration procedure:
The cup anemometer was calibrated against Standard air velocity transducer model: 8455-32 and pitot tube with precision differential pressure meter model: DPM2500 in an close testsection of Eiffel-type wind tunnel with 900 cm² cross test section area. The WI-CL-007 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0052-21 and MW-0066-22

Uncertainty of Measurement:
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'

Calibrated by:
☒ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] to [1]

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

Certificate Number
CL-009-66

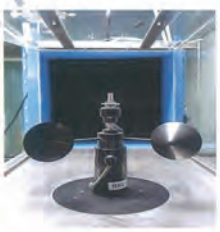
MEASUREMENT RESULTS [5]

The cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle, UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

v_{std}[6] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v_{uuc}[7] (m/s)	Error (m/s)	U (k=2) (m/s)
0.981	23.56	23.45	0.8	-0.2	0.15
2.030	23.40	23.45	1.9	-0.2	0.16
3.049	23.50	23.45	2.9	-0.2	0.17
4.129	23.50	23.45	3.9	-0.3	0.20
5.01	23.50	23.45	4.8	-0.2	0.17
5.97	23.54	23.45	5.7	-0.3	0.17
7.05	23.42	23.45	6.8	-0.3	0.18
8.18	23.50	23.45	7.9	-0.3	0.19
9.10	23.34	23.45	8.8	-0.3	0.19
10.10	23.40	23.45	9.7	-0.4	0.19
11.14	23.40	23.45	10.8	-0.4	0.20
12.13	23.32	23.45	11.8	-0.4	0.20
13.20	23.10	23.45	12.9	-0.3	0.20
14.25	23.36	23.45	13.9	-0.4	0.22
15.24	23.22	23.45	14.8	-0.4	0.21
16.30	23.40	23.45	15.8	-0.5	0.22

Remark:
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Velocity of standard
[7] Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set- up is not true to scale due to imaging geometry.

End of Certificate of Calibration

Jiranatee Associates Co., Ltd.

JNAC
JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd. Watthapra, Bangkokyai,
Bangkok 10600 (Thailand)
Tel: +6608680812
Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department.

Certificate Number
CL-009-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02E
Data logger: 110-WS-16N
SERIAL NUMBER : Sensor: -
Data logger: 1159
ID NUMBER : RYG_FS0081
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 16 Jan 2023
MEASUREMENT DATE : 19 Jan 2023
ISSUE DATE : 19 Jan 2023

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow;

Temperature	: 23.0 ± 3.0	°C
Relative Humidity	: 55.0 ± 15.0	%RH
Atmospheric Pressure	: 1010± 10	hPa

PLACE OF CALIBRATION : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION

: Wind tunnel cross-section area[1]	900	cm^2
Win direction frontal area[2]	129	cm^2
Diameter of mounting pipe[3]	-	mm
Blockage ratio of test object[4]	0.143	[-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.8)°C, (47.3) %RH and (1014.8) hPa.

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model AX4009TS-DM04-P3-S-U0 in an close test-section of Eiffel-type wind tunnel with 900 cm² cross test section area. The WI-CL-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: DA-0043-22

Uncertainty of Measurement:
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'

TABULATION OF RESULTS:
The table on next page give the measured values.

Calibered by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] to [1]

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

Jiranatee Associates Co., Ltd.

Certificate Number
CL-009-66

MEASUREMENT RESULTS [a]

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed m/s	D^{*}_{std} Degree (°)	$D^{\dagger}_{uuc}$ Degree (°)	Error Degree (°)	*U (k=2)* Degree (°)
5.01	0.000	0	0	0.58
	45.000	43	-3	0.76
	90.000	89	-2	0.76
	135.000	134	-1	0.74
	180.000	177	-3	0.74
	225.000	229	4	0.58
	270.000	273	3	0.68
	315.000	317	2	0.74

Remark:
[a] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[*] Direction of standard
[†] Direction of Unit Under Calibration

End of Certificate of Calibration

Jiranatee Associates Co., Ltd.

JNAC
JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd. Watthapra, Bangkokyai,
Bangkok 10600 (Thailand)
Tel: +6608680812
Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department.

REVIEW BY Oramakorn P.
APPROVED BY [signature]
NEXT CAL. DATE 10/8/24

Certificate Number
CL-020-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 200-WS-25LB
SERIAL NUMBER : Sensor: -
Data logger: A5375
ID NUMBER : RYG_FS0413
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 27 Jan 2023
MEASUREMENT DATE : 10 Feb 2023
ISSUE DATE : 10 Feb 2023

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:

Temperature	: 23.0 ± 3.0	°C
Relative Humidity	: 55.0 ± 15.0	%RH
Atmospheric Pressure	: 1010 ± 10	hPa

PLACE OF CALIBRATION : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS

: Wind tunnel cross-section area[1]	900	cm^2
Win direction frontal area[2]	100	cm^2
Diameter of mounting pipe[3]	-	mm
Blockage ratio of test object[4]	0.111	[-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.0) °C, (41.7) %RH and (1015.0) hPa.

Calibration procedure:
The cup anemometer was calibrated against Standard air velocity transducer model: 8455-12 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel-type wind tunnel with 900 cm² cross test section area. The WI-CL-007 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0052-21 and MW-0066-22

Uncertainty of Measurement:
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'

TABULATION OF RESULTS:
The table on next page give the measured values.

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JNAC JIRANATE ASSOCIATES CO., LTD.

Approved signatory: ....
Mr. Parinya Booncharoen
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] to [1]

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

Jiranatee Associates Co., Ltd.

Certificate Number
CL-020-66

MEASUREMENT RESULTS [§]

The cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle, UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

v_{std}[‡] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v_{uuc}[†] (m/s)	Error (m/s)	*U (k=2)* (m/s)
0.984	24.10	24.00	0.7	-0.3	0.16
2.029	23.98	24.00	1.8	-0.3	0.16
3.044	23.96	24.00	2.9	-0.2	0.19
4.136	24.20	24.00	3.8	-0.3	0.20
5.00	23.80	24.00	4.8	-0.2	0.21
5.98	24.24	24.00	5.8	-0.2	0.17
7.05	23.90	24.00	6.9	-0.2	0.19
8.19	24.14	24.00	8.0	-0.2	0.19
9.09	23.88	24.00	8.9	-0.2	0.20
10.09	23.88	24.00	9.8	-0.2	0.19
11.16	23.74	24.00	11.0	-0.2	0.23
12.13	23.82	24.00	12.0	-0.2	0.24
13.19	23.70	24.00	13.0	-0.2	0.22
14.26	23.66	24.00	14.0	-0.3	0.28
15.24	23.66	24.00	14.9	-0.3	0.23
16.30	23.70	24.00	16.0	-0.3	0.23

Remark:
[§] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[‡] Velocity of standard
[†] Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP

Calibration set-up of the cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set- up is not true to scale due to imaging geometry.

End of Certificate of Calibration

JNAC JIRANATE ASSOCIATES CO., LTD.

Jiranatee Associates Co., Ltd.

JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
Petchkasem 7,7/1, Rd. Watthapra, Bangkokyai,
Bangkok 10600 (Thailand)
Tel: +6608680812
Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department.

Certificate Number
CL-018-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 200-WS-25LB
SERIAL NUMBER : Sensor: -
Data logger: A5375
ID NUMBER : RYG_FS0413
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 27 Jan 2023
MEASUREMENT DATE : 10 Feb 2023
ISSUE DATE : 10 Feb 2023

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:

Temperature	: 23.0 ± 3.0	°C
Relative Humidity	: 55.0 ± 15.0	%RH
Atmospheric Pressure	: 1010± 10	hPa

PLACE OF CALIBRATION : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION

: Wind tunnel cross-section area[1]	900	cm^2
Win direction frontal area[2]	129	cm^2
Diameter of mounting pipe[3]	-	mm
Blockage ratio of test object[4]	0.143	[-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.8)°C, (50.2) %RH and (1012.2) hPa.

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model: AX4009TS-DM04-P3-S-U0 in an close test-section of Eiffel-type wind tunnel with 900 cm² cross test section area. The WI-CL-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: DA-0043-22

Uncertainty of Measurement:
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'

TABULATION OF RESULTS:
The table on next page give the measured values.

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] to [1]

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

Certificate Number
CL-018-66

MEASUREMENT RESULTS [5]

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed m/s	D'_{std} Degree (°)	D'_{uuc} Degree (°)	Error Degree (°)	*U (k=2)* Degree (°)
4.99	0.000	0	0	0.58
	45.000	41	-4	0.58
	90.001	87	-3	0.74
	135.000	133	-2	0.74
	180.000	180	0	0.74
	225.000	227	2	0.68
	270.000	273	3	0.68
	315.000	318	3	0.74

Remark:
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Direction of standard
[7] Direction of Unit Under Calibration

End of Certificate of Calibration

Jiranatee Associates Co., Ltd.

JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
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Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department.

BY Mnakorn P.
APPROVED BY [signature]
DATE 18/5/24

Certificate Number
CL-006-65

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-016
Data logger: A5910
ID NUMBER : RYG_FS0609
CONDITION AS-RECEIVED : New item
CUSTOMER : ALS laboratory group (Thailand) co., ltd
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 09 Nov 2022
MEASUREMENT DATE : 18 Nov 2022
ISSUE DATE : 23 Nov 2022

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:

Temperature	: 23.0 ± 3.0	°C
Relative Humidity	: 55.0 ± 15.0	%RH
Atmospheric Pressure	: 1010± 10	hPa

PLACE OF CALIBRATION : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS

: Wind tunnel cross-section area[1]	900	cm^2
Win direction frontal area[2]	100	cm^2
Diameter of mounting pipe[3]	-	mm
Blockage ratio of test object[4]	0.111	[-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.7) °C, (49.5) %RH and (1011.2) hPa

Calibration procedure:
The cup anemometer was calibrated against Standard air velocity transducer model: 8455-12 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel-type wind tunnel with 900 cm² cross test section area. The WI-CL-007 based on IEC 61400 12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0052-21 and MW-0066-22

Uncertainty of Measurement:
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'

TABULATION OF RESULTS:
The table on next page give the measured values.

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

Approved signatory:
Mr. Parinya Boonchareon
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] to [1]

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

Certificate Number
CL-006-65

MEASUREMENT RESULTS [5]

The cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle, UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

V_{std}[6] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	V_{uuc}[7] (m/s)	Error (m/s)	*U (k=2)* (m/s)
0.971	23.98	23.70	0.8	-0.2	0.15
2.042	23.46	23.70	1.8	-0.2	0.16
3.069	23.90	23.70	2.8	-0.2	0.21
4.221	23.60	23.70	3.9	-0.4	0.20
5.02	23.80	23.70	4.8	-0.2	0.20
5.99	23.84	23.70	5.8	-0.2	0.19
7.06	23.66	23.70	6.8	-0.2	0.18
8.17	23.78	23.70	7.9	-0.2	0.18
9.10	23.60	23.70	8.8	-0.3	0.22
10.09	23.74	23.70	9.9	-0.2	0.19
11.16	23.68	23.70	10.9	-0.2	0.22
12.14	23.94	23.70	11.8	-0.3	0.22
13.19	23.70	23.70	13.0	-0.2	0.22
14.27	23.94	23.70	13.8	-0.4	0.22
15.25	23.78	23.70	15.1	-0.2	0.26
16.30	23.84	23.70	15.9	-0.4	0.25

Remark:
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Velocity of standard
[7] Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP

Calibration set-up of the cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set- up is not true to scale due to imaging geometry.

End of Certificate of Calibration

JIRANATE ASSOCIATES CO., LTD.

Jiranatee Associates Co.,Ltd
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Website: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department.

Certificate Number
CL-006-65

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-016
Data logger: A5910
ID NUMBER : RYG_FS0609
CONDITION AS-RECEIVED : New item
CUSTOMER : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 09 Nov 2022
MEASUREMENT DATE : 18 Nov 2022
ISSUE DATE : 23 Nov 2022

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:

Temperature	: 23.0 ± 3.0	°C
Relative Humidity	: 55.0 ± 15.0	%RH
Atmospheric Pressure	: 1010± 10	hPa

PLACE OF CALIBRATION : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION

: Wind tunnel cross-section area[1]	900	cm^2
Win direction frontal area[2]	129	cm^2
Diameter of mounting pipe[3]	-	mm
Blockage ratio of test object[4]	0.143	[-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.1)°C, (45.1) %RH and (1012.5) hPa.

TABULATION OF RESULTS:
The table on next page give the measured values.

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model: AX4009TS-DM04-P3-S-U0 in an close test section of Eiffel type wind tunnel with 900 cm^2 cross test section area. The WI CL-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: DA-0043-22

Uncertainty of Measurement:
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data- Guide to the expression of uncertainty in measurement'

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JNAC JIRANATE ASSOCIATES CO., LTD.

Approved signatory: ..... Mr. Paninya Boonchareon
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] to [1]

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

Certificate Number
CL-006-65

MEASUREMENT RESULTS [5]

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed	D'_{std}	D'_{uut}	Error	U (k=2)
m/s	Degree (°)	Degree (°)	Degree (°)	Degree (°)
	0.000	0	0	0.58
	45.000	44	-2	0.76
	90.000	87	-3	0.58
5.01	135.000	132	-3	0.68
	180.000	177	-3	0.68
	225.000	222	-3	0.58
	270.001	270	0	0.74
	315.000	318	3	0.58

Remark:
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
D'_{std} Direction of standard
D'_{uut} Direction of Unit Under Calibration

End of Certificate of Calibration

JNAC JIRANATE ASSOCIATES CO., LTD.

JNAC

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

Calibration No. : RH-06112022

Measurement Item	: Relative humidity with data logger
Manufacturer	: Novalynx
Model/Type	: 110-WS-25DL-D
Serial Number	: A5910
ID No.	: RYG_FS0609
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 (25±3)°C, and relative humidity of (50±15)%.

Measurement Method:
Unit Under Calibration (UUC) was calibrated by comparison method with standard thermo hygrometer in the humidity generator chamber to determine the errors.

Traceability:
This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the international system of units (SI) via MCS Calibration, Inc. Certificate number: 20314-101. Due date: Mar 14,2023.

Measurement Date : Nov 18, 2022
Issued Date : Nov 23, 2022

Measurement Results:
This equipment was connected with Indoor air quality probe and Displayed (RH) on display. Model: HMP60, Serial number: U3641223
Calibration was performed in the range of 20%RH to 80%RH
The results of calibration are reported in table below.

Determined (%RH)	Standard (%RH)	UUC (%RH)	Error (%RH)	Uncertainty ±(%RH)
20	19.98	17.6	-2.4	0.56
50	50.28	47.3	-3.0	0.61
80	80.30	77.6	-2.7	0.52

Performed by
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JNAC JIRANATE ASSOCIATES CO., LTD.

Approved Signatory: ..... Mr. Paninya Boonchareon.
Calibration Department Manager

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

JNAC

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

ilac-MRA

CERTIFICATE OF CALIBRATION

Certificate No.: CL-161-65

Equipment Name: Data Logger with Temperature Sensor
Manufacturer: Novalynx
Model: 110-WS-25DL-D
Serial No.: A5910
ID No.: RYG_FS0609

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

Received date: 09 Nov 2022
Calibration date: 18 Nov2022
Issue date: 23 Nov 2022

Reference Used During Calibration
1.Standard Temperature Probe Model: STS 100 A500. Serial No.: 667682-09. Due date: 23 Mar 2023
2.Digital Temperature Indicator Model: DTI-1000 A MK II, Serial No.: 671407-00591 Due date: 22 July 2023

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

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

Traceability
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0034-22, Certificate number: ER-0092-22

Calibrated by
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JNAC JIRANATE ASSOCIATES CO., LTD.

Approved Signatory: ..... Mr. Paninya Boonchareon
Calibration Department Manager

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

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

Certificate No.: CL 161-65

Result of Calibration: [✓] Without Adjustment [ ] With Adjustment

Calibration Range: 20 40 C

Function:

This equipment was connected with temperature sensor Model: HMP60 S/N: U3641223.

Dimension : Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.03	19.8	0.2	0.30
60	25.02	24.8	0.2	0.30
60	30.00	29.7	0.3	0.30
60	35.00	34.6	0.4	0.30
60	40.00	39.5	0.5	0.30

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 ★

JIRANATE ASSOCIATES CO., LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
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Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

REVIEWED BY: Phakorn P.
APPROVED BY:
ISSUE DATE: 17/5/24

Certificate Number
CL-002-65

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-012
Data logger: A5909
ID NUMBER : RYG_FS0608
CONDITION AS-RECEIVED : New item
CUSTOMER : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 09 Nov 2022
MEASUREMENT DATE : 17 Nov 2022
ISSUE DATE : 23 Nov 2022

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:

Temperature	: 23.0 ± 3.0	°C
Relative Humidity	: 55.0 ± 15.0	%RH
Atmospheric Pressure	: 1010± 10	hPa

PLACE OF CALIBRATION : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION

: Wind tunnel cross-section area[1]	900	cm^2
Win direction frontal area[2]	129	cm^2
Diameter of mounting pipe[3]	-	mm
Blockage ratio of test object[4]	0.143	[-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.0)°C, (50.6) %RH and (1009.4) hPa.

TABULATION OF RESULTS:
The table on next page give the measured values.

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model: AX4009TS-DM04-F3-S 18 in an close test-section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WI-CL-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: DA-0043-22.

Uncertainty of Measurement:
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM "Evaluation of measurement data – Guide to the expression of uncertainty in measurement"

Calibrated by:
[✓] Mr. Sorawit Thachalad
[ ] Miss Jittraporn Lertsomphol

Approved signatory: Mr. Pannya Booncharoen
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] to [1]

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

Certificate Number
CL-002-65

MEASUREMENT RESULTS [5]

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed m/s	D'_{std} Degree (°)	D'_{uut} Degree (°)	Error Degree (°)	U (k=2) Degree (°)
5.00	0.000	0	0	0.58
	45.000	42	-3	0.74
	89.999	88	-2	0.68
	135.001	133	-2	0.68
	180.001	179	-1	0.68
	225.000	225	0	0.68
	270.000	271	1	0.68
	315.000	318	3	0.74

Remark:
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Direction of standard
[7] Direction of Unit Under Calibration

End of Certificate of Calibration

JIRANATE ASSOCIATES CO., LTD.

Jiranatee Associates Co.,Ltd
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Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department

Certificate Number
CL-002-65

CERTIFICATE OF CALIBRATION

Page 1 of 2 Pages

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 110-WS-25DL-D
SERIAL NUMBER : Sensor: WSD-012
Data logger: A5909
ID NUMBER : RYG_FS0608
CONDITION AS-RECEIVED : New item
CUSTOMER : ALS laboratory group (Thailand) co., ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 09 Nov 2022
MEASUREMENT DATE : 17 Nov 2022
ISSUE DATE : 23 Nov 2022

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:

Temperature	: 23.0 ± 3.0	°C
Relative Humidity	: 55.0 ± 15.0	%RH
Atmospheric Pressure	: 1010± 10	hPa

PLACE OF CALIBRATION : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS

: Wind tunnel cross-section area[1]	900	cm^2
Win direction frontal area[2]	100	cm^2
Diameter of mounting pipe[3]	-	mm
Blockage ratio of test object[4]	0.111	[-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.8) °C, (46.3) %RH and (1014.7) hPa.

TABULATION OF RESULTS:
The table on next page give the measured values.

Calibration procedure:
The cup anemometer was calibrated against Standard air velocity transducer model: 8455-12 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel type wind tunnel with 900 cm^2 cross test section area. The WI-CL-002 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0052-21 and MW-0066-22

Uncertainty of Measurement:
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM "Evaluation of measurement data – Guide to the expression of uncertainty in measurement"

Calibrated by:
[✓] Mr. Sorawit Thachalad
[ ] Miss Jittraporn Lertsomphol

Approved signatory: Mr. Pannya Booncharoen
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] to [1]

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

Certificate Number
CL-002-65

MEASUREMENT RESULTS [5]

The cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle, UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

v_{std}[2] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v_{uuc}[3] (m/s)	Error (m/s)	U (k=2) (m/s)
0.988	23.90	23.80	0.8	-0.2	0.15
2.035	23.70	23.80	1.8	-0.2	0.16
3.040	23.90	23.80	2.8	-0.2	0.19
4.194	23.60	23.80	3.8	-0.4	0.20
5.01	23.70	23.80	4.8	-0.2	0.19
6.00	23.78	23.80	5.8	-0.2	0.17
7.08	23.80	23.80	6.8	-0.2	0.18
8.18	23.60	23.80	8.0	-0.2	0.20
9.10	23.80	23.80	8.9	-0.2	0.20
10.09	23.64	23.80	9.9	-0.2	0.21
11.15	23.56	23.80	10.9	-0.3	0.21
12.16	23.66	23.80	11.9	-0.3	0.21
13.20	23.52	23.80	12.9	-0.3	0.22
14.26	23.60	23.80	14.1	-0.2	0.22
15.25	23.58	23.80	15.0	-0.2	0.22
16.30	23.60	23.80	16.2	-0.1	0.24

Remark:

[4] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place

[2] Velocity of standard

[3] Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP

Calibration set up of the cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set up is not true to scale due to imaging geometry.

End of Certificate of Calibration

JNAC JIRANATE ASSOCIATES CO., LTD.

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

CERTIFICATE OF CALIBRATION

Certificate No.: CL-157-65
Page 1 of 2

Equipment Name: Data Logger with Temperature Sensor
Manufacturer: Novalynx
Model: 110-WS-25DL-D
Serial No.: A5909
ID No.: RYG_FS0608

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

Received date: 09 Nov 2022
Calibration date: 18 Nov2022
Issue date: 23 Nov 2022

Reference Used During Calibration
1.Standard Temperature Probe Model: STS-100 A500, Serial No.: 667682-09, Due date: 23 Mar 2023
2.Digital Temperature Indicator Model: DTI-1000 A MK II, Serial No.: 671407-00591 Due date: 22 July 2023

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

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

Traceability
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TF-0034-22, Certificate number: FR-0092-22

Calibrated by
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JNAC JIRANATE ASSOCIATES CO., LTD.

Approved Signatory: .....
Mr. Parinya Boonchareen
Calibration Department Manager

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

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

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

Function:
This equipment was connected with temperature sensor Model: HMP60 S/N: U3641220.

Dimension : Diameter 12 mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	19.98	19.9	-0.1	0.30
60	25.00	24.8	-0.2	0.30
60	30.00	29.8	-0.2	0.30
60	35.01	34.7	-0.3	0.30
60	40.01	39.5	-0.5	0.30

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 ✯

JNAC JIRANATE ASSOCIATES CO., LTD.

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

CERTIFICATE OF CALIBRATION

Calibration No. : RH-02112022
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger
Manufacturer : Novalynx
Model/Type : 110-WS-25DL-D
Serial Number : A5909
ID No. : RYG_FS0608
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 (25±3)°C, and relative humidity of (50±15)%

Measurement Method:
Unit Under Calibration (UUC) was calibrated by comparison method with standard thermo hygrometer in the humidity generator chamber to determine the errors.

Traceability:
This instrument was calibrated using standard equipment whose accuracy is traceability through National Institute of Standards and Technology to the international system of units (SI) via MCS Calibration, Inc. Certificate number: 20314-101. Due date: Mar 14,2023.

Measurement Date : Nov 18, 2022
Issued Date : Nov 23, 2022

Measurement Results:
This equipment was connected with Indoor air quality probe and Displayed (UR) on display, Model: HMP60, Serial number: U3641220
Calibration was performed in the range of 20%RH to 80%RH
The results of calibration are reported in table below.

Determined (%RH)	Standard (Reading) (%RH)	UUC (Reading) (%RH)	Error (%RH)	Uncertainty ±(%RH)
20	19.94	17.4	-2.5	0.67
50	50.31	47.1	-3.3	0.65
80	80.30	77.4	-2.9	0.67

Performed by
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JNAC JIRANATE ASSOCIATES CO., LTD.

Approved Signatory: .....
Mr. Parinya Boonchareen
Calibration Department Manager

THIS CALIBRATION REPORT MAY NOT BE REPRODUCEDCEXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY.

JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
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E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department.

REVIEW BY Nopakorn P.
APPROVED BY
NEXT CAL DATE 10/8/24

Certificate Number
CL-021-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Cup anemometer
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 200-WS-25LB
SERIAL NUMBER : Sensor: -
Data logger: A5376
ID NUMBER : RYG_FS0414
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 27 Jan 2023
MEASUREMENT DATE : 10 Feb 2023
ISSUE DATE : 10 Feb 2023

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:

Temperature	: 23.0 ± 3.0	°C
Relative Humidity	: 55.0 ± 15.0	%RH
Atmospheric Pressure	: 1010 ± 10	hPa

PLACE OF CALIBRATION : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS

: Wind tunnel cross-section area[1]	900	cm^2
Win direction frontal area[2]	100	cm^2
Diameter of mounting pipe[3]	-	mm
Blockage ratio of test object[4]	0.111	(-)

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.1) °C, (47.6) %RH and (1014.7) hPa.

Calibration procedure:
The cup anemometer was calibrated against Standard air velocity transducer model: 8455-12 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WI-CL-007 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0052-21 and MW-0066-22

Uncertainty of Measurement:
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'

TABULATION OF RESULTS:
The table on next page give the measured values.

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittragorn Lertsomphol

Approved signatory:
Mr. Parinya Boonchareon
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] to [1]

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

Certificate Number
CL-021-66

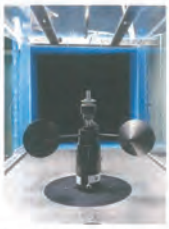
MEASUREMENT RESULTS [5]

The cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle, UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

v_{std}[6] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v_{uuc}[7] (m/s)	Error (m/s)	U (k=2) (m/s)
0.985	24.10	24.10	0.8	-0.2	0.36
2.033	24.10	24.10	1.9	-0.1	0.16
3.040	23.94	24.10	3.0	-0.1	0.23
4.134	24.10	24.10	4.0	-0.1	0.20
4.99	23.92	24.10	4.9	-0.1	0.44
5.98	24.10	24.10	6.0	0.0	0.18
7.05	23.90	24.10	7.0	-0.1	0.36
8.19	24.06	24.10	8.2	0.0	0.26
9.09	23.84	24.10	9.1	0.0	0.24
10.09	23.92	24.10	10.1	0.0	0.28
11.15	23.80	24.10	11.1	0.0	0.45
12.14	23.80	24.10	12.2	0.0	0.31
13.19	23.80	24.10	13.2	0.0	0.47
14.26	23.74	24.10	14.2	0.0	0.42
15.25	23.78	24.10	15.1	-0.1	0.66
16.28	23.70	24.10	16.3	0.0	0.56

Remark:
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Velocity of standard
[7] Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set- up is not true to scale due to imaging geometry.

End of Certificate of Calibration

JIRANATEE ASSOCIATES CO.,LTD.

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Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department.

Certificate Number
CL-019-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM : Wind Direction Sensor
MANUFACTURER : Novalynx
MODEL/TYPE : Sensor: WS-02F
Data logger: 200-WS-25LB
SERIAL NUMBER : Sensor: -
Data logger: A5376
ID NUMBER : RYG_FS0414
CONDITION AS-RECEIVED : Used item
CUSTOMER : ALS laboratory group (Thailand) Co., Ltd.
104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.

RECEIVED DATE : 27 Jan 2023
MEASUREMENT DATE : 10 Feb 2023
ISSUE DATE : 10 Feb 2023

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:

Temperature	: 23.0 ± 3.0	°C
Relative Humidity	: 55.0 ± 15.0	%RH
Atmospheric Pressure	: 1010± 10	hPa

PLACE OF CALIBRATION : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION

: Wind tunnel cross-section area[1]	900	cm^2
Win direction frontal area[2]	129	cm^2
Diameter of mounting pipe[3]	-	mm
Blockage ratio of test object[4]	0.143	(-)

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (24.0)°C, (49.0) %RH and (1014.1) hPa.

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model: AX4009TS-DM04-P3-S-U0 in an close test-section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WI-CL-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: DA-0043-22

Uncertainty of Measurement:
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'

TABULATION OF RESULTS:
The table on next page give the measured values.

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittragorn Lertsomphol

Approved signatory:
Mr. Parinya Boonchareon
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] to [1]

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

Certificate Number
CL-019-66

MEASUREMENT RESULTS [5]

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed m/s	$D°_{std}$ Degree (°)	$D°_{uuc}$ Degree (°)	Error Degree (°)	U (k=2) Degree (°)
4.99	0.000	0	0	0.58
	45.000	41	-4	0.58
	90.000	87	-3	0.58
	135.001	132	-3	0.68
	180.000	179	-1	0.74
	225.000	227	2	0.91
	270.001	273	3	0.58
	315.000	318	3	0.74

Remark:
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Direction of standard
[7] Direction of Unit Under Calibration

End of Certificate of Calibration

Jiranatee Associates Co., Ltd.

JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
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Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department.

REVIEW BY Naralom P.
APPROVED BY [signature]
NEXT CAL. DATE 5/4/24

Certificate Number
CL-001-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM	: Cup anemometer
MANUFACTURER	: Novalynx
MODEL/TYPE	: Sensor: WS-02F Data logger: WS-25DL
SERIAL NUMBER	: Sensor: - Data logger: A4481
ID NUMBER	: BKK_FS0141
CONDITION AS-RECEIVED	: Used item
CUSTOMER	: ALS laboratory group (Thailand) Co., Ltd. 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.
RECEIVED DATE	: 28 Dec 2022
MEASUREMENT DATE	: 05 Jan 2023
ISSUE DATE	: 09 Jan 2023

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:

Temperature	: 23.0 ± 3.0	°C
Relative Humidity	: 55.0 ± 15.0	%RH
Atmospheric Pressure	: 1010± 10	hPa

PLACE OF CALIBRATION : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITIONS

Wind tunnel cross-section area[1]	900	cm^2
Win direction frontal area[2]	100	cm^2
Diameter of mounting pipe[3]	-	mm
Blockage ratio of test object[4]	0.111	[-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.9) °C, (47.3) %RH and (1015.0) hPa.

TABULATION OF RESULTS:
The table on next page give the measured values.

Calibration procedure:
The cup anemometer was calibrated against Standard air velocity transducer model: 8455-12 and pitot tube with precision differential pressure meter model: DPM2500 in an close test-section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WI-CL-007 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0052-21 and MW-0066-22

Uncertainty of Measurement:
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JNAC JIRANATEE ASSOCIATES CO., LTD.

Approved signatory: [signature]
Mr. Parinya Boonchareon
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] to [1]

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

Jiranatee Associates Co., Ltd.

Certificate Number
CL-001-66

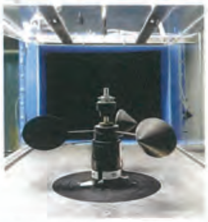
MEASUREMENT RESULTS [5]

The cup anemometer, Unit Under Calibration (UUC) was exercise at 10 m/s for 5 minutes prior to calibration being performed. The standard air velocity 0.5 m/s to 5 m/s was calculated by a standard air velocity transducer and above 5 m/s to 30 m/s was calculated by a pitot tube with precision differential pressure meter which was installed 40 mm and 300 mm respectively away from wind tunnel nozzle, UUC was installed at center of the test section. The calibration was carried out under both rising and falling air velocity in the range of 1 m/s to 16 m/s at calibration interval of 1 m/s. The results of calibration and associated measurement uncertainties are reported in the table below.

v_{std}[6] (m/s)	Temp. wind tunnel (°C)	Temp. room (°C)	v_{uuc}[7] (m/s)	Error (m/s)	*U (k=2)* (m/s)
0.989	23.82	23.85	0.7	-0.3	0.16
2.031	23.90	23.85	1.7	-0.3	0.16
3.051	24.00	23.85	2.9	-0.2	0.20
4.132	23.84	23.85	3.9	-0.2	0.20
5.00	23.88	23.85	4.9	-0.1	0.24
5.98	23.94	23.85	5.8	-0.2	0.18
7.06	23.82	23.85	6.9	-0.2	0.19
8.17	23.90	23.85	8.0	-0.1	0.22
9.08	23.72	23.85	9.0	-0.1	0.21
10.09	23.86	23.85	9.9	-0.2	0.20
11.14	23.60	23.85	11.0	-0.1	0.26
12.14	23.74	23.85	12.1	-0.1	0.28
13.21	23.68	23.85	13.0	-0.2	0.21
14.28	23.70	23.85	14.1	-0.2	0.27
15.26	23.64	23.85	15.0	-0.3	0.26
16.30	23.60	23.85	16.1	-0.2	0.28

Remark:
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Velocity of standard
[7] Velocity of Unit Under Calibration

PHOTO OF CALIBRATION SET-UP



Calibration set-up of the cup anemometer calibration in the wind tunnel of Jiranatee Associates Co., Ltd. The cup anemometer shown may differ from the calibrated one. Remark: The proportion of the set- up is not true to scale due to imaging geometry.

JNAC JIRANATEE ASSOCIATES CO., LTD.

End of Certificate of Calibration

JIRANATEE ASSOCIATES CO.,LTD.

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Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Air speed measurement laboratory
Calibration services department.

Certificate Number
CL-001-66

CERTIFICATE OF CALIBRATION

MEASUREMENT ITEM	: Wind Direction Sensor
MANUFACTURER	: Novalynx
MODEL/TYPE	: Sensor: WS-02F Data logger: WS-25DL
SERIAL NUMBER	: Sensor: - Data logger: A4481
ID NUMBER	: BKK_FS0141
CONDITION AS-RECEIVED	: Used item
CUSTOMER	: ALS laboratory group (Thailand) Co., Ltd. 104 Phatthanakan 40, Phatthanakan Rd, Khwaeng Suan Luang, Khet Suan Luang, Bangkok 10250 Thailand.
RECEIVED DATE	: 28 Dec 2022
MEASUREMENT DATE	: 06 Jan 2023
ISSUE DATE	: 09 Jan 2023

ENVIRONMENTAL CONDITIONS:
Ambient condition in the laboratory are as follow:

Temperature	: 23.0 ± 3.0	°C
Relative Humidity	: 55.0 ± 15.0	%RH
Atmospheric Pressure	: 1010± 10	hPa

PLACE OF CALIBRATION : Eiffel-type wind tunnel of Jiranatee Associates Co., Ltd.

CALIBRATION CONDITION

Wind tunnel cross-section area[1]	900	cm^2
Win direction frontal area[2]	129	cm^2
Diameter of mounting pipe[3]	-	mm
Blockage ratio of test object[4]	0.143	[-]

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are (23.5) °C, (48.8) %RH and (1015.8) hPa.

TABULATION OF RESULTS:
The table on next page give the measured values.

Calibration procedure:
The wind direction sensor was calibrated against Standard Rotary Encoder model: AX4009TS-DM04-P3-5-U0 in an close test-section of Eiffel-type wind tunnel with 900 cm^2 cross test section area. The WI-CL-008 based on IEC 61400-12-1, Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines, March 2017 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: DA-0043-22

Uncertainty of Measurement:
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor k=2, Which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been determined in accordance with the GUM 'Evaluation of measurement data - Guide to the expression of uncertainty in measurement'

Calibrated by:
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JNAC JIRANATEE ASSOCIATES CO., LTD.

Approved signatory: [signature]
Mr. Parinya Boonchareon
Calibration Department Manager

Remark:
[1] Nozzle cross-section area of the wind tunnel
[2] Projected cross-section area of the tested object include mounting pipe
[3] Diameter of mounting pipe
[4] Ratio [2] to [1]

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

Certificate Number
CL-001-66

MEASUREMENT RESULTS [5]

The wind direction sensor was calibrated against standard rotary encoder by comparison method. During calibration, the measurement was carried out at 45° intervals in clockwise and counterclockwise directions after offset adjustment has been made. The flow speed of wind tunnel (usually 5 m/s) is kept constant while the sensor is rotated around its vertical axis. The results of calibration and associated measurement uncertainties are reported in the table below.

Air speed m/s	D'_{std} Degree (°)	D'_{uuc} Degree (°)	Error Degree (°)	*U (k=2)* Degree (°)
5.02	0.000	0	0	0.58
	45.000	41	-4	0.74
	90.000	87	-3	0.68
	135.000	134	-1	0.74
	180.001	181	1	0.74
	225.000	228	3	0.74
	270.001	273	3	0.74
	315.000	318	3	0.68

Remark:
[5] Calibration results only count for the tested circumstances and environmental conditions during which calibration took place
[6] Direction of standard
[7] Direction of Unit Under Calibration

JNAC JIRANATEE ASSOCIATES CO., LTD.

End of Certificate of Calibration

Jiranatee Associates Co., Ltd.

CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 13-Jan-23
Next Cal. Date : 13-Jul-23

Console Control Meter Data

Calibration No. : C-130123-BKK_FS0518
Dry Gas Meter ID : BKK_FS0518
Serial No. : 1504025
Model No. : XC-572-V

Barometric Pressure (mmHg) : 760
Relative Humidity (%) : 55.0
Temperature (C°) : 30.0

Reference Dry Gas Meter Data

Reference Dry Gas Meter ID : BKK_FS1122
Serial No. : A2003240
Correction Factor (Y) : 1.0160
Next Calibration Date : 05/27/23

ΔH (mm.H_2O)	Θ Minutes	Reference Dry Gas Meter Calibration Vr (Liters) Final	Vr (Liters) Initial	Vr (Liters) Total	Tr (°C)	Console Control ; Drygas Meter Vm (Liters) Final	Vm (Liters) Initial	Vm (Liters) Total	Ti (°C)	To (°C)	Avg.Tm (°C)	Dry Gas Meter Correction Factor (Y)	Orifice Calibration Factor ΔH@
15	12.56	150.00	0.00	150.00	31.0	311219.8	311064.0	155.80	29.0	29.0	29.0	0.9703	46.7405
25	9.48	150.00	0.00	150.00	31.0	311379.6	311225.0	154.60	29.0	29.0	29.0	0.9769	46.2782
50	6.58	150.00	0.00	150.00	30.0	311544.0	311390.0	154.00	29.0	29.0	29.0	0.9816	44.2975
80	5.16	150.00	0.00	150.00	30.0	311708.6	311555.0	153.60	30.0	30.0	30.0	0.9846	43.4421
120	4.16	150.00	0.00	150.00	30.0	311867.8	311715.0	152.80	30.0	30.0	30.0	0.9859	42.3535
											Avg.	0.9799	45.0224

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

ΔH@ : 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: Natthapol Jiengwareewong
(Mr.Natthapol Jiengwareewong)
Field Specialist(1)

FORM NO.: F 06-024 REVISION NO.: 2 ISSUE DATE: 30 Jun 22

Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK_FS0522
Lab test duct Number : 258-1-13-01
Calibration Sheet No. : C-130123-BKK_FS0522

Calibration Date : 13 Jan 23
Standard Pitot ID : BKK_FS0441
Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube (ΔP, mm.H_2O)	Type s pitot tube (ΔP, mm.H_2O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
			$\overline{Cp}$	0.842	0.842

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

$$\left[\overline{Cp}_{(A)} - \overline{Cp}_{(B)}\right] \text{ must BE} \leq 0.01$$

$$\text{Average deviation(A or B)} = \frac{\sum_{1}^{3}\left[Cp\ (s) - Cp(A\ or\ B)\right]}{3} \text{ must BE} \leq 0.01$$

Calibrated by : Saksit Phaisanphisut
(Mr. Saksit Phaisanphisut)
Field Scientist (4)

Approved by : Natthapol Jiengwareewong
(Mr.Natthapol Jiengwareewong)
Specialist (1)

FORM NO.: F 06-025 REVISION NO.: 1 ISSUE DATE: 30 Jun 22

Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK_FS0523
Lab test duct Number : 258-1-13-01
Calibration Sheet No. : C-130123-BKK_FS0523

Calibration Date : 13 Jan 23
Standard Pitot ID : BKK_FS0441
Cp Standard : 0.99

Type S Pitot Tube Coefficient Data					
	Type s pitot tube Leg A,B	Standard pitot tube (ΔP, mm.H_2O)	Type s pitot tube (ΔP, mm.H_2O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 2	A	12.00	17.00	0.840	-
	B	12.00	17.00	-	0.840
Test 3	A	12.00	16.80	0.845	-
	B	12.00	16.80	-	0.845
			$\overline{Cp}$	0.842	0.842

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

$$\left[\overline{Cp}_{(A)} - \overline{Cp}_{(B)}\right] \text{ must BE} \leq 0.01$$

$$\text{Average deviation(A or B)} = \frac{\sum_{1}^{3}\left[Cp\ (s) - Cp(A\ or\ B)\right]}{3} \text{ must BE} \leq 0.01$$

Calibrated by : Saksit Phaisanphisut
(Mr. Saksit Phaisanphisut)
Field Scientist (4)

Approved by : Natthapol Jiengwareewong
(Mr.Natthapol Jiengwareewong)
Specialist (1)

FORM NO.: F 06-025 REVISION NO.: 1 ISSUE DATE: 30 Jun 22

DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date : 13 Jan 23
Calibration sheet No. : C-130123-BKK_FS0519
Ambient Temperature (°C) :30
Relative Humidity (%) : 55

Digital Temperature ID : BKK_FS0519
Console Serial No. : 1504025
Model : XC-572-V

Reference Temperature ID : BKK_FS0609
Serial No. : 7688004
Model : FLUKE 714
Last Calibrate : 25 Jan 22

Location	Reference Temperature °C	Digital Temperature °C	Error °C	Remark
Stack	0	0	0	
	25	25	0	
	50	50	0	
	100	100	0	
	150	150	0	
	200	200	0	
	250	250	0	
	300	300	0	
	500	500	0	
	1000	1001	1	
	1200	1201	1	
Probe	100	100	0	
	120	120	0	
	140	140	0	
Filter	100	100	0	
	120	120	0	
	140	140	0	
Exit	0	0	0	
	10	10	0	
	20	20	0	
Meter	0	0	0	
	25	25	0	
	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 : Natthapol Jiengwareewong
Mr.Natthapol Jiengwareewong
Specialist (1)

FORM NO.: F 06-027 REVISION NO.: - ISSUE DATE: 2/5/02

PROBE NOZZLE DIAMETER

CALIBRATION DATA SHEET

Calibration Date :	13 Jan 23	Nozzle Set ID. :	BKK_FS0524
Calibration Sheet No. :	C-130123-BKK_FS0524	Vernier Caliper ID.:	BKK_FS1123

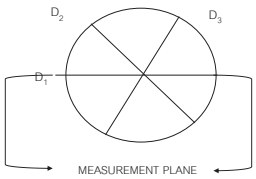
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo	$(D_1 + D_2 + D_3) / 3$
	D_1	D_2	D_3	ΔD	D_{avg}
1	0.318	0.318	0.318	0.000	0.318
2	0.472	0.474	0.475	0.003	0.474
3	0.632	0.635	0.634	0.003	0.634
4	0.792	0.792	0.792	0.000	0.792
5	0.952	0.952	0.952	0.000	0.952
6	1.091	1.110	1.092	0.019	1.098
7	1.256	1.262	1.262	0.006	1.260
8	1.601	1.598	1.600	0.003	1.600

Where :

D_1, D_2, D_3 = There 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 $\leq$ 0.100 mm.

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



Calibrated by : Saksit Phaisanphisut

(Mr. Saksit Phaisanphisut)

Field Scientist (4)

Approved by : Natthapon Jiengwareewong

(Mr.Natthapol Jiengwareewong)

Field Specialist (1)

FORM NO.: F 06-026 REVISION NO.: - ISSUE DATE: 9/1/03

RYG_EN0003

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel. +66 2643 8361-6 , e-mail: service.thailand@sartorius.com

NSC-TISI-TIS 17025
CALIBRATION 0426

SARTORIUS

REVIEW BY Thanutall
APPROVED BY D.
NEXT CAL. DATE 01/03/24

Certificate of Calibration

Model Number :	MSE224S-100-DU	Certificate No. :	23BCI0115
Description :	Analytical Balance	Issued Date :	Friday, March 03, 2023
Serial Number :	0031709552	Reference No. :	204833
ID No. :	RYG_EN0003		
Manufacturer :	Sartorius	Page No. :	1 of 2

Customer Name : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd.(Balance Room)
616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated By : Mr.Chonchai Inthana
Calibration Date : Wednesday, March 01, 2023

Calibration Procedure No. : This calibration was conducted by Using in-house calibration procedure number (WI-003) Based on UKAS LAB 14 : 2019

Metrological data :
Capacity : 220 g Readability : 0.0001 g

Ambients Conditions:
Temperature : 23.0 °C ± 5.0 °C
Humidity : 56.0 % 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 form list of Sartorius Metrological Specifications.

Traceability:

Model Number	Description	Traceability	Cetificate 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	DKSH	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.

Mr.chonchai Intrhana(Technical Manager)

STAMP

SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel. +66 2643 8361-6 Fax: +66 2643-8367, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number :	MSE224S-100-DU	Certificate No. :	23BCI0115
Description :	Analytical Balance	Issued Date :	Friday, March 03, 2023
Serial Number :	0031709552	Reference No. :	204833
ID No. :	RYG_EN0003		
Manufacturer :	Sartorius	Page No. :	2 of 2

Calibration Results : Without Adjustment

Repeatability

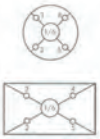
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

Nominal Value : (Low Load) 20 g	20.0000	200.0000
	20.0001	200.0000
Tolerance 0.0001 g	20.0000	200.0001
	20.0000	200.0000
	20.0000	200.0001
Nominal Value : (High Load) 200 g	20.0001	200.0001
	20.0000	200.0001
Tolerance 0.0001 g	20.0000	200.0000
	20.0000	200.0001
	20.0000	200.0001
Standard Deviation	0.00004	0.00005

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 maximim 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 : 100 g
Tolerance 0.0004 g



	Difference
1	–
2	0.0001
3	0.0000
4	0.0000
5	0.0001
6	-

Linearity

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

Tolerance 0.0002 g

Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
0.01	0.0100	0.0100	0.0000	0.00013
0.05	0.0500	0.0500	0.0000	0.00013
0.1	0.1000	0.1000	0.0000	0.00013
0.5	0.5000	0.5000	0.0000	0.00014
1	1.0000	1.0000	0.0000	0.00014
5	5.0000	5.0000	0.0000	0.00014
10	10.0000	10.0000	0.0000	0.00014
20	20.0000	20.0000	0.0000	0.00024
50	50.0000	50.0000	0.0000	0.00015
100	100.0000	100.0000	0.0000	0.00019
200	200.0000	200.0001	0.0001	0.00032

End of Report

SOP FM 33 03 February 2022

Lot No. 2355721-1

ANALYZER CALIBRATION DATA

Client	: Gulf NC Co., Ltd.	Location	: ปล่อง HRSG 11
Date	: 15 Jun 23	Test Operator	: SathapornT.

O_2 ANALYZER
Model : TELEDYNE API 200EH Serial No. : 735
Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.01	0.03	0.08
Low-Level Gas	8.04	8.05	8.07	0.08
Span Gas	16.00	16.01	16.03	0.08

NO_X ANALYZER
Model : TELEDYNE API 200EH Serial No. : 735
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.03	0.05	0.02
Low-Level Gas	54.96	54.93	54.92	0.01
Span Gas	82.51	82.50	82.48	0.02

SO2 ANALYZER
Model : TELEDYNE API 100EH Serial No. : 410
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.01	0.01
Low-Level Gas	55.55	55.54	55.54	0.00
Span Gas	79.76	79.75	79.74	0.01

CO ANALYZER
Model : TELEDYNE API 300EM Serial No. : 425
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.03	0.04	0.01
Low-Level Gas	54.84	54.81	54.80	0.01
Span Gas	79.74	79.72	79.71	0.01

Calibrated by

Sathapron Th.

(Mr.Sathaporn Thakaew)

Environmental Field Scientist (3)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group

Lot No. 2355721-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client	: Gulf NC Co., Ltd.	Location	: เมือง HRSG 11
Date	: 15 Jun 23	Test Operator	: SathapornT.

O_2 ANALYZER

Cylinder Conc. (%) : 16.00 Span (%) : 25

	O_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.01	0.03	0.08	0.03	0.08	0.00
Upscale Gas	16.01	16.03	0.08	16.03	0.08	0.00

NO_X ANALYZER

Cylinder Conc. (ppm) : 82.51 Span (ppm) : 100

	NO_X Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.03	0.05	0.02	0.06	0.03	0.01
Upscale Gas	82.50	82.47	0.03	82.45	0.05	0.02

SO_2 ANALYZER

Cylinder Conc. (ppm) : 79.76 Span (ppm) : 100

	SO_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.01	0.01	0.01	0.01	0.00
Upscale Gas	79.75	79.73	0.02	79.72	0.03	0.01

CO ANALYZER

Cylinder Conc. (ppm) : 79.74 Span (ppm) : 100

	CO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.03	0.04	0.01	0.04	0.01	0.00
Upscale Gas	79.72	79.70	0.02	79.70	0.02	0.00

Calibrated by

Sathapron Th.

(Mr.Sathaporn Thakaew)

Environmental Field Scientist (3)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group

EMISSION TEST RESULT

		Run #	1
Client	Gulf NC Co., Ltd.	Location	เมือง HRSG 11
Date	15 Jun 23	Test Operator	SathapornT.
Start Time	12:10	Finish Time	12:30
SO_2 Analyzer Model	TELEDYNE API 100EH	Serial No.	410
NO_x/O_2 Analyzer Model	TELEDYNE API 200EH	Serial No.	735
CO/CO_2 Analyzer Model	TELEDYNE API 300EM	Serial No.	425

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
12:10	14.51	3.62	12.08	0.81	20.88	
12:11	14.51	3.61	11.22	0.80	20.39	
12:12	14.51	3.63	11.63	0.80	20.20	
12:13	14.50	3.59	13.27	0.80	19.82	
12:14	14.48	3.61	14.71	0.80	19.67	
12:15	14.48	3.63	15.75	0.80	19.64	
12:16	14.49	3.60	16.18	0.79	19.79	
12:17	14.50	3.60	15.93	0.79	19.87	
12:18	14.51	3.61	15.15	0.79	19.81	
12:19	14.53	3.61	14.22	0.79	19.83	
12:20	14.53	3.64	13.54	0.78	19.65	
12:21	14.53	3.62	13.46	0.78	19.42	
12:22	14.52	3.60	13.74	0.78	19.20	
12:23	14.52	3.59	14.10	0.78	19.18	
12:24	14.53	3.61	14.27	0.78	19.29	
12:25	14.52	3.59	14.19	0.77	19.50	
12:26	14.53	3.63	13.91	0.77	19.42	
12:27	14.52	3.60	13.67	0.78	19.33	
12:28	14.52	3.58	13.55	0.79	19.36	
12:29	14.51	3.57	13.68	0.79	19.51	
12:30	14.52	3.59	13.90	0.79	19.55	
Average	**14.51**	**3.61**	**13.91**	**0.79**	**19.68**	

Sathapron Th.

(Mr.Sathaporn Thakaew)

Environmental Field Scientist (3)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group

EMISSION TEST RESULT

		Run #	2
Client	Gulf NC Co., Ltd.	Location	เมือง HRSG 11
Date	15 Jun 23	Test Operator	SathapornT.
Start Time	12:31	Finish Time	12:51
SO_2 Analyzer Model	TELEDYNE API 100EH	Serial No.	410
NO_x/O_2 Analyzer Model	TELEDYNE API 200EH	Serial No.	735
CO/CO_2 Analyzer Model	TELEDYNE API 300EM	Serial No.	425

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
12:31	14.52	3.57	14.11	0.80	19.55	
12:32	14.51	3.60	14.26	0.80	19.48	
12:33	14.52	3.61	14.42	0.80	19.45	
12:34	14.52	3.64	14.70	0.80	19.41	
12:35	14.49	3.59	15.12	0.80	19.20	
12:36	14.47	3.63	16.11	0.80	19.07	
12:37	14.46	3.66	17.48	0.81	19.35	
12:38	14.46	3.64	17.86	0.81	19.62	
12:39	14.46	3.64	18.00	0.81	19.89	
12:40	14.47	3.64	17.97	0.81	20.00	
12:41	14.46	3.60	17.93	0.81	19.75	
12:42	14.47	3.61	17.87	0.81	19.62	
12:43	14.47	3.63	17.71	0.81	19.48	
12:44	14.46	3.60	17.53	0.81	19.49	
12:45	14.47	3.62	17.40	0.82	19.44	
12:46	14.46	3.65	17.56	0.82	19.46	
12:47	14.46	3.69	17.70	0.82	19.47	
12:48	14.45	3.60	17.85	0.82	19.63	
12:49	14.46	3.67	17.82	0.82	19.51	
12:50	14.46	3.67	17.76	0.82	19.54	
12:51	14.45	3.65	17.63	0.83	19.45	
Average	**14.47**	**3.63**	**16.89**	**0.81**	**19.52**	

Sathapron Th.

(Mr.Sathaporn Thakaew)

Environmental Field Scientist (3)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group

EMISSION TEST RESULT

		Run #	3
Client	Gulf NC Co., Ltd.	Location	เมือง HRSG 11
Date	15 Jun 23	Test Operator	SathapornT.
Start Time	12:52	Finish Time	13:12
SO_2 Analyzer Model	TELEDYNE API 100EH	Serial No.	410
NO_x/O_2 Analyzer Model	TELEDYNE API 200EH	Serial No.	735
CO/CO_2 Analyzer Model	TELEDYNE API 300EM	Serial No.	425

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
12:52	14.46	3.62	17.55	0.83	19.38	
12:53	14.45	3.65	17.47	0.83	19.26	
12:54	14.45	3.63	17.52	0.83	19.22	
12:55	14.45	3.63	17.65	0.82	19.26	
12:56	14.45	3.64	17.71	0.82	19.29	
12:57	14.46	3.63	17.69	0.82	19.33	
12:58	14.45	3.65	17.71	0.81	19.28	
12:59	14.45	3.65	17.75	0.81	19.26	
13:00	14.45	3.63	17.80	0.81	19.23	
13:01	14.46	3.67	17.78	0.80	19.20	
13:02	14.45	3.62	17.82	0.80	19.14	
13:03	14.45	3.67	17.96	0.80	19.06	
13:04	14.45	3.60	18.03	0.80	19.12	
13:05	14.45	3.63	18.12	0.81	19.18	
13:06	14.45	3.65	18.12	0.81	19.16	
13:07	14.45	3.65	18.03	0.81	19.28	
13:08	14.45	3.65	17.84	0.81	19.19	
13:09	14.45	3.62	17.72	0.81	19.11	
13:10	14.45	3.67	17.70	0.81	19.05	
13:11	14.45	3.64	17.71	0.81	19.02	
13:12	14.45	3.63	17.80	0.81	19.01	
Average	**14.45**	**3.64**	**17.76**	**0.81**	**19.19**	

Sathapron Th.

(Mr.Sathaporn Thakaew)

Environmental Field Scientist (3)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group

Lot No. 2355725-1

ANALYZER CALIBRATION DATA

Client : Gulf NC Co., Ltd. Location : เสียง HRSG 12
Date : 16 Jun 23 Test Operator : SathapornT.

O_2 ANALYZER
Model : TELEDYNE API 200EH Serial No. : 735
Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.01	0.02	0.04
Low-Level Gas	8.04	8.05	8.07	0.08
Span Gas	16.00	16.01	16.03	0.08

NO_X ANALYZER
Model : TELEDYNE API 200EH Serial No. : 735
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.02	0.03	0.01
Low-Level Gas	54.96	54.95	54.94	0.01
Span Gas	82.51	82.50	82.49	0.01

SO2 ANALYZER
Model : TELEDYNE API 100EH Serial No. : 410
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.01	0.01
Low-Level Gas	55.55	55.54	55.54	0.00
Span Gas	79.76	79.75	79.74	0.01

CO ANALYZER
Model : TELEDYNE API 300EM Serial No. : 425
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.02	0.03	0.01
Low-Level Gas	54.84	54.81	54.80	0.01
Span Gas	79.74	79.72	79.71	0.01

Calibrated by

Sathapron Th.

(Mr.Sathaporn Thakaew)

Environmental Field Scientist (3)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group

Lot No. 2355725-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf NC Co., Ltd. Location : เสียง HRSG 12
Date : 16 Jun 23 Test Operator : SathapornT.

O_2 ANALYZER
Cylinder Conc. (%) : 16.00 Span (%) : 25

	O_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.01	0.02	0.04	0.02	0.04	0.00
Upscale Gas	16.01	16.03	0.08	16.04	0.12	0.04

NO_X ANALYZER
Cylinder Conc. (ppm) : 82.51 Span (ppm) : 100

	NO_X Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.02	0.04	0.02	0.04	0.02	0.00
Upscale Gas	82.50	82.48	0.02	82.48	0.02	0.00

SO_2 ANALYZER
Cylinder Conc. (ppm) : 79.76 Span (ppm) : 100

	SO_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.01	0.01	0.01	0.01	0.00
Upscale Gas	79.75	79.73	0.02	79.72	0.03	0.01

CO ANALYZER
Cylinder Conc. (ppm) : 79.74 Span (ppm) : 100

	CO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.02	0.04	0.02	0.04	0.02	0.00
Upscale Gas	79.72	79.70	0.02	79.70	0.02	0.00

Calibrated by

Sathapron Th.

(Mr.Sathaporn Thakaew)

Environmental Field Scientist (3)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group

EMISSION TEST RESULT

		Run #	1
Client	Gulf NC Co., Ltd.	Location	เสียง HRSG 12
Date	16 Jun 23	Test Operator	SathapornT.
Start Time	11:30	Finish Time	11:50
SO_2 Analyzer Model	TELEDYNE API 100EH	Serial No.	410
NO_x/O_2 Analyzer Model	TELEDYNE API 200EH	Serial No.	735
CO/CO_2 Analyzer Model	TELEDYNE API 300EM	Serial No.	425

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
11:30	14.70	3.38	16.53	0.43	31.06	
11:31	14.69	3.36	16.46	0.43	31.00	
11:32	14.70	3.39	16.46	0.43	30.95	
11:33	14.70	3.37	16.41	0.42	31.03	
11:34	14.71	3.31	16.20	0.42	31.08	
11:35	14.73	3.32	15.83	0.42	31.31	
11:36	14.74	3.35	15.46	0.41	31.58	
11:37	14.73	3.32	15.19	0.41	31.38	
11:38	14.72	3.38	15.50	0.41	30.99	
11:39	14.70	3.37	16.03	0.43	30.98	
11:40	14.69	3.39	16.35	0.43	31.09	
11:41	14.69	3.36	16.21	0.43	31.17	
11:42	14.70	3.37	16.05	0.42	31.09	
11:43	14.70	3.38	16.20	0.43	30.98	
11:44	14.70	3.34	16.42	0.42	30.95	
11:45	14.70	3.34	16.59	0.43	30.90	
11:46	14.69	3.36	16.68	0.44	30.83	
11:47	14.69	3.36	16.64	0.43	30.92	
11:48	14.70	3.34	16.23	0.44	31.00	
11:49	14.70	3.36	16.11	0.44	30.87	
11:50	14.70	3.36	16.35	0.44	30.77	
Average	**14.70**	**3.36**	**16.19**	**0.43**	**31.04**	

Sathapron Th.

(Mr.Sathaporn Thakaew)

Environmental Field Scientist (3)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group

EMISSION TEST RESULT

		Run #	2
Client	Gulf NC Co., Ltd.	Location	เสียง HRSG 12
Date	16 Jun 23	Test Operator	SathapornT.
Start Time	11:51	Finish Time	12:11
SO_2 Analyzer Model	TELEDYNE API 100EH	Serial No.	410
NO_x/O_2 Analyzer Model	TELEDYNE API 200EH	Serial No.	735
CO/CO_2 Analyzer Model	TELEDYNE API 300EM	Serial No.	425

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
11:51	14.70	3.35	16.62	0.44	30.75	
11:52	14.70	3.36	16.55	0.45	30.88	
11:53	14.72	3.34	16.40	0.45	30.81	
11:54	14.71	3.33	16.27	0.45	30.75	
11:55	14.71	3.32	16.33	0.46	30.67	
11:56	14.70	3.34	16.48	0.46	30.55	
11:57	14.70	3.35	16.78	0.46	30.49	
11:58	14.70	3.37	16.93	0.46	30.54	
11:59	14.70	3.33	16.87	0.47	30.57	
12:00	14.71	3.35	16.75	0.45	30.52	
12:01	14.71	3.35	16.62	0.45	30.47	
12:02	14.72	3.32	16.43	0.45	30.64	
12:03	14.74	3.33	16.19	0.44	30.80	
12:04	14.78	3.30	16.16	0.44	31.67	
12:05	14.83	3.28	16.06	0.44	32.92	
12:06	14.86	3.24	15.31	0.43	33.45	
12:07	14.87	3.27	14.83	0.43	33.42	
12:08	14.85	3.27	15.07	0.43	32.73	
12:09	14.81	3.28	16.49	0.46	32.23	
12:10	14.78	3.30	17.87	0.46	31.91	
12:11	14.78	3.29	18.61	0.46	31.77	
Average	**14.75**	**3.32**	**16.46**	**0.45**	**31.36**	

Sathapron Th.

(Mr.Sathaporn Thakaew)

Environmental Field Scientist (3)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group

EMISSION TEST RESULT

		Run #	3
Client	Gulf NC Co., Ltd.	Location	เส้นท่อ HRSG 12
Date	16 Jun 23	Test Operator	SathapornT.
Start Time	12:12	Finish Time	12:32
SO_2 Analyzer Model	TELEDYNE API 100EH	Serial No.	410
NO_x/O_2 Analyzer Model	TELEDYNE API 200EH	Serial No.	735
CO/CO_2 Analyzer Model	TELEDYNE API 300EM	Serial No.	425

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
12:12	14.78	3.31	18.77	0.46	31.69	
12:13	14.77	3.31	18.77	0.46	31.61	
12:14	14.78	3.32	18.71	0.46	31.59	
12:15	14.78	3.29	18.69	0.46	31.62	
12:16	14.78	3.29	18.79	0.45	31.54	
12:17	14.78	3.31	18.91	0.45	31.57	
12:18	14.77	3.30	19.03	0.45	31.65	
12:19	14.78	3.32	19.08	0.44	31.48	
12:20	14.77	3.30	19.12	0.44	31.50	
12:21	14.81	3.27	18.36	0.44	32.03	
12:22	14.84	3.27	17.41	0.43	32.38	
12:23	14.84	3.25	16.08	0.43	32.49	
12:24	14.85	3.25	15.70	0.43	32.77	
12:25	14.84	3.26	15.68	0.43	32.56	
12:26	14.82	3.28	16.08	0.42	32.14	
12:27	14.80	3.30	17.00	0.42	31.82	
12:28	14.78	3.32	17.87	0.42	31.54	
12:29	14.78	3.30	18.72	0.42	31.48	
12:30	14.77	3.29	19.11	0.43	31.64	
12:31	14.78	3.33	18.66	0.42	31.99	
12:32	14.81	3.27	17.22	0.44	32.38	
Average	**14.79**	**3.29**	**17.99**	**0.44**	**31.88**	

Sathapron Th.

(Mr.Sathaporn Thakaew)

Environmental Field Scientist (3)

FORM NO.: F 06-062 REVISION NO.: 2 ISSUE DATE: 3/06/19

ALS Laboratory Group

Lot No. 2355702-1

ANALYZER CALIBRATION DATA

Client : Gulf NC Co., Ltd. Location : เส้นท่อ HRSG 11
Date : 15 Jun 23 Test Operator : Sathapron.T

O_2 ANALYZER
Model : TELEDYNE API 200EH Serial No. : 735
Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.01	0.03	0.08
Low-Level Gas	8.04	8.05	8.07	0.08
Span Gas	16.00	16.01	16.03	0.08

NO_X ANALYZER
Model : TELEDYNE API 200EH Serial No. : 735
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.03	0.05	0.02
Low-Level Gas	54.96	54.93	54.92	0.01
Span Gas	82.51	82.50	82.48	0.02

SO2 ANALYZER
Model : TELEDYNE API 100EH Serial No. : 410
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.01	0.01
Low-Level Gas	55.55	55.54	55.54	0.00
Span Gas	79.76	79.75	79.74	0.01

CO ANALYZER
Model : TELEDYNE API 300EM Serial No. : 425
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.03	0.04	0.01
Low-Level Gas	54.84	54.81	54.80	0.01
Span Gas	79.74	79.72	79.71	0.01

Calibrated by

Sathapron Th.

(Mr.Sathapron Thakarw)

Environmental Field Scientist (3)

FORM NO.: F 06-104 REVISION NO.: - ISSUE DATE: 3/06/19

ALS Laboratory Group

Lot No. 2355702-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : Gulf NC Co., Ltd. Location : เส้นท่อ HRSG 11
Date : 15 Jun 23 Test Operator : Sathapron.T

O_2 ANALYZER
Cylinder Conc. (%) : 16.00 Span (%) : 25

	O_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.01	0.03	0.08	0.03	0.08	0.00
Upscale Gas	16.01	16.03	0.08	16.03	0.08	0.00

NO_X ANALYZER
Cylinder Conc. (ppm) : 82.51 Span (ppm) : 100

	NO_X Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.03	0.05	0.02	0.06	0.03	0.01
Upscale Gas	82.50	82.47	0.03	82.45	0.05	0.02

SO_2 ANALYZER
Cylinder Conc. (ppm) : 79.76 Span (ppm) : 100

	SO_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.01	0.01	0.01	0.01	0.00
Upscale Gas	79.75	79.73	0.02	79.72	0.03	0.01

CO ANALYZER
Cylinder Conc. (ppm) : 79.74 Span (ppm) : 100

	CO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.03	0.04	0.01	0.04	0.01	0.00
Upscale Gas	79.72	79.70	0.02	79.70	0.02	0.00

Calibrated by

Sathapron Th.

(Mr.Sathapron Thakarw)

Environmental Field Scientist (3)

FORM NO.: F 06-104 REVISION NO.: - ISSUE DATE: 3/06/19

ALS Laboratory Group

CEMs Data

Client Name Gulf NC Co., Ltd. Date 15 Jun 23
Plant Name GNC Location เส้นท่อ HRSG 11

Run No: 1 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
15 Jun 23	11:10	0.75	15.28	22.43	14.34	48.74
15 Jun 23	11:11	0.83	14.91	22.31	14.34	48.82
15 Jun 23	11:12	0.90	14.54	22.19	14.33	48.84
15 Jun 23	11:13	0.93	14.54	22.13	14.33	48.85
15 Jun 23	11:14	0.96	14.46	22.04	14.33	48.86
15 Jun 23	11:15	0.92	14.58	22.01	14.33	48.88
15 Jun 23	11:16	0.89	14.89	22.13	14.33	48.95
15 Jun 23	11:17	0.82	15.19	22.25	14.33	48.90
15 Jun 23	11:18	0.78	15.20	22.31	14.33	48.92
15 Jun 23	11:19	0.75	15.14	22.37	14.33	48.88
15 Jun 23	11:20	0.73	14.98	22.38	14.34	48.86
15 Jun 23	11:21	0.79	14.77	22.35	14.33	48.88
15 Jun 23	11:22	0.87	14.50	22.31	14.33	48.83
15 Jun 23	11:23	0.90	14.26	22.08	14.32	48.85
15 Jun 23	11:24	0.94	14.21	21.98	14.32	48.94
15 Jun 23	11:25	0.97	14.35	22.12	14.32	48.97
15 Jun 23	11:26	0.91	14.48	22.22	14.32	48.96
15 Jun 23	11:27	0.84	14.50	22.26	14.32	48.94
15 Jun 23	11:28	0.80	14.51	22.25	14.33	48.92
15 Jun 23	11:29	0.76	14.43	22.09	14.34	49.01
15 Jun 23	11:30	0.73	14.67	22.08	14.34	49.01
Max		0.97	15.28	22.43	14.34	49.01
Avg		0.85	14.69	22.20	14.33	48.90

Run No: 2 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
15 Jun 23	11:31	0.73	14.77	22.04	14.34	49.01
15 Jun 23	11:32	0.81	14.56	22.06	14.33	48.99
15 Jun 23	11:33	0.87	14.26	21.98	14.34	49.00
15 Jun 23	11:34	0.91	14.46	21.98	14.33	49.03
15 Jun 23	11:35	0.94	14.47	22.05	14.33	49.01
15 Jun 23	11:36	0.96	14.41	21.99	14.34	49.02
15 Jun 23	11:37	0.88	14.79	21.97	14.33	48.99
15 Jun 23	11:38	0.82	14.97	22.04	14.33	49.03
15 Jun 23	11:39	0.77	15.25	22.11	14.33	49.01
15 Jun 23	11:40	0.75	15.35	22.26	14.33	48.94
15 Jun 23	11:41	0.72	15.22	22.31	14.34	48.87
15 Jun 23	11:42	0.74	15.08	22.12	14.34	48.88
15 Jun 23	11:43	0.82	14.90	22.05	14.34	48.93
15 Jun 23	11:44	0.88	15.13	22.08	14.33	48.86
15 Jun 23	11:45	0.93	14.96	22.27	14.33	48.85
15 Jun 23	11:46	0.95	14.78	22.36	14.33	48.83
15 Jun 23	11:47	0.93	14.91	22.41	14.34	48.81
15 Jun 23	11:48	0.86	15.17	22.37	14.34	48.79
15 Jun 23	11:49	0.80	15.27	22.32	14.34	48.83
15 Jun 23	11:50	0.77	15.49	22.39	14.34	48.83
15 Jun 23	11:51	0.73	15.35	22.43	14.34	48.77
Max		0.96	15.49	22.43	14.34	49.03
Avg		0.84	14.93	22.17	14.34	48.92

Run No: 3 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
15 Jun 23	11:52	0.69	15.18	22.26	14.34	48.82
15 Jun 23	11:53	0.74	15.19	22.25	14.34	48.83
15 Jun 23	11:54	0.82	14.88	22.29	14.34	48.84
15 Jun 23	11:55	0.88	14.78	22.21	14.34	48.86
15 Jun 23	11:56	0.92	14.69	22.17	14.34	48.88
15 Jun 23	11:57	0.94	14.78	22.15	14.33	48.94
15 Jun 23	11:58	0.89	15.06	22.36	14.33	48.83
15 Jun 23	11:59	0.83	15.07	22.31	14.34	48.80
15 Jun 23	12:00	0.78	15.10	22.24	14.34	48.52
15 Jun 23	12:01	0.75	14.87	22.14	14.35	48.51
15 Jun 23	12:02	0.71	14.80	22.03	14.35	48.51
15 Jun 23	12:03	0.69	14.69	21.94	14.35	48.54
15 Jun 23	12:04	0.76	14.47	21.98	14.35	48.60
15 Jun 23	12:05	0.85	14.17	22.22	14.35	48.97
15 Jun 23	12:06	0.92	11.46	21.76	14.41	46.07
15 Jun 23	12:07	0.94	9.65	21.38	14.42	46.00
15 Jun 23	12:08	0.90	10.35	20.33	14.41	45.12
15 Jun 23	12:09	0.84	12.02	20.57	14.42	44.99
15 Jun 23	12:10	0.74	14.23	19.82	14.39	45.02
15 Jun 23	12:11	0.68	15.92	19.93	14.39	45.04
15 Jun 23	12:12	0.63	16.05	20.02	14.39	45.09
Max		0.94	16.05	22.36	14.42	48.94
Avg		0.80	14.16	21.64	14.36	47.51

Run No: 4 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
15 Jun 23	12:13	0.61	16.23	20.14	14.39	44.68
15 Jun 23	12:14	0.63	15.42	20.36	14.42	44.03
15 Jun 23	12:15	0.71	13.65	20.24	14.43	43.63
15 Jun 23	12:16	0.79	12.62	20.07	14.45	43.54
15 Jun 23	12:17	0.83	12.40	20.00	14.44	43.52
15 Jun 23	12:18	0.85	12.53	19.62	14.43	43.52
15 Jun 23	12:19	0.84	13.27	19.43	14.43	43.56
15 Jun 23	12:20	0.77	13.82	19.54	14.43	43.59
15 Jun 23	12:21	0.72	14.01	19.78	14.43	43.59
15 Jun 23	12:22	0.68	13.72	19.90	14.44	43.54
15 Jun 23	12:23	0.64	13.51	19.79	14.44	43.51
15 Jun 23	12:24	0.63	13.27	19.67	14.45	43.53
15 Jun 23	12:25	0.63	13.24	19.73	14.44	43.54
15 Jun 23	12:26	0.73	13.11	19.80	14.43	43.61
15 Jun 23	12:27	0.80	13.21	19.95	14.43	43.58
15 Jun 23	12:28	0.85	13.30	19.92	14.42	43.53
15 Jun 23	12:29	0.86	13.51	19.87	14.42	43.52
15 Jun 23	12:30	0.83	13.71	19.89	14.42	43.53
15 Jun 23	12:31	0.77	14.25	19.81	14.42	43.51
15 Jun 23	12:32	0.69	14.90	19.58	14.41	44.54
15 Jun 23	12:33	0.65	17.30	19.37	14.37	44.99
Max		0.86	17.30	20.36	14.45	44.99
Avg		0.74	13.86	19.83	14.43	43.74

Run No: 5 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
15 Jun 23	12:34	0.62	18.04	19.88	14.37	44.97
15 Jun 23	12:35	0.61	17.98	20.19	14.37	44.96
15 Jun 23	12:36	0.66	17.66	20.64	14.37	44.99
15 Jun 23	12:37	0.73	17.18	20.45	14.37	45.01
15 Jun 23	12:38	0.79	17.09	20.24	14.37	45.01
15 Jun 23	12:39	0.82	16.95	20.06	14.37	45.02
15 Jun 23	12:40	0.84	16.79	20.03	14.37	45.03
15 Jun 23	12:41	0.82	16.69	20.03	14.37	45.03
15 Jun 23	12:42	0.75	16.76	20.06	14.37	45.30
15 Jun 23	12:43	0.69	17.38	19.99	14.36	45.48
15 Jun 23	12:44	0.67	17.78	20.23	14.36	45.49
15 Jun 23	12:45	0.64	17.78	20.26	14.37	45.47
15 Jun 23	12:46	0.61	17.84	20.16	14.37	45.49
15 Jun 23	12:47	0.64	17.49	20.18	14.37	45.51
15 Jun 23	12:48	0.72	16.98	20.09	14.37	45.58
15 Jun 23	12:49	0.78	16.70	20.00	14.36	45.56
15 Jun 23	12:50	0.82	16.72	19.86	14.36	45.47
15 Jun 23	12:51	0.84	16.80	19.89	14.36	45.45
15 Jun 23	12:52	0.86	16.91	19.99	14.36	45.49
15 Jun 23	12:53	0.85	16.89	20.05	14.36	45.52
15 Jun 23	12:54	0.79	17.13	20.02	14.36	45.55
Max		0.86	18.04	20.64	14.37	-
Avg		0.74	17.21	20.11	14.37	-

Run No: 6 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
15 Jun 23	12:55	0.72	17.35	19.99	14.36	45.61
15 Jun 23	12:56	0.67	17.60	19.91	14.36	45.66
15 Jun 23	12:57	0.64	17.70	19.91	14.36	45.59
15 Jun 23	12:58	0.62	17.73	19.90	14.37	45.68
15 Jun 23	12:59	0.64	17.67	19.77	14.37	45.76
15 Jun 23	13:00	0.72	17.55	19.66	14.36	45.82
15 Jun 23	13:01	0.78	17.45	19.67	14.36	45.80
15 Jun 23	13:02	0.82	17.27	19.95	14.36	45.76
15 Jun 23	13:03	0.84	17.22	19.93	14.36	45.72
15 Jun 23	13:04	0.85	17.10	20.10	14.36	45.65
15 Jun 23	13:05	0.87	16.85	19.93	14.35	45.73
15 Jun 23	13:06	0.85	16.99	19.89	14.35	45.70
15 Jun 23	13:07	0.80	17.16	19.86	14.35	45.65
15 Jun 23	13:08	0.71	17.32	19.80	14.36	45.66
15 Jun 23	13:09	0.67	17.53	19.71	14.36	45.68
15 Jun 23	13:10	0.66	17.86	19.86	14.36	45.65
15 Jun 23	13:11	0.63	17.83	20.04	14.36	45.64
15 Jun 23	13:12	0.68	17.48	20.05	14.36	45.77
15 Jun 23	13:13	0.76	17.32	19.87	14.35	45.75
15 Jun 23	13:14	0.80	17.16	19.90	14.35	45.79
15 Jun 23	13:15	0.83	17.08	19.88	14.36	45.78
Max		0.87	17.86	20.10	14.37	45.82
Avg		0.74	17.39	19.89	14.36	45.71

CEMs Data

Client Name	Gulf NC Co., Ltd.	Date	15 Jun 23
Plant Name	GNC	Location	ปล่อง HRSG 11

Run No: 7 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	Load MW
15 Jun 23	13:16	0.85	17.11	19.90	14.35	46.85
15 Jun 23	13:17	0.89	16.60	20.03	14.31	47.58
15 Jun 23	13:18	0.89	16.41	20.63	14.32	48.72
15 Jun 23	13:19	0.84	16.07	21.27	14.32	48.76
15 Jun 23	13:20	0.78	15.98	21.49	14.32	48.83
15 Jun 23	13:21	0.75	15.90	21.64	14.32	48.83
15 Jun 23	13:22	0.73	15.88	21.69	14.32	48.87
15 Jun 23	13:23	0.72	15.76	21.65	14.32	48.93
15 Jun 23	13:24	0.77	15.64	21.68	14.32	48.97
15 Jun 23	13:25	0.85	15.20	21.86	14.32	48.98
15 Jun 23	13:26	0.91	14.95	21.83	14.31	49.01
15 Jun 23	13:27	0.94	15.02	21.79	14.31	49.02
15 Jun 23	13:28	0.96	14.91	21.81	14.30	49.03
15 Jun 23	13:29	0.98	14.93	21.98	14.30	49.05
15 Jun 23	13:30	0.92	15.10	21.96	14.30	49.02
15 Jun 23	13:31	0.85	15.29	21.92	14.31	48.95
15 Jun 23	13:32	0.80	15.35	21.89	14.31	48.94
15 Jun 23	13:33	0.75	15.43	21.62	14.31	48.95
15 Jun 23	13:34	0.73	15.58	21.75	14.31	48.96
15 Jun 23	13:35	0.73	15.66	21.87	14.31	48.96
15 Jun 23	13:36	0.81	15.36	22.06	14.31	48.92
Max		0.98	17.11	22.06	14.35	49.05
Avg		0.83	15.63	21.54	14.31	48.77

Run No: 8 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	Load MW
15 Jun 23	13:37	0.88	15.07	21.87	14.31	48.84
15 Jun 23	13:38	0.92	14.90	21.91	14.31	48.81
15 Jun 23	13:39	0.93	15.01	21.99	14.30	48.75
15 Jun 23	13:40	0.97	14.94	22.04	14.30	48.73
15 Jun 23	13:41	0.98	14.98	22.05	14.30	48.69
15 Jun 23	13:42	0.92	15.24	22.12	14.31	48.67
15 Jun 23	13:43	0.84	15.74	21.96	14.31	48.63
15 Jun 23	13:44	0.79	15.87	21.71	14.31	48.72
15 Jun 23	13:45	0.74	16.09	21.61	14.31	48.70
15 Jun 23	13:46	0.73	16.07	21.68	14.31	48.72
15 Jun 23	13:47	0.73	15.84	21.94	14.31	48.70
15 Jun 23	13:48	0.80	15.53	21.86	14.31	48.67
15 Jun 23	13:49	0.86	15.30	21.89	14.31	48.62
15 Jun 23	13:50	0.91	15.01	21.81	14.31	48.55
15 Jun 23	13:51	0.94	14.61	21.81	14.31	48.55
15 Jun 23	13:52	0.96	14.42	21.90	14.31	48.54
15 Jun 23	13:53	0.98	14.23	21.81	14.31	48.33
15 Jun 23	13:54	0.98	13.76	21.89	14.32	47.99
15 Jun 23	13:55	0.90	13.44	21.63	14.33	48.01
15 Jun 23	13:56	0.82	13.96	21.30	14.33	48.05
15 Jun 23	13:57	0.78	14.21	21.30	14.33	48.11
Max		0.98	16.09	22.12	14.33	48.84
Avg		0.87	14.96	21.81	14.31	48.54

Run No: 9 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	Load MW
15 Jun 23	13:58	0.77	14.32	21.62	14.34	48.38
15 Jun 23	13:59	0.72	14.86	21.66	14.32	48.58
15 Jun 23	14:00	0.77	15.25	21.84	14.32	48.51
15 Jun 23	14:01	0.85	14.99	21.74	14.32	48.52
15 Jun 23	14:02	0.90	14.84	21.70	14.32	48.58
15 Jun 23	14:03	0.95	14.99	21.68	14.31	48.58
15 Jun 23	14:04	0.98	14.89	22.05	14.31	48.54
15 Jun 23	14:05	0.99	14.74	21.89	14.31	48.46
15 Jun 23	14:06	0.97	15.03	21.72	14.31	48.46
15 Jun 23	14:07	0.90	15.35	21.69	14.31	48.50
15 Jun 23	14:08	0.82	15.60	21.53	14.32	48.46
15 Jun 23	14:09	0.79	15.81	21.59	14.32	48.48
15 Jun 23	14:10	0.76	15.86	21.52	14.32	48.59
15 Jun 23	14:11	0.76	15.78	21.93	14.32	48.56
15 Jun 23	14:12	0.78	15.40	21.87	14.32	48.54
15 Jun 23	14:13	0.86	15.04	22.00	14.31	48.54
15 Jun 23	14:14	0.91	14.61	21.78	14.32	48.57
15 Jun 23	14:15	0.96	14.46	21.78	14.32	48.55
15 Jun 23	14:16	0.97	14.36	21.80	14.32	48.55
15 Jun 23	14:17	0.99	14.33	21.76	14.32	48.52
15 Jun 23	14:18	1.00	14.33	21.75	14.32	48.50
Max		1.00	15.86	22.05	14.34	48.59
Avg		0.88	14.99	21.76	14.32	48.52

Run No: 10 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	Load MW
15 Jun 23	14:19	0.95	14.56	21.69	14.32	48.51
15 Jun 23	14:20	0.86	14.78	21.60	14.32	48.53
15 Jun 23	14:21	0.80	14.98	21.45	14.33	48.52
15 Jun 23	14:22	0.77	15.27	21.47	14.33	48.57
15 Jun 23	14:23	0.75	15.48	21.60	14.32	48.58
15 Jun 23	14:24	0.74	15.55	21.63	14.32	48.56
15 Jun 23	14:25	0.83	15.09	21.75	14.32	48.56
15 Jun 23	14:26	0.89	14.65	21.86	14.32	48.57
15 Jun 23	14:27	0.94	14.58	21.77	14.32	48.54
15 Jun 23	14:28	0.94	14.54	21.83	14.33	48.53
15 Jun 23	14:29	0.99	14.67	21.73	14.32	48.50
15 Jun 23	14:30	1.01	14.66	21.58	14.32	48.53
15 Jun 23	14:31	0.98	14.87	21.56	14.31	48.55
15 Jun 23	14:32	0.89	15.11	21.56	14.31	48.50
15 Jun 23	14:33	0.82	15.23	21.41	14.32	48.52
15 Jun 23	14:34	0.79	15.51	21.41	14.32	48.53
15 Jun 23	14:35	0.75	15.74	21.38	14.32	48.53
15 Jun 23	14:36	0.73	15.94	21.39	14.32	48.54
15 Jun 23	14:37	0.78	15.77	21.41	14.32	48.57
15 Jun 23	14:38	0.86	15.49	21.55	14.32	48.50
15 Jun 23	14:39	0.92	15.30	21.68	14.32	48.46
Max		1.01	15.94	21.86	14.33	48.58
Avg		0.86	15.13	21.59	14.32	48.53

Run No: 11 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	Load MW
15 Jun 23	14:40	0.94	15.22	21.50	14.31	48.46
15 Jun 23	14:41	0.96	15.16	21.42	14.31	48.46
15 Jun 23	14:42	0.98	15.26	21.37	14.31	48.48
15 Jun 23	14:43	0.97	15.31	21.37	14.31	48.50
15 Jun 23	14:44	0.91	15.47	21.52	14.32	48.47
15 Jun 23	14:45	0.85	15.63	21.60	14.32	48.46
15 Jun 23	14:46	0.79	15.79	21.45	14.32	48.48
15 Jun 23	14:47	0.77	15.87	21.64	14.32	48.46
15 Jun 23	14:48	0.74	15.71	21.68	14.32	48.49
15 Jun 23	14:49	0.77	15.60	21.70	14.33	48.46
15 Jun 23	14:50	0.86	15.44	21.71	14.33	48.40
15 Jun 23	14:51	0.92	15.23	21.71	14.32	48.40
15 Jun 23	14:52	0.93	15.24	21.71	14.32	48.37
15 Jun 23	14:53	0.97	15.24	21.71	14.31	48.26
15 Jun 23	14:54	0.99	15.01	21.74	14.31	48.30
15 Jun 23	14:55	0.95	15.12	21.57	14.30	48.34
15 Jun 23	14:56	0.88	15.52	21.68	14.31	48.27
15 Jun 23	14:57	0.83	15.59	21.72	14.31	48.15
15 Jun 23	14:58	0.78	15.67	21.61	14.31	48.12
15 Jun 23	14:59	0.77	15.59	21.63	14.31	48.25
15 Jun 23	15:00	0.73	15.85	21.63	14.31	48.34
Max		0.99	15.87	21.74	14.33	48.50
Avg		0.87	15.45	21.60	14.31	48.38

Run No: 12 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	Load MW
15 Jun 23	15:01	0.79	15.88	21.71	14.31	48.34
15 Jun 23	15:02	0.88	15.55	21.82	14.31	48.33
15 Jun 23	15:03	0.92	15.25	21.81	14.31	48.35
15 Jun 23	15:04	0.95	15.17	21.71	14.31	48.31
15 Jun 23	15:05	0.99	15.11	21.69	14.30	48.27
15 Jun 23	15:06	0.98	15.12	21.64	14.31	48.36
15 Jun 23	15:07	0.91	15.43	21.69	14.31	48.29
15 Jun 23	15:08	0.84	15.86	21.89	14.31	48.04
15 Jun 23	15:09	0.81	15.79	21.83	14.32	48.02
15 Jun 23	15:10	0.78	15.83	21.94	14.32	47.99
15 Jun 23	15:11	0.76	15.80	21.94	14.32	47.95
15 Jun 23	15:12	0.77	15.68	21.82	14.32	47.85
15 Jun 23	15:13	0.85	15.54	21.61	14.32	47.85
15 Jun 23	15:14	0.92	15.50	21.65	14.32	47.77
15 Jun 23	15:15	0.95	15.57	21.45	14.32	47.82
15 Jun 23	15:16	0.97	15.59	21.53	14.31	47.99
15 Jun 23	15:17	0.98	15.60	21.41	14.31	48.14
15 Jun 23	15:18	0.91	15.77	21.47	14.31	48.29
15 Jun 23	15:19	0.84	16.16	21.43	14.31	48.38
15 Jun 23	15:20	0.81	16.13	21.59	14.31	48.37
15 Jun 23	15:21	0.77	16.02	21.62	14.31	48.30
Max		0.99	16.16	21.94	14.32	48.38
Avg		0.88	15.64	21.68	14.31	48.14

Reference Method Data

Client Name	Gulf NC Co., Ltd.	Date	15 Jun 23
Plant Name	GNC	Location	ปล่อง HRSG 11

Run No: 1 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	CO_2 Vol%
15 Jun 23	11:10	0.89	15.36	24.02	14.41	3.69
15 Jun 23	11:11	0.87	15.43	24.02	14.40	3.66
15 Jun 23	11:12	0.86	15.45	23.94	14.41	3.68
15 Jun 23	11:13	0.83	15.46	23.86	14.41	3.65
15 Jun 23	11:14	0.86	15.38	23.75	14.41	3.67
15 Jun 23	11:15	0.85	15.27	23.55	14.42	3.70
15 Jun 23	11:16	0.85	15.17	23.52	14.41	3.67
15 Jun 23	11:17	0.85	15.16	23.36	14.41	3.66
15 Jun 23	11:18	0.84	15.19	23.19	14.41	3.69
15 Jun 23	11:19	0.84	15.28	23.31	14.41	3.64
15 Jun 23	11:20	0.83	15.29	23.42	14.41	3.65
15 Jun 23	11:21	0.83	15.31	23.45	14.41	3.69
15 Jun 23	11:22	0.82	15.23	23.47	14.41	3.68
15 Jun 23	11:23	0.82	15.22	23.47	14.41	3.68
15 Jun 23	11:24	0.82	15.17	23.42	14.40	3.68
15 Jun 23	11:25	0.83	15.11	23.33	14.41	3.67
15 Jun 23	11:26	0.83	15.06	23.15	14.41	3.66
15 Jun 23	11:27	0.82	14.99	23.05	14.41	3.66
15 Jun 23	11:28	0.83	14.98	23.09	14.40	3.69
15 Jun 23	11:29	0.83	15.01	23.08	14.41	3.72
15 Jun 23	11:30	0.83	14.92	23.23	14.41	3.66
Max		0.89	15.46	24.02	14.42	3.72
Avg		0.84	15.22	23.46	14.41	3.68

Run No: 2 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	CO_2 Vol%
15 Jun 23	11:31	0.82	14.80	23.15	14.42	3.68
15 Jun 23	11:32	0.82	14.72	22.99	14.42	3.66
15 Jun 23	11:33	0.82	14.71	23.01	14.42	3.63
15 Jun 23	11:34	0.81	14.81	22.89	14.42	3.68
15 Jun 23	11:35	0.81	14.90	22.86	14.42	3.64
15 Jun 23	11:36	0.80	14.97	22.85	14.43	3.69
15 Jun 23	11:37	0.80	15.03	22.73	14.42	3.65
15 Jun 23	11:38	0.80	15.09	22.78	14.43	3.68
15 Jun 23	11:39	0.80	15.10	22.74	14.43	3.65
15 Jun 23	11:40	0.79	15.18	22.72	14.43	3.63
15 Jun 23	11:41	0.79	15.23	22.72	14.43	3.64
15 Jun 23	11:42	0.79	15.27	22.72	14.42	3.68
15 Jun 23	11:43	0.79	15.27	22.79	14.42	3.65
15 Jun 23	11:44	0.79	15.30	22.75	14.43	3.68
15 Jun 23	11:45	0.79	15.29	22.73	14.42	3.65
15 Jun 23	11:46	0.80	15.33	22.68	14.42	3.69
15 Jun 23	11:47	0.80	15.54	22.72	14.42	3.65
15 Jun 23	11:48	0.80	15.71	22.83	14.41	3.66
15 Jun 23	11:49	0.80	15.73	22.97	14.42	3.63
15 Jun 23	11:50	0.80	15.67	22.98	14.43	3.70
15 Jun 23	11:51	0.81	15.69	22.97	14.43	3.65
Max		0.82	15.73	23.15	14.43	3.70
Avg		0.80	15.21	22.84	14.42	3.66

Run No: 3 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	CO_2 Vol%
15 Jun 23	11:52	0.81	15.68	22.85	14.43	3.66
15 Jun 23	11:53	0.81	15.67	22.95	14.43	3.67
15 Jun 23	11:54	0.82	15.58	22.83	14.43	3.66
15 Jun 23	11:55	0.83	15.47	22.64	14.45	3.66
15 Jun 23	11:56	0.83	15.34	22.66	14.45	3.63
15 Jun 23	11:57	0.82	15.31	22.68	14.45	3.65
15 Jun 23	11:58	0.83	15.35	22.60	14.45	3.68
15 Jun 23	11:59	0.84	15.31	22.57	14.44	3.62
15 Jun 23	12:00	0.84	15.36	22.51	14.45	3.63
15 Jun 23	12:01	0.84	15.43	22.56	14.45	3.64
15 Jun 23	12:02	0.83	15.44	22.59	14.45	3.65
15 Jun 23	12:03	0.83	15.31	22.55	14.45	3.64
15 Jun 23	12:04	0.83	15.17	22.44	14.45	3.65
15 Jun 23	12:05	0.82	15.01	22.40	14.46	3.62
15 Jun 23	12:06	0.82	14.92	22.23	14.46	3.63
15 Jun 23	12:07	0.82	14.84	22.20	14.45	3.65
15 Jun 23	12:08	0.82	14.63	22.31	14.46	3.64
15 Jun 23	12:09	0.81	13.64	22.00	14.49	3.63
15 Jun 23	12:10	0.81	12.08	21.67	14.51	3.62
15 Jun 23	12:11	0.80	11.22	21.16	14.51	3.61
15 Jun 23	12:12	0.80	11.63	20.96	14.51	3.63
Max		0.84	15.68	22.95	14.51	3.68
Avg		0.82	14.69	22.35	14.46	3.64

Run No: 4 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	CO_2 Vol%
15 Jun 23	12:13	0.80	13.27	20.56	14.50	3.59
15 Jun 23	12:14	0.80	14.71	20.41	14.48	3.61
15 Jun 23	12:15	0.80	15.75	20.38	14.48	3.63
15 Jun 23	12:16	0.79	16.18	20.52	14.49	3.60
15 Jun 23	12:17	0.79	15.93	20.61	14.50	3.60
15 Jun 23	12:18	0.79	15.15	20.55	14.51	3.61
15 Jun 23	12:19	0.79	14.22	20.57	14.53	3.61
15 Jun 23	12:20	0.78	13.54	20.39	14.53	3.64
15 Jun 23	12:21	0.78	13.46	20.15	14.53	3.62
15 Jun 23	12:22	0.78	13.74	19.92	14.52	3.60
15 Jun 23	12:23	0.78	14.10	19.90	14.52	3.59
15 Jun 23	12:24	0.78	14.27	20.01	14.53	3.61
15 Jun 23	12:25	0.77	14.19	20.23	14.52	3.59
15 Jun 23	12:26	0.77	13.91	20.15	14.53	3.63
15 Jun 23	12:27	0.78	13.67	20.05	14.52	3.60
15 Jun 23	12:28	0.79	13.55	20.08	14.52	3.58
15 Jun 23	12:29	0.79	13.68	20.23	14.51	3.57
15 Jun 23	12:30	0.79	13.90	20.28	14.52	3.59
15 Jun 23	12:31	0.80	14.11	20.27	14.52	3.57
15 Jun 23	12:32	0.80	14.26	20.21	14.51	3.60
15 Jun 23	12:33	0.80	14.42	20.17	14.52	3.61
Max		0.80	16.18	20.61	14.53	3.64
Avg		0.79	14.29	20.27	14.51	3.60

Run No: 5 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	CO_2 Vol%
15 Jun 23	12:34	0.80	14.70	20.14	14.52	3.64
15 Jun 23	12:35	0.80	15.12	19.92	14.49	3.59
15 Jun 23	12:36	0.80	16.11	19.78	14.47	3.63
15 Jun 23	12:37	0.81	17.48	20.09	14.46	3.66
15 Jun 23	12:38	0.81	17.86	20.36	14.46	3.64
15 Jun 23	12:39	0.81	18.00	20.64	14.46	3.64
15 Jun 23	12:40	0.81	17.97	20.76	14.47	3.64
15 Jun 23	12:41	0.81	17.93	20.49	14.46	3.60
15 Jun 23	12:42	0.81	17.87	20.36	14.47	3.61
15 Jun 23	12:43	0.81	17.71	20.22	14.47	3.63
15 Jun 23	12:44	0.81	17.53	20.22	14.46	3.60
15 Jun 23	12:45	0.82	17.40	20.17	14.47	3.62
15 Jun 23	12:46	0.82	17.56	20.20	14.46	3.65
15 Jun 23	12:47	0.82	17.70	20.22	14.46	3.69
15 Jun 23	12:48	0.82	17.85	20.36	14.45	3.60
15 Jun 23	12:49	0.82	17.82	20.25	14.46	3.67
15 Jun 23	12:50	0.82	17.76	20.29	14.46	3.67
15 Jun 23	12:51	0.83	17.63	20.19	14.45	3.65
15 Jun 23	12:52	0.83	17.55	20.11	14.46	3.62
15 Jun 23	12:53	0.83	17.47	19.99	14.45	3.65
15 Jun 23	12:54	0.83	17.52	19.94	14.45	3.63
Max		0.83	18.00	20.76	14.52	3.69
Avg		0.82	17.36	20.22	14.46	3.64

Run No: 6 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	CO_2 Vol%
15 Jun 23	12:55	0.82	17.65	19.99	14.45	3.63
15 Jun 23	12:56	0.82	17.71	20.02	14.45	3.64
15 Jun 23	12:57	0.82	17.69	20.06	14.46	3.63
15 Jun 23	12:58	0.81	17.71	20.01	14.45	3.65
15 Jun 23	12:59	0.81	17.75	19.99	14.45	3.65
15 Jun 23	13:00	0.81	17.80	19.96	14.45	3.63
15 Jun 23	13:01	0.80	17.78	19.93	14.46	3.67
15 Jun 23	13:02	0.80	17.82	19.86	14.45	3.62
15 Jun 23	13:03	0.80	17.96	19.79	14.45	3.67
15 Jun 23	13:04	0.80	18.03	19.83	14.45	3.60
15 Jun 23	13:05	0.81	18.12	19.90	14.45	3.63
15 Jun 23	13:06	0.81	18.12	19.89	14.45	3.65
15 Jun 23	13:07	0.81	18.03	20.01	14.45	3.65
15 Jun 23	13:08	0.81	17.84	19.92	14.45	3.65
15 Jun 23	13:09	0.81	17.72	19.83	14.45	3.62
15 Jun 23	13:10	0.81	17.70	19.78	14.45	3.67
15 Jun 23	13:11	0.81	17.71	19.73	14.45	3.64
15 Jun 23	13:12	0.81	17.80	19.73	14.45	3.63
15 Jun 23	13:13	0.81	17.89	19.78	14.45	3.62
15 Jun 23	13:14	0.80	17.99	19.85	14.45	3.63
15 Jun 23	13:15	0.80	18.02	19.91	14.45	3.64
Max		0.82	18.12	20.06	14.46	3.67
Avg		0.81	17.85	19.89	14.45	3.64

Reference Method Data

Client Name	Gulf NC Co., Ltd.	Date	15 Jun 23
Plant Name	GNC	Location	ปล่อง HRSG 11

Run No: 7 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	CO_2 Vol%
15 Jun 23	13:16	0.81	18.01	19.83	14.44	3.63
15 Jun 23	13:17	0.80	18.04	19.72	14.44	3.67
15 Jun 23	13:18	0.80	18.03	19.78	14.45	3.60
15 Jun 23	13:19	0.80	17.90	19.74	14.44	3.65
15 Jun 23	13:20	0.80	17.67	19.94	14.42	3.66
15 Jun 23	13:21	0.80	17.27	20.17	14.42	3.61
15 Jun 23	13:22	0.80	16.89	20.68	14.42	3.63
15 Jun 23	13:23	0.80	16.53	20.98	14.42	3.63
15 Jun 23	13:24	0.81	16.31	21.13	14.42	3.67
15 Jun 23	13:25	0.81	16.19	21.15	14.41	3.68
15 Jun 23	13:26	0.81	16.09	21.20	14.41	3.66
15 Jun 23	13:27	0.81	16.04	21.22	14.42	3.64
15 Jun 23	13:28	0.81	15.97	21.34	14.42	3.68
15 Jun 23	13:29	0.81	15.90	21.39	14.41	3.69
15 Jun 23	13:30	0.81	15.89	21.35	14.41	3.67
15 Jun 23	13:31	0.81	15.83	21.43	14.41	3.66
15 Jun 23	13:32	0.80	15.81	21.46	14.41	3.69
15 Jun 23	13:33	0.80	15.83	21.44	14.41	3.63
15 Jun 23	13:34	0.79	15.87	21.47	14.41	3.64
15 Jun 23	13:35	0.79	15.83	21.36	14.41	3.66
15 Jun 23	13:36	0.79	15.82	21.23	14.40	3.71
Max		0.81	18.04	21.47	14.45	3.71
Avg		0.80	16.55	20.86	14.42	3.66

Run No: 8 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	CO_2 Vol%
15 Jun 23	13:37	0.79	15.85	21.28	14.40	3.67
15 Jun 23	13:38	0.80	15.94	21.32	14.40	3.66
15 Jun 23	13:39	0.80	15.95	21.45	14.41	3.66
15 Jun 23	13:40	0.80	15.99	21.41	14.40	3.70
15 Jun 23	13:41	0.81	16.02	21.35	14.40	3.66
15 Jun 23	13:42	0.81	16.05	21.51	14.40	3.69
15 Jun 23	13:43	0.81	16.02	21.51	14.40	3.63
15 Jun 23	13:44	0.81	16.04	21.60	14.41	3.69
15 Jun 23	13:45	0.82	16.08	21.51	14.41	3.67
15 Jun 23	13:46	0.82	16.20	21.52	14.41	3.64
15 Jun 23	13:47	0.81	16.32	21.35	14.41	3.67
15 Jun 23	13:48	0.80	16.38	21.25	14.41	3.68
15 Jun 23	13:49	0.80	16.40	21.20	14.41	3.64
15 Jun 23	13:50	0.79	16.36	21.23	14.41	3.68
15 Jun 23	13:51	0.80	16.28	21.28	14.40	3.67
15 Jun 23	13:52	0.79	16.18	21.31	14.40	3.65
15 Jun 23	13:53	0.80	16.09	21.44	14.41	3.62
15 Jun 23	13:54	0.80	15.89	21.31	14.41	3.67
15 Jun 23	13:55	0.81	15.55	21.36	14.41	3.64
15 Jun 23	13:56	0.81	15.39	21.30	14.42	3.64
15 Jun 23	13:57	0.81	14.99	21.30	14.42	3.67
Max		0.82	16.40	21.60	14.42	3.70
Avg		0.80	16.00	21.37	14.41	3.66

Run No: 9 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	CO_2 Vol%
15 Jun 23	13:58	0.80	14.63	21.17	14.43	3.66
15 Jun 23	13:59	0.80	14.43	20.92	14.42	3.65
15 Jun 23	14:00	0.80	14.43	20.89	14.43	3.63
15 Jun 23	14:01	0.82	14.53	21.09	14.43	3.68
15 Jun 23	14:02	0.81	14.83	21.11	14.42	3.68
15 Jun 23	14:03	0.82	15.27	21.27	14.42	3.70
15 Jun 23	14:04	0.82	15.73	21.24	14.41	3.61
15 Jun 23	14:05	0.82	15.84	21.20	14.41	3.68
15 Jun 23	14:06	0.81	15.91	21.20	14.41	3.65
15 Jun 23	14:07	0.80	15.98	21.31	14.41	3.70
15 Jun 23	14:08	0.80	15.97	21.22	14.41	3.67
15 Jun 23	14:09	0.82	16.01	21.23	14.41	3.66
15 Jun 23	14:10	0.81	16.06	21.11	14.41	3.69
15 Jun 23	14:11	0.80	16.07	21.07	14.41	3.65
15 Jun 23	14:12	0.81	16.14	20.97	14.41	3.65
15 Jun 23	14:13	0.82	16.12	21.08	14.41	3.60
15 Jun 23	14:14	0.83	16.08	21.20	14.41	3.66
15 Jun 23	14:15	0.84	16.03	21.32	14.41	3.65
15 Jun 23	14:16	0.84	15.95	21.35	14.41	3.65
15 Jun 23	14:17	0.85	15.81	21.27	14.41	3.63
15 Jun 23	14:18	0.85	15.59	21.24	14.41	3.65
Max		0.85	16.14	21.35	14.43	3.70
Avg		0.82	15.59	21.17	14.41	3.66

Run No: 10 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	CO_2 Vol%
15 Jun 23	14:19	0.85	15.48	21.16	14.42	3.67
15 Jun 23	14:20	0.86	15.42	21.19	14.42	3.67
15 Jun 23	14:21	0.86	15.35	21.15	14.42	3.64
15 Jun 23	14:22	0.85	15.33	21.10	14.41	3.65
15 Jun 23	14:23	0.85	15.36	21.00	14.41	3.64
15 Jun 23	14:24	0.84	15.43	20.94	14.42	3.61
15 Jun 23	14:25	0.85	15.52	20.91	14.41	3.68
15 Jun 23	14:26	0.83	15.67	20.94	14.41	3.66
15 Jun 23	14:27	0.82	15.87	21.08	14.41	3.65
15 Jun 23	14:28	0.81	15.87	21.14	14.40	3.64
15 Jun 23	14:29	0.81	15.71	21.12	14.41	3.66
15 Jun 23	14:30	0.82	15.62	21.14	14.41	3.65
15 Jun 23	14:31	0.82	15.58	21.04	14.41	3.62
15 Jun 23	14:32	0.83	15.61	21.10	14.41	3.62
15 Jun 23	14:33	0.81	15.59	21.00	14.41	3.65
15 Jun 23	14:34	0.81	15.65	21.00	14.41	3.67
15 Jun 23	14:35	0.82	15.79	20.98	14.40	3.65
15 Jun 23	14:36	0.82	15.84	20.83	14.41	3.60
15 Jun 23	14:37	0.82	15.87	20.81	14.41	3.62
15 Jun 23	14:38	0.82	15.95	20.80	14.40	3.64
15 Jun 23	14:39	0.82	16.12	20.75	14.40	3.64
Max		0.86	16.12	21.19	14.42	3.68
Avg		0.83	15.65	21.01	14.41	3.65

Run No: 11 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	CO_2 Vol%
15 Jun 23	14:40	0.81	16.18	20.83	14.41	3.62
15 Jun 23	14:41	0.80	16.25	20.94	14.41	3.67
15 Jun 23	14:42	0.80	16.25	21.10	14.40	3.65
15 Jun 23	14:43	0.81	16.23	21.04	14.40	3.63
15 Jun 23	14:44	0.81	16.23	20.80	14.40	3.66
15 Jun 23	14:45	0.81	16.29	20.79	14.40	3.65
15 Jun 23	14:46	0.81	16.29	20.70	14.41	3.64
15 Jun 23	14:47	0.81	16.23	20.73	14.41	3.67
15 Jun 23	14:48	0.81	16.21	20.75	14.40	3.63
15 Jun 23	14:49	0.81	16.18	20.76	14.40	3.60
15 Jun 23	14:50	0.81	16.21	20.87	14.41	3.67
15 Jun 23	14:51	0.82	16.20	20.91	14.40	3.62
15 Jun 23	14:52	0.82	16.16	20.95	14.41	3.62
15 Jun 23	14:53	0.82	16.19	21.02	14.41	3.65
15 Jun 23	14:54	0.82	16.25	21.06	14.41	3.65
15 Jun 23	14:55	0.82	16.26	20.91	14.41	3.65
15 Jun 23	14:56	0.82	16.25	20.93	14.40	3.67
15 Jun 23	14:57	0.83	16.21	20.87	14.40	3.64
15 Jun 23	14:58	0.83	16.14	20.87	14.40	3.65
15 Jun 23	14:59	0.83	16.08	20.93	14.40	3.65
15 Jun 23	15:00	0.83	16.10	21.00	14.39	3.65
Max		0.83	16.29	21.10	14.41	3.67
Avg		0.82	16.20	20.89	14.40	3.65

Run No: 12 — Time Base : 21 min

Date	Time	SO_2 ppm	NO_x ppm	CO ppm	O_2 Vol%	CO_2 Vol%
15 Jun 23	15:01	0.82	16.09	20.95	14.40	3.65
15 Jun 23	15:02	0.82	16.08	20.92	14.39	3.63
15 Jun 23	15:03	0.82	16.16	20.97	14.39	3.62
15 Jun 23	15:04	0.81	16.28	21.00	14.39	3.66
15 Jun 23	15:05	0.81	16.31	21.15	14.38	3.63
15 Jun 23	15:06	0.81	16.26	21.08	14.40	3.65
15 Jun 23	15:07	0.80	16.20	20.99	14.39	3.65
15 Jun 23	15:08	0.80	16.20	20.97	14.39	3.65
15 Jun 23	15:09	0.80	16.14	20.96	14.39	3.67
15 Jun 23	15:10	0.80	16.14	20.96	14.39	3.66
15 Jun 23	15:11	0.81	16.23	21.05	14.40	3.64
15 Jun 23	15:12	0.81	16.23	21.01	14.40	3.68
15 Jun 23	15:13	0.81	16.19	21.15	14.40	3.67
15 Jun 23	15:14	0.81	16.25	21.13	14.41	3.67
15 Jun 23	15:15	0.81	16.19	21.07	14.40	3.61
15 Jun 23	15:16	0.82	16.17	21.02	14.41	3.67
15 Jun 23	15:17	0.82	16.23	20.86	14.41	3.62
15 Jun 23	15:18	0.81	16.32	20.65	14.42	3.63
15 Jun 23	15:19	0.81	16.33	20.70	14.42	3.61
15 Jun 23	15:20	0.80	16.35	20.60	14.42	3.63
15 Jun 23	15:21	0.80	16.31	20.50	14.43	3.60
Max		0.82	16.35	21.15	14.43	3.68
Avg		0.81	16.22	20.94	14.40	3.64

Lot No. 2355705-1

ANALYZER CALIBRATION DATA

Client :	Gulf NC Co., Ltd.	**Location** :	ปล่อง HRSG 12
Date :	16 Jun 23	**Test Operator** :	Sathapron.T

O_2 ANALYZER
Model : TELEDYNE API 200EH — **Serial No.** : 735
Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.01	0.02	0.04
Low-Level Gas	8.04	8.05	8.07	0.08
Span Gas	16.00	16.01	16.03	0.08

NO_x ANALYZER
Model : TELEDYNE API 200EH — **Serial No.** : 735
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.02	0.03	0.01
Low-Level Gas	54.96	54.95	54.94	0.01
Span Gas	82.51	82.50	82.49	0.01

SO_2 ANALYZER
Model : TELEDYNE API 100EH — **Serial No.** : 410
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.01	0.01
Low-Level Gas	55.55	55.54	55.54	0.00
Span Gas	79.76	79.75	79.74	0.01

CO ANALYZER
Model : TELEDYNE API 300EM — **Serial No.** : 425
Span (ppm) : 100

	Cylinder Value (ppm)	Initial Analyzers Calibration Response (ppm)	Final Analyzers Calibration Response (ppm)	Difference (Percent of Span)
Zero Gas	0.00	0.02	0.03	0.01
Low-Level Gas	54.84	54.81	54.80	0.01
Span Gas	79.74	79.72	79.71	0.01

Calibrated by

Sathapron Th.

(Mr.Sathapron Thakarw)

Environmental Field Scientist (3)

Lot No. 2355705-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client	: Gulf NC Co., Ltd.	Location	: ปล่อง HRSG 12
Date	: 16 Jun 23	Test Operator	: Sathapron.T

O_2 ANALYZER
Cylinder Conc. (%) : 16.00 Span (%) : 25

	O_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.01	0.02	0.04	0.02	0.04	0.00
Upscale Gas	16.01	16.03	0.08	16.04	0.12	0.04

NO_X ANALYZER
Cylinder Conc. (ppm) : 82.51 Span (ppm) : 100

	NO_X Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.02	0.04	0.02	0.04	0.02	0.00
Upscale Gas	82.50	82.48	0.02	82.48	0.02	0.00

SO_2 ANALYZER
Cylinder Conc. (ppm) : 79.76 Span (ppm) : 100

	SO_2 Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.00	0.01	0.01	0.01	0.01	0.00
Upscale Gas	79.75	79.73	0.02	79.72	0.03	0.01

CO ANALYZER
Cylinder Conc. (ppm) : 79.74 Span (ppm) : 100

	CO Analyzer Calibration Response	Initial Values		Final Values		Drift (% of Span)
		System Calibration Response	System Cal Bias (% of Span)	System Calibration Response	System Cal Bias (% of Span)	
Zero Gas	0.02	0.04	0.02	0.04	0.02	0.00
Upscale Gas	79.72	79.70	0.02	79.70	0.02	0.00

Calibrated by

Sathapron Th.

(Mr.Sathapron Thakarw)

Environmental Field Scientist (3)

FORM NO.: F 06-104 REVISION NO.: - ISSUE DATE: 3/06/19

ALS Laboratory Group

CEMs Data

Client Name Gulf NC Co., Ltd. Date 16 Jun 23
Plant Name GNC Location ปล่อง HRSG 12

Run No: 1 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
16 Jun 23	10:40	0.51	13.60	39.23	14.64	44.45
16 Jun 23	10:41	0.51	14.29	39.77	14.63	43.72
16 Jun 23	10:42	0.53	14.26	39.39	14.63	43.37
16 Jun 23	10:43	0.50	14.04	39.20	14.64	43.28
16 Jun 23	10:44	0.50	13.95	39.16	14.64	42.13
16 Jun 23	10:45	0.51	13.25	38.70	14.66	41.60
16 Jun 23	10:46	0.56	15.30	38.25	14.68	40.37
16 Jun 23	10:47	<Samp	<Samp	<Samp	<Samp	40.68
16 Jun 23	10:48	InVld	InVld	InVld	InVld	41.52
16 Jun 23	10:49	InVld	InVld	InVld	InVld	41.11
16 Jun 23	10:50	InVld	InVld	InVld	InVld	41.38
16 Jun 23	10:51	InVld	InVld	InVld	InVld	42.44
16 Jun 23	10:52	InVld	InVld	InVld	InVld	42.45
16 Jun 23	10:53	InVld	InVld	InVld	InVld	41.94
16 Jun 23	10:54	InVld	InVld	InVld	InVld	42.51
16 Jun 23	10:55	InVld	InVld	InVld	InVld	42.66
16 Jun 23	10:56	InVld	InVld	InVld	InVld	42.17
16 Jun 23	10:57	InVld	InVld	InVld	InVld	41.22
16 Jun 23	10:58	InVld	InVld	InVld	InVld	40.31
16 Jun 23	10:59	InVld	InVld	InVld	InVld	40.47
16 Jun 23	11:00	InVld	InVld	InVld	InVld	40.60
Max		0.56	15.30	39.77	14.68	44.45
Avg		0.52	14.10	39.10	14.65	41.92

Run No: 2 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
16 Jun 23	11:01	InVld	InVld	InVld	InVld	41.47
16 Jun 23	11:02	InVld	InVld	InVld	InVld	42.21
16 Jun 23	11:03	InVld	InVld	InVld	InVld	40.95
16 Jun 23	11:04	InVld	InVld	InVld	InVld	40.29
16 Jun 23	11:05	InVld	InVld	InVld	InVld	40.43
16 Jun 23	11:06	InVld	InVld	InVld	InVld	40.94
16 Jun 23	11:07	InVld	InVld	InVld	InVld	41.50
16 Jun 23	11:08	InVld	InVld	InVld	InVld	41.12
16 Jun 23	11:09	InVld	InVld	InVld	InVld	41.40
16 Jun 23	11:10	InVld	InVld	InVld	InVld	41.68
16 Jun 23	11:11	InVld	InVld	InVld	InVld	42.51
16 Jun 23	11:12	InVld	InVld	InVld	InVld	43.40
16 Jun 23	11:13	<Samp	<Samp	<Samp	<Samp	42.75
16 Jun 23	11:14	InVld	InVld	InVld	InVld	42.66
16 Jun 23	11:15	InVld	InVld	InVld	InVld	42.75
16 Jun 23	11:16	InVld	InVld	InVld	InVld	41.83
16 Jun 23	11:17	InVld	InVld	InVld	InVld	41.89
16 Jun 23	11:18	InVld	InVld	InVld	InVld	41.76
16 Jun 23	11:19	<Samp	<Samp	<Samp	<Samp	40.57
16 Jun 23	11:20	<Samp	<Samp	<Samp	<Samp	40.15
16 Jun 23	11:21	<Samp	<Samp	<Samp	<Samp	40.04
Max		-	-	-	-	43.40
Avg		-	-	-	-	41.54

Run No: 3 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
16 Jun 23	11:22	InVld	InVld	InVld	InVld	40.12
16 Jun 23	11:23	InVld	InVld	InVld	InVld	40.45
16 Jun 23	11:24	InVld	InVld	InVld	InVld	40.60
16 Jun 23	11:25	InVld	InVld	InVld	InVld	41.21
16 Jun 23	11:26	<Samp	<Samp	<Samp	<Samp	40.92
16 Jun 23	11:27	InVld	InVld	InVld	InVld	40.73
16 Jun 23	11:28	<Samp	<Samp	<Samp	<Samp	40.79
16 Jun 23	11:29	0.52	15.61	37.16	14.65	40.69
16 Jun 23	11:30	0.52	15.20	37.50	14.67	40.32
16 Jun 23	11:31	0.50	14.78	37.47	14.69	40.19
16 Jun 23	11:32	0.49	14.40	37.83	14.70	39.71
16 Jun 23	11:33	0.46	13.27	38.42	14.72	40.03
16 Jun 23	11:34	0.41	13.95	37.72	14.69	40.40
16 Jun 23	11:35	0.42	15.11	37.07	14.66	41.46
16 Jun 23	11:36	0.44	15.77	37.27	14.64	42.14
16 Jun 23	11:37	0.47	15.38	37.77	14.63	41.83
16 Jun 23	11:38	0.47	14.79	37.69	14.64	41.89
16 Jun 23	11:39	0.52	15.11	37.63	14.65	41.73
16 Jun 23	11:40	0.50	15.40	37.39	14.64	41.65
16 Jun 23	11:41	0.48	15.84	37.33	14.65	41.34
16 Jun 23	11:42	0.46	15.48	37.26	14.65	41.67
Max		0.52	15.84	38.42	14.72	42.14
Avg		0.48	15.01	37.54	14.66	40.95

Run No: 4 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
16 Jun 23	11:43	0.46	15.77	37.33	14.65	41.90
16 Jun 23	11:44	0.45	15.28	37.43	14.64	41.80
16 Jun 23	11:45	0.43	14.27	37.75	14.65	41.52
16 Jun 23	11:46	0.44	15.36	37.23	14.64	41.65
16 Jun 23	11:47	0.43	15.96	37.26	14.64	41.78
16 Jun 23	11:48	0.48	15.78	37.27	14.64	41.71
16 Jun 23	11:49	<Samp	<Samp	<Samp	<Samp	41.07
16 Jun 23	11:50	0.49	15.23	37.38	14.67	40.32
16 Jun 23	11:51	0.51	15.13	37.20	14.67	40.34
16 Jun 23	11:52	0.46	15.25	37.14	14.66	41.25
16 Jun 23	11:53	0.48	15.68	37.04	14.64	41.70
16 Jun 23	11:54	0.46	15.95	37.12	14.64	41.69
16 Jun 23	11:55	0.43	15.93	37.24	14.64	41.25
16 Jun 23	11:56	0.42	15.51	37.18	14.66	40.86
16 Jun 23	11:57	0.46	15.56	37.29	14.66	40.51
16 Jun 23	11:58	0.47	15.38	36.87	14.66	40.34
16 Jun 23	11:59	0.48	15.38	37.28	14.69	39.74
16 Jun 23	12:00	0.50	14.06	37.55	14.70	39.12
16 Jun 23	12:01	0.53	15.99	39.71	14.79	37.76
16 Jun 23	12:02	0.50	13.69	40.97	14.85	37.37
16 Jun 23	12:03	0.48	12.80	41.32	14.87	37.46
Max		0.53	15.99	41.32	14.87	41.90
Avg		0.47	15.20	37.78	14.68	40.53

Run No: 5 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
16 Jun 23	12:04	0.48	13.04	40.70	14.86	37.97
16 Jun 23	12:05	0.45	14.12	39.62	14.81	39.32
16 Jun 23	12:06	0.45	17.19	38.68	14.74	39.45
16 Jun 23	12:07	0.44	18.03	38.76	14.73	39.44
16 Jun 23	12:08	0.46	17.70	38.56	14.74	39.44
16 Jun 23	12:09	0.50	17.68	38.59	14.74	39.42
16 Jun 23	12:10	0.50	17.54	38.56	14.74	39.43
16 Jun 23	12:11	0.50	17.31	38.58	14.74	39.38
16 Jun 23	12:12	0.50	17.32	38.56	14.74	39.41
16 Jun 23	12:13	0.47	17.63	38.51	14.74	39.38
16 Jun 23	12:14	0.48	17.72	38.49	14.74	39.39
16 Jun 23	12:15	0.47	17.71	38.56	14.74	39.40
16 Jun 23	12:16	0.46	17.73	38.45	14.73	39.40
16 Jun 23	12:17	0.50	17.85	38.46	14.74	38.52
16 Jun 23	12:18	0.47	16.03	39.78	14.82	37.42
16 Jun 23	12:19	0.51	13.41	40.01	14.83	37.97
16 Jun 23	12:20	0.55	14.24	39.79	14.82	37.46
16 Jun 23	12:21	0.50	13.48	40.50	14.84	37.94
16 Jun 23	12:22	0.49	14.20	39.62	14.81	38.55
16 Jun 23	12:23	0.49	15.42	39.05	14.78	38.84
16 Jun 23	12:24	0.44	16.04	38.63	14.76	39.33
Max		0.55	18.03	40.70	14.86	39.45
Avg		0.48	16.26	39.07	14.77	38.90

Run No: 6 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
16 Jun 23	12:25	0.45	17.53	38.43	14.74	39.38
16 Jun 23	12:26	0.46	18.24	38.46	14.73	39.28
16 Jun 23	12:27	0.49	17.74	38.86	14.73	38.50
16 Jun 23	12:28	0.52	15.34	39.60	14.78	37.90
16 Jun 23	12:29	0.52	13.94	39.89	14.81	37.97
16 Jun 23	12:30	0.53	14.21	40.06	14.82	37.31
16 Jun 23	12:31	0.52	13.04	41.13	14.86	36.16
16 Jun 23	12:32	0.51	11.35	44.09	14.92	35.49
16 Jun 23	12:33	0.53	10.05	45.36	14.94	35.82
16 Jun 23	12:34	0.49	10.38	45.42	14.93	36.76
16 Jun 23	12:35	0.49	11.92	42.86	14.88	38.04
16 Jun 23	12:36	0.47	14.33	40.65	14.84	37.84
16 Jun 23	12:37	0.49	14.09	41.41	14.86	37.79
16 Jun 23	12:38	0.55	13.66	41.94	14.86	37.63
16 Jun 23	12:39	0.52	13.20	42.07	14.86	38.03
16 Jun 23	12:40	0.53	13.78	41.26	14.85	38.62
16 Jun 23	12:41	0.50	14.74	40.13	14.83	38.69
16 Jun 23	12:42	0.48	15.08	40.17	14.83	38.94
16 Jun 23	12:43	0.46	15.24	39.32	14.81	40.27
16 Jun 23	12:44	0.41	18.35	38.08	14.75	40.51
16 Jun 23	12:45	0.42	19.16	38.02	14.74	40.57
Max		0.55	19.16	45.42	14.94	40.57
Avg		0.49	14.54	40.82	14.83	38.17

CEMs Data

Client Name Gulf NC Co., Ltd. Date 16 Jun 23
Plant Name GNC Location ปล่อง HRSG 12

Run No: 7 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
16 Jun 23	13:05	0.52	19.18	37.93	14.75	41.08
16 Jun 23	13:06	0.49	19.22	37.83	14.75	41.03
16 Jun 23	13:07	0.44	19.12	37.88	14.76	41.05
16 Jun 23	13:08	0.45	19.17	37.94	14.76	41.07
16 Jun 23	13:09	0.46	19.12	37.85	14.76	41.07
16 Jun 23	13:10	0.42	19.20	37.94	14.76	41.06
16 Jun 23	13:11	0.43	19.35	38.02	14.75	41.06
16 Jun 23	13:12	0.42	19.24	37.98	14.75	41.06
16 Jun 23	13:13	0.44	19.55	37.97	14.75	41.84
16 Jun 23	13:14	0.45	17.08	38.30	14.69	45.41
16 Jun 23	13:15	0.50	15.11	39.40	14.64	46.32
16 Jun 23	13:16	0.51	15.72	39.63	14.63	47.60
16 Jun 23	13:17	0.55	15.37	40.41	14.61	46.98
16 Jun 23	13:18	0.54	14.61	40.27	14.63	46.43
16 Jun 23	13:19	0.50	14.76	40.05	14.64	45.96
16 Jun 23	13:20	0.46	14.82	39.78	14.64	45.43
16 Jun 23	13:21	0.45	15.04	39.19	14.65	44.67
16 Jun 23	13:22	0.40	14.68	38.75	14.65	43.71
16 Jun 23	13:23	0.46	14.91	38.14	14.66	42.14
16 Jun 23	13:24	0.41	16.51	37.55	14.68	41.65
16 Jun 23	13:25	0.40	16.45	37.49	14.69	41.49
Max		0.55	19.55	40.41	14.76	47.60
Avg		0.46	17.06	38.59	14.70	43.24

Run No: 8 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
16 Jun 23	13:26	0.42	16.31	37.53	14.70	41.43
16 Jun 23	13:27	0.46	16.27	37.43	14.70	41.50
16 Jun 23	13:28	0.47	16.46	37.28	14.69	42.31
16 Jun 23	13:29	0.50	17.00	37.39	14.67	44.09
16 Jun 23	13:30	0.52	15.69	38.83	14.65	46.42
16 Jun 23	13:31	0.53	15.92	39.99	14.61	47.31
16 Jun 23	13:32	0.53	15.68	40.75	14.62	45.90
16 Jun 23	13:33	0.50	14.69	40.14	14.63	45.53
16 Jun 23	13:34	0.44	15.13	39.78	14.63	46.08
16 Jun 23	13:35	0.45	15.55	40.02	14.62	46.09
16 Jun 23	13:36	0.47	15.41	39.97	14.62	46.01
16 Jun 23	13:37	0.43	15.78	39.86	14.62	45.90
16 Jun 23	13:38	0.44	15.98	39.79	14.62	45.95
16 Jun 23	13:39	0.45	16.12	39.77	14.61	46.02
16 Jun 23	13:40	0.47	15.93	39.79	14.62	45.81
16 Jun 23	13:41	0.50	16.00	39.72	14.62	45.86
16 Jun 23	13:42	0.53	15.94	39.73	14.62	46.00
16 Jun 23	13:43	0.55	15.99	39.87	14.62	46.11
16 Jun 23	13:44	0.52	15.84	39.94	14.61	46.11
16 Jun 23	13:45	0.50	15.72	39.90	14.62	46.18
16 Jun 23	13:46	0.49	15.81	39.89	14.62	46.43
Max		0.55	17.00	40.75	14.70	47.31
Avg		0.48	15.87	39.40	14.63	45.38

Run No: 9 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
16 Jun 23	13:47	0.47	15.67	40.05	14.62	46.79
16 Jun 23	13:48	0.47	15.61	40.20	14.60	46.34
16 Jun 23	13:49	0.45	15.49	39.99	14.62	45.53
16 Jun 23	13:50	0.42	15.76	39.71	14.63	45.28
16 Jun 23	13:51	0.44	15.76	39.62	14.64	45.09
16 Jun 23	13:52	0.42	15.82	39.58	14.63	45.27
16 Jun 23	13:53	0.46	15.66	39.98	14.63	44.75
16 Jun 23	13:54	0.49	15.38	39.53	14.63	45.33
16 Jun 23	13:55	0.52	15.95	40.03	14.63	44.78
16 Jun 23	13:56	0.53	15.56	39.32	14.63	44.65
16 Jun 23	13:57	0.52	16.42	39.26	14.64	44.38
16 Jun 23	13:58	0.51	15.91	39.15	14.65	44.21
16 Jun 23	13:59	0.49	15.52	39.10	14.65	44.25
16 Jun 23	14:00	0.46	15.29	39.24	14.65	43.88
16 Jun 23	14:01	0.45	14.74	38.97	14.66	43.67
16 Jun 23	14:02	0.46	14.63	38.77	14.66	43.93
16 Jun 23	14:03	0.45	14.88	38.80	14.66	44.13
16 Jun 23	14:04	0.45	15.21	39.03	14.66	43.96
16 Jun 23	14:05	0.43	15.16	38.73	14.65	44.13
16 Jun 23	14:06	0.44	15.65	38.97	14.65	44.37
16 Jun 23	14:07	0.44	16.01	38.96	14.65	44.03
Max		0.53	16.42	40.20	14.66	46.79
Avg		0.47	15.53	39.38	14.64	44.70

Run No: 10 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
16 Jun 23	14:08	0.47	15.74	38.72	14.65	44.12
16 Jun 23	14:09	0.47	15.80	38.82	14.66	43.99
16 Jun 23	14:10	0.50	15.78	38.76	14.66	43.94
16 Jun 23	14:11	0.53	15.66	38.81	14.66	43.77
16 Jun 23	14:12	0.50	15.44	38.59	14.66	44.11
16 Jun 23	14:13	0.46	15.49	38.99	14.66	44.15
16 Jun 23	14:14	0.48	15.52	38.83	14.66	44.30
16 Jun 23	14:15	0.47	15.56	39.04	14.66	44.37
16 Jun 23	14:16	0.47	15.53	39.11	14.66	44.11
16 Jun 23	14:17	0.45	15.56	39.02	14.66	43.70
16 Jun 23	14:18	0.45	15.15	38.71	14.66	44.50
16 Jun 23	14:19	0.46	15.71	39.20	14.65	44.10
16 Jun 23	14:20	0.46	15.50	38.79	14.65	43.94
16 Jun 23	14:21	0.48	15.50	38.63	14.65	43.77
16 Jun 23	14:22	0.52	15.48	38.71	14.66	43.65
16 Jun 23	14:23	0.50	15.27	38.59	14.65	43.86
16 Jun 23	14:24	0.55	15.50	38.64	14.65	43.91
16 Jun 23	14:25	0.51	15.31	38.75	14.65	43.87
16 Jun 23	14:26	0.48	15.27	38.74	14.65	43.66
16 Jun 23	14:27	0.50	14.89	38.68	14.66	43.51
16 Jun 23	14:28	0.46	14.68	38.74	14.66	43.63
Max		0.55	15.80	39.20	14.66	44.50
Avg		0.48	15.44	38.80	14.66	43.95

Run No: 11 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
16 Jun 23	14:29	0.43	14.68	38.83	14.65	43.71
16 Jun 23	14:30	0.48	14.79	38.86	14.66	43.20
16 Jun 23	14:31	0.45	14.47	38.53	14.67	42.78
16 Jun 23	14:32	0.41	14.73	38.06	14.67	43.12
16 Jun 23	14:33	0.44	15.17	38.48	14.66	44.19
16 Jun 23	14:34	0.46	15.35	38.84	14.65	44.43
16 Jun 23	14:35	0.50	15.67	38.93	14.65	44.09
16 Jun 23	14:36	0.50	15.57	38.70	14.65	43.70
16 Jun 23	14:37	0.56	15.12	38.67	14.67	43.17
16 Jun 23	14:38	0.52	14.85	38.30	14.67	42.87
16 Jun 23	14:39	0.50	15.26	38.14	14.67	43.16
16 Jun 23	14:40	0.49	14.77	38.37	14.67	43.10
16 Jun 23	14:41	0.44	14.37	38.43	14.67	42.89
16 Jun 23	14:42	0.42	14.73	38.25	14.67	42.73
16 Jun 23	14:43	0.46	15.17	38.01	14.67	42.43
16 Jun 23	14:44	0.40	16.57	37.35	14.67	42.48
16 Jun 23	14:45	0.42	16.95	37.27	14.67	42.44
16 Jun 23	14:46	0.44	16.77	37.22	14.67	42.50
16 Jun 23	14:47	0.45	16.46	37.51	14.67	41.90
16 Jun 23	14:48	0.46	15.69	37.37	14.68	41.12
16 Jun 23	14:49	0.51	16.79	37.29	14.69	40.92
Max		0.56	16.95	38.93	14.69	44.43
Avg		0.46	15.43	38.16	14.67	42.90

Run No: 12 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	Load MW
16 Jun 23	14:50	0.50	16.81	37.17	14.69	41.04
16 Jun 23	14:51	0.52	16.70	37.01	14.68	42.34
16 Jun 23	14:52	0.52	16.37	37.55	14.67	41.41
16 Jun 23	14:53	0.53	15.13	37.36	14.69	41.58
16 Jun 23	14:54	0.46	16.76	37.27	14.67	42.82
16 Jun 23	14:55	0.47	15.33	38.12	14.67	41.83
16 Jun 23	14:56	0.46	14.75	37.33	14.68	41.15
16 Jun 23	14:57	0.43	16.32	37.34	14.69	40.74
16 Jun 23	14:58	0.43	16.24	37.13	14.69	41.46
16 Jun 23	14:59	0.42	16.58	37.26	14.66	42.97
16 Jun 23	15:00	0.45	15.03	38.00	14.64	42.59
16 Jun 23	15:01	0.49	14.48	37.96	14.66	41.15
16 Jun 23	15:02	0.48	15.65	37.26	14.68	40.70
16 Jun 23	15:03	0.50	16.62	37.21	14.68	40.94
16 Jun 23	15:04	0.53	16.92	37.08	14.66	41.68
16 Jun 23	15:05	0.51	16.84	37.14	14.65	41.99
16 Jun 23	15:06	0.50	15.71	37.43	14.66	41.13
16 Jun 23	15:07	0.46	16.05	37.09	14.67	40.33
16 Jun 23	15:08	0.43	15.25	37.97	14.71	40.30
16 Jun 23	15:09	0.44	15.09	37.59	14.70	40.43
16 Jun 23	15:10	0.42	15.79	37.25	14.69	40.83
Max		0.53	16.92	38.12	14.71	42.97
Avg		0.47	15.92	37.41	14.68	41.40

Reference Method Data

Client Name Gulf NC Co., Ltd. Date 16 Jun 23
Plant Name GNC Location ปล่อง HRSG 12

Run No: 1 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
16 Jun 23	10:40	0.44	13.94	34.35	14.77	3.30
16 Jun 23	10:41	0.43	14.43	33.75	14.75	3.32
16 Jun 23	10:42	0.44	15.27	33.74	14.73	3.36
16 Jun 23	10:43	0.44	15.20	34.29	14.72	3.34
16 Jun 23	10:44	0.44	15.00	34.58	14.71	3.38
16 Jun 23	10:45	0.44	14.99	34.71	14.71	3.38
16 Jun 23	10:46	0.44	14.96	34.54	14.71	3.41
16 Jun 23	10:47	0.43	14.83	34.37	14.72	3.37
16 Jun 23	10:48	0.42	14.73	34.11	14.72	3.31
16 Jun 23	10:49	0.41	14.93	33.75	14.73	3.37
16 Jun 23	10:50	0.41	15.32	33.36	14.75	3.33
16 Jun 23	10:51	0.41	15.69	33.01	14.74	3.32
16 Jun 23	10:52	0.42	15.97	32.92	14.74	3.36
16 Jun 23	10:53	0.39	16.15	32.88	14.73	3.34
16 Jun 23	10:54	0.39	16.29	32.96	14.72	3.34
16 Jun 23	10:55	0.39	16.21	33.13	14.72	3.35
16 Jun 23	10:56	0.39	15.60	33.42	14.72	3.37
16 Jun 23	10:57	0.39	15.39	33.17	14.71	3.32
16 Jun 23	10:58	0.40	15.47	33.22	14.71	3.35
16 Jun 23	10:59	0.40	15.26	33.31	14.71	3.33
16 Jun 23	11:00	0.40	15.07	33.19	14.71	3.35
Max		0.44	16.29	34.71	14.77	3.41
Avg		0.42	15.27	33.65	14.72	3.35

Run No: 2 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
16 Jun 23	11:01	0.40	15.25	32.99	14.73	3.35
16 Jun 23	11:02	0.41	15.54	32.81	14.74	3.33
16 Jun 23	11:03	0.41	15.78	32.68	14.74	3.30
16 Jun 23	11:04	0.41	15.98	32.49	14.73	3.34
16 Jun 23	11:05	0.41	16.22	32.59	14.72	3.36
16 Jun 23	11:06	0.41	16.07	32.81	14.72	3.35
16 Jun 23	11:07	0.40	15.74	32.77	14.73	3.34
16 Jun 23	11:08	0.42	15.59	32.58	14.74	3.36
16 Jun 23	11:09	0.43	15.86	32.51	14.73	3.36
16 Jun 23	11:10	0.43	16.13	32.38	14.72	3.35
16 Jun 23	11:11	0.43	16.40	32.33	14.72	3.35
16 Jun 23	11:12	0.44	16.55	32.25	14.71	3.34
16 Jun 23	11:13	0.44	16.60	32.30	14.71	3.38
16 Jun 23	11:14	0.44	16.58	32.48	14.71	3.35
16 Jun 23	11:15	0.44	16.29	32.85	14.70	3.36
16 Jun 23	11:16	0.45	15.69	33.43	14.70	3.35
16 Jun 23	11:17	0.45	14.91	33.52	14.70	3.36
16 Jun 23	11:18	0.45	14.66	33.28	14.70	3.36
16 Jun 23	11:19	0.45	14.55	33.32	14.70	3.37
16 Jun 23	11:20	0.44	14.69	33.00	14.71	3.36
16 Jun 23	11:21	0.44	15.18	32.65	14.70	3.36
Max		0.45	16.60	33.52	14.74	3.38
Avg		0.43	15.73	32.76	14.71	3.35

Run No: 3 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
16 Jun 23	11:22	0.45	15.88	32.64	14.71	3.35
16 Jun 23	11:23	0.44	15.82	32.56	14.72	3.37
16 Jun 23	11:24	0.44	15.60	32.66	14.73	3.33
16 Jun 23	11:25	0.45	15.42	32.73	14.74	3.35
16 Jun 23	11:26	0.45	15.42	32.70	14.74	3.34
16 Jun 23	11:27	0.46	15.65	32.38	14.73	3.38
16 Jun 23	11:28	0.46	16.13	32.27	14.71	3.36
16 Jun 23	11:29	0.46	16.49	32.26	14.70	3.34
16 Jun 23	11:30	0.43	16.53	32.15	14.70	3.38
16 Jun 23	11:31	0.43	16.46	32.08	14.69	3.36
16 Jun 23	11:32	0.43	16.46	32.04	14.70	3.39
16 Jun 23	11:33	0.42	16.41	32.11	14.70	3.37
16 Jun 23	11:34	0.42	16.20	32.14	14.71	3.31
16 Jun 23	11:35	0.42	15.83	32.38	14.73	3.32
16 Jun 23	11:36	0.41	15.46	32.67	14.74	3.35
16 Jun 23	11:37	0.41	15.19	32.46	14.73	3.32
16 Jun 23	11:38	0.41	15.50	32.07	14.72	3.38
16 Jun 23	11:39	0.43	16.03	32.06	14.70	3.37
16 Jun 23	11:40	0.43	16.35	32.18	14.69	3.39
16 Jun 23	11:41	0.43	16.21	32.25	14.69	3.36
16 Jun 23	11:42	0.42	16.05	32.17	14.70	3.37
Max		0.46	16.53	32.73	14.74	3.39
Avg		0.43	15.96	32.33	14.71	3.36

Run No: 4 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
16 Jun 23	11:43	0.43	16.20	32.06	14.70	3.38
16 Jun 23	11:44	0.42	16.42	32.02	14.70	3.34
16 Jun 23	11:45	0.43	16.59	31.97	14.70	3.34
16 Jun 23	11:46	0.44	16.68	31.90	14.69	3.36
16 Jun 23	11:47	0.43	16.64	31.99	14.69	3.36
16 Jun 23	11:48	0.44	16.23	32.07	14.70	3.34
16 Jun 23	11:49	0.44	16.11	31.94	14.70	3.36
16 Jun 23	11:50	0.44	16.35	31.84	14.70	3.36
16 Jun 23	11:51	0.44	16.62	31.82	14.70	3.35
16 Jun 23	11:52	0.45	16.55	31.95	14.70	3.36
16 Jun 23	11:53	0.45	16.40	31.87	14.72	3.34
16 Jun 23	11:54	0.45	16.27	31.81	14.71	3.33
16 Jun 23	11:55	0.46	16.33	31.72	14.71	3.32
16 Jun 23	11:56	0.46	16.48	31.61	14.70	3.34
16 Jun 23	11:57	0.46	16.78	31.55	14.70	3.35
16 Jun 23	11:58	0.46	16.93	31.60	14.70	3.37
16 Jun 23	11:59	0.47	16.87	31.62	14.70	3.33
16 Jun 23	12:00	0.45	16.75	31.58	14.71	3.35
16 Jun 23	12:01	0.45	16.62	31.53	14.71	3.35
16 Jun 23	12:02	0.45	16.43	31.69	14.72	3.32
16 Jun 23	12:03	0.44	16.19	31.87	14.74	3.33
Max		0.47	16.93	32.07	14.74	3.38
Avg		0.45	16.50	31.81	14.70	3.35

Run No: 5 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
16 Jun 23	12:04	0.44	16.16	32.75	14.78	3.30
16 Jun 23	12:05	0.44	16.06	34.04	14.83	3.28
16 Jun 23	12:06	0.43	15.31	34.57	14.86	3.24
16 Jun 23	12:07	0.43	14.83	34.55	14.87	3.27
16 Jun 23	12:08	0.43	15.07	33.84	14.85	3.27
16 Jun 23	12:09	0.46	16.49	33.32	14.81	3.28
16 Jun 23	12:10	0.46	17.87	33.00	14.78	3.30
16 Jun 23	12:11	0.46	18.61	32.85	14.78	3.29
16 Jun 23	12:12	0.46	18.77	32.77	14.78	3.31
16 Jun 23	12:13	0.46	18.77	32.69	14.77	3.31
16 Jun 23	12:14	0.46	18.71	32.67	14.78	3.32
16 Jun 23	12:15	0.46	18.69	32.69	14.78	3.29
16 Jun 23	12:16	0.45	18.79	32.61	14.78	3.29
16 Jun 23	12:17	0.45	18.91	32.65	14.78	3.31
16 Jun 23	12:18	0.45	19.03	32.73	14.77	3.30
16 Jun 23	12:19	0.44	19.08	32.57	14.78	3.32
16 Jun 23	12:20	0.44	19.12	32.57	14.77	3.30
16 Jun 23	12:21	0.44	18.36	33.11	14.81	3.27
16 Jun 23	12:22	0.43	17.41	33.47	14.84	3.27
16 Jun 23	12:23	0.43	16.08	33.58	14.84	3.25
16 Jun 23	12:24	0.43	15.70	33.87	14.85	3.25
Max		0.46	19.12	34.57	14.87	3.32
Avg		0.45	17.51	33.19	14.80	3.29

Run No: 6 Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
16 Jun 23	12:25	0.43	15.68	33.66	14.84	3.26
16 Jun 23	12:26	0.42	16.08	33.23	14.82	3.28
16 Jun 23	12:27	0.42	17.00	32.91	14.80	3.30
16 Jun 23	12:28	0.42	17.87	32.62	14.78	3.32
16 Jun 23	12:29	0.42	18.72	32.55	14.78	3.30
16 Jun 23	12:30	0.43	19.11	32.72	14.77	3.29
16 Jun 23	12:31	0.42	18.66	33.09	14.78	3.33
16 Jun 23	12:32	0.44	17.22	33.47	14.81	3.27
16 Jun 23	12:33	0.44	16.23	33.75	14.82	3.30
16 Jun 23	12:34	0.43	15.64	34.33	14.85	3.29
16 Jun 23	12:35	0.42	14.53	35.83	14.88	3.23
16 Jun 23	12:36	0.43	13.48	37.26	14.90	3.21
16 Jun 23	12:37	0.44	12.84	37.76	14.91	3.24
16 Jun 23	12:38	0.44	13.06	36.77	14.89	3.22
16 Jun 23	12:39	0.45	14.11	35.26	14.86	3.27
16 Jun 23	12:40	0.45	15.31	34.85	14.86	3.24
16 Jun 23	12:41	0.45	15.45	35.07	14.86	3.25
16 Jun 23	12:42	0.46	15.27	35.20	14.86	3.27
16 Jun 23	12:43	0.44	15.23	34.94	14.86	3.22
16 Jun 23	12:44	0.43	15.72	34.25	14.84	3.26
16 Jun 23	12:45	0.44	15.23	34.94	14.86	3.22
Max		0.46	19.11	37.76	14.91	3.33
Avg		0.43	15.83	34.50	14.84	3.27

Reference Method Data

Client Name: Gulf NC Co., Ltd.
Plant Name: GNC
Date: 16 Jun 23
Location: เลขที่ HRSG 12

Run No: 7 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
16 Jun 23	13:05	0.42	20.40	32.29	14.61	3.36
16 Jun 23	13:06	0.43	20.49	32.28	14.61	3.36
16 Jun 23	13:07	0.43	20.58	32.20	14.60	3.40
16 Jun 23	13:08	0.43	20.60	32.33	14.60	3.40
16 Jun 23	13:09	0.44	20.64	32.32	14.61	3.36
16 Jun 23	13:10	0.43	20.68	32.28	14.60	3.38
16 Jun 23	13:11	0.44	20.74	32.37	14.61	3.38
16 Jun 23	13:12	0.45	20.79	32.43	14.61	3.36
16 Jun 23	13:13	0.45	20.81	32.42	14.60	3.37
16 Jun 23	13:14	0.46	20.82	32.44	14.61	3.34
16 Jun 23	13:15	0.42	20.85	32.38	14.61	3.37
16 Jun 23	13:16	0.42	20.74	32.42	14.61	3.40
16 Jun 23	13:17	0.42	19.94	32.59	14.58	3.43
16 Jun 23	13:18	0.43	18.62	33.07	14.53	3.44
16 Jun 23	13:19	0.44	17.55	33.54	14.52	3.41
16 Jun 23	13:20	0.44	17.09	34.01	14.50	3.43
16 Jun 23	13:21	0.45	16.75	34.15	14.50	3.41
16 Jun 23	13:22	0.45	16.50	34.05	14.50	3.40
16 Jun 23	13:23	0.46	16.45	33.84	14.51	3.42
16 Jun 23	13:24	0.46	16.58	33.50	14.51	3.46
16 Jun 23	13:25	0.44	16.55	33.18	14.51	3.45
Max		0.46	20.85	34.15	14.61	3.46
Avg		0.44	19.25	32.86	14.58	3.40

Run No: 8 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
16 Jun 23	13:26	0.44	16.56	32.62	14.53	3.47
16 Jun 23	13:27	0.43	17.00	32.21	14.53	3.41
16 Jun 23	13:28	0.42	17.65	32.07	14.54	3.42
16 Jun 23	13:29	0.43	17.77	32.00	14.56	3.44
16 Jun 23	13:30	0.44	17.76	31.99	14.56	3.43
16 Jun 23	13:31	0.42	17.83	31.90	14.56	3.36
16 Jun 23	13:32	0.43	17.94	31.80	14.55	3.42
16 Jun 23	13:33	0.44	17.80	32.43	14.53	3.44
16 Jun 23	13:34	0.44	17.57	33.31	14.50	3.45
16 Jun 23	13:35	0.45	17.32	34.01	14.50	3.44
16 Jun 23	13:36	0.45	17.08	34.12	14.49	3.45
16 Jun 23	13:37	0.45	16.95	33.98	14.50	3.40
16 Jun 23	13:38	0.46	17.05	33.80	14.50	3.43
16 Jun 23	13:39	0.47	17.19	33.84	14.49	3.47
16 Jun 23	13:40	0.47	17.28	33.80	14.49	3.44
16 Jun 23	13:41	0.45	17.42	33.69	14.49	3.44
16 Jun 23	13:42	0.45	17.57	33.72	14.50	3.43
16 Jun 23	13:43	0.45	17.54	33.76	14.50	3.45
16 Jun 23	13:44	0.44	17.51	33.68	14.50	3.47
16 Jun 23	13:45	0.44	17.49	33.66	14.49	3.42
16 Jun 23	13:46	0.44	17.46	33.75	14.49	3.45
Max		0.47	17.94	34.12	14.56	3.47
Avg		0.44	17.42	33.15	14.51	3.44

Run No: 9 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
16 Jun 23	13:47	0.43	17.42	33.74	14.49	3.49
16 Jun 23	13:48	0.43	17.44	33.71	14.49	3.48
16 Jun 23	13:49	0.43	17.46	33.71	14.49	3.45
16 Jun 23	13:50	0.46	17.50	33.83	14.49	3.45
16 Jun 23	13:51	0.46	17.43	33.91	14.49	3.46
16 Jun 23	13:52	0.45	17.35	33.81	14.49	3.48
16 Jun 23	13:53	0.46	17.35	33.72	14.50	3.42
16 Jun 23	13:54	0.46	17.43	33.63	14.51	3.41
16 Jun 23	13:55	0.46	17.48	33.57	14.51	3.46
16 Jun 23	13:56	0.43	17.35	33.65	14.51	3.40
16 Jun 23	13:57	0.43	17.24	33.52	14.51	3.44
16 Jun 23	13:58	0.43	17.16	33.67	14.51	3.43
16 Jun 23	13:59	0.42	17.26	33.48	14.51	3.43
16 Jun 23	14:00	0.42	17.40	33.32	14.51	3.42
16 Jun 23	14:01	0.42	17.52	33.24	14.52	3.46
16 Jun 23	14:02	0.41	17.43	33.13	14.51	3.43
16 Jun 23	14:03	0.41	17.16	33.13	14.52	3.45
16 Jun 23	14:04	0.41	17.01	33.03	14.53	3.41
16 Jun 23	14:05	0.43	16.74	32.88	14.52	3.43
16 Jun 23	14:06	0.43	16.68	32.80	14.53	3.44
16 Jun 23	14:07	0.43	16.72	32.91	14.52	3.41
Max		0.46	17.52	33.91	14.53	3.49
Avg		0.43	17.27	33.45	14.50	3.44

Run No: 10 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
16 Jun 23	14:08	0.42	16.82	32.89	14.52	3.43
16 Jun 23	14:09	0.43	17.02	32.97	14.52	3.42
16 Jun 23	14:10	0.42	17.27	33.04	14.51	3.43
16 Jun 23	14:11	0.43	17.37	32.84	14.52	3.39
16 Jun 23	14:12	0.43	17.34	32.85	14.52	3.42
16 Jun 23	14:13	0.43	17.37	32.87	14.52	3.43
16 Jun 23	14:14	0.43	17.33	32.86	14.53	3.43
16 Jun 23	14:15	0.46	17.24	32.67	14.52	3.45
16 Jun 23	14:16	0.46	17.27	32.88	14.53	3.41
16 Jun 23	14:17	0.45	17.30	33.01	14.52	3.41
16 Jun 23	14:18	0.46	17.35	33.09	14.52	3.41
16 Jun 23	14:19	0.46	17.33	33.08	14.52	3.43
16 Jun 23	14:20	0.46	17.27	33.05	14.52	3.47
16 Jun 23	14:21	0.43	17.23	32.98	14.53	3.42
16 Jun 23	14:22	0.43	17.20	33.03	14.52	3.42
16 Jun 23	14:23	0.43	17.21	32.93	14.52	3.43
16 Jun 23	14:24	0.42	17.19	32.80	14.52	3.44
16 Jun 23	14:25	0.42	17.15	32.65	14.52	3.42
16 Jun 23	14:26	0.42	17.16	32.63	14.52	3.43
16 Jun 23	14:27	0.41	17.13	32.69	14.52	3.43
16 Jun 23	14:28	0.41	17.15	32.81	14.51	3.43
Max		0.46	17.37	33.09	14.53	3.47
Avg		0.43	17.23	32.89	14.52	3.43

Run No: 11 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
16 Jun 23	14:29	0.41	17.12	32.78	14.51	3.43
16 Jun 23	14:30	0.43	17.07	32.75	14.52	3.45
16 Jun 23	14:31	0.43	16.89	32.75	14.51	3.41
16 Jun 23	14:32	0.43	16.79	32.75	14.51	3.40
16 Jun 23	14:33	0.42	16.79	32.86	14.52	3.40
16 Jun 23	14:34	0.43	16.68	32.71	14.52	3.42
16 Jun 23	14:35	0.42	16.70	32.53	14.53	3.40
16 Jun 23	14:36	0.43	16.88	32.54	14.52	3.43
16 Jun 23	14:37	0.43	17.05	32.72	14.51	3.45
16 Jun 23	14:38	0.43	17.15	32.81	14.51	3.43
16 Jun 23	14:39	0.43	17.22	32.85	14.51	3.46
16 Jun 23	14:40	0.46	17.13	32.66	14.53	3.45
16 Jun 23	14:41	0.46	16.98	32.54	14.53	3.40
16 Jun 23	14:42	0.45	16.90	32.39	14.53	3.43
16 Jun 23	14:43	0.46	16.88	32.40	14.53	3.40
16 Jun 23	14:44	0.46	16.71	32.48	14.53	3.43
16 Jun 23	14:45	0.46	16.68	32.39	14.53	3.42
16 Jun 23	14:46	0.43	16.95	32.22	14.53	3.43
16 Jun 23	14:47	0.43	17.43	31.90	14.53	3.39
16 Jun 23	14:48	0.43	18.17	31.74	14.53	3.40
16 Jun 23	14:49	0.42	18.43	31.58	14.54	3.41
Max		0.46	18.43	32.86	14.54	3.46
Avg		0.44	17.08	32.49	14.52	3.42

Run No: 12 — Time Base : 21 min

Date	Time	SO2 ppm	NOx ppm	CO ppm	O2 Vol%	CO2 Vol%
16 Jun 23	14:50	0.42	18.27	31.62	14.55	3.41
16 Jun 23	14:51	0.42	17.96	31.57	14.55	3.40
16 Jun 23	14:52	0.41	17.94	31.47	14.56	3.42
16 Jun 23	14:53	0.44	18.16	31.42	14.56	3.41
16 Jun 23	14:54	0.45	18.27	31.32	14.56	3.39
16 Jun 23	14:55	0.45	18.10	31.53	14.55	3.42
16 Jun 23	14:56	0.45	17.89	31.55	14.56	3.41
16 Jun 23	14:57	0.45	17.90	31.53	14.54	3.42
16 Jun 23	14:58	0.44	17.74	31.86	14.54	3.38
16 Jun 23	14:59	0.44	17.51	31.69	14.55	3.39
16 Jun 23	15:00	0.45	17.60	31.61	14.56	3.39
16 Jun 23	15:01	0.44	18.01	31.46	14.56	3.40
16 Jun 23	15:02	0.44	18.11	31.41	14.56	3.39
16 Jun 23	15:03	0.45	17.73	31.76	14.55	3.40
16 Jun 23	15:04	0.45	16.94	31.88	14.55	3.40
16 Jun 23	15:05	0.46	16.89	31.72	14.56	3.38
16 Jun 23	15:06	0.46	17.44	31.36	14.57	3.40
16 Jun 23	15:07	0.46	18.02	31.23	14.56	3.37
16 Jun 23	15:08	0.43	18.31	31.19	14.56	3.42
16 Jun 23	15:09	0.43	18.13	31.32	14.56	3.40
16 Jun 23	15:10	0.43	17.93	31.34	14.56	3.38
Max		0.46	18.31	31.88	14.57	3.42
Avg		0.44	17.85	31.52	14.55	3.40

CEMs Opacity Data

Client Name: Gulf NC Co.,Ltd.
Plant Name: GNC
Date: 15-Jun-23
Location: HRSG 11

Run No.1		Run No.2		Run No.3		Run No.4		Run No.5	
Time	Opacity (%)	Time	Opacity (%)	Time	Opacity (%)	Time	Opacity (%)	Time	Opacity (%)
11:10	4.28	12:10	4.48	13:10	3.89	14:10	4.22	15:10	3.81
11:11	4.23	12:11	4.54	13:11	3.77	14:11	4.22	15:11	3.78
11:12	4.27	12:12	4.48	13:12	3.85	14:12	4.30	15:12	3.76
11:13	4.19	12:13	4.56	13:13	3.73	14:13	4.31	15:13	3.70
11:14	4.17	12:14	4.71	13:14	3.72	14:14	4.32	15:14	3.78
11:15	4.20	12:15	4.99	13:15	3.59	14:15	4.13	15:15	3.73
11:16	4.16	12:16	4.83	13:16	3.63	14:16	4.06	15:16	3.71
11:17	4.09	12:17	4.86	13:17	3.54	14:17	3.98	15:17	3.79
11:18	4.05	12:18	4.87	13:18	3.57	14:18	4.03	15:18	3.81
11:19	4.33	12:19	4.95	13:19	3.54	14:19	4.00	15:19	3.79
11:20	4.11	12:20	5.12	13:20	3.55	14:20	4.06	15:20	3.76
11:21	4.03	12:21	5.09	13:21	3.58	14:21	4.00	15:21	3.70
11:22	4.09	12:22	5.30	13:22	3.56	14:22	3.99	15:22	3.76
11:23	4.07	12:23	5.13	13:23	3.58	14:23	4.03	15:23	3.73
11:24	4.09	12:24	5.16	13:24	3.65	14:24	4.12	15:24	3.62
11:25	4.06	12:25	4.96	13:25	3.79	14:25	4.04	15:25	3.46
11:26	4.03	12:26	4.88	13:26	3.96	14:26	3.99	15:26	3.36
11:27	4.08	12:27	4.81	13:27	4.17	14:27	3.89	15:27	3.31
11:28	4.04	12:28	4.93	13:28	4.27	14:28	3.85	15:28	3.35
11:29	4.00	12:29	4.78	13:29	4.43	14:29	3.87	15:29	3.30
11:30	3.88	12:30	4.70	13:30	4.47	14:30	3.77	15:30	3.35
11:31	4.01	12:31	4.65	13:31	4.59	14:31	3.91	15:31	3.31
11:32	3.98	12:32	4.69	13:32	4.69	14:32	3.86	15:32	3.41
11:33	3.94	12:33	4.57	13:33	5.03	14:33	3.85	15:33	3.21
11:34	3.90	12:34	4.53	13:34	5.03	14:34	3.80	15:34	3.42
11:35	3.84	12:35	4.75	13:35	4.95	14:35	3.76	15:35	3.25
11:36	3.80	12:36	4.55	13:36	5.01	14:36	3.81	15:36	3.24
11:37	3.88	12:37	4.44	13:37	5.02	14:37	3.88	15:37	3.21
11:38	3.93	12:38	4.47	13:38	5.04	14:38	3.90	15:38	3.21
11:39	3.89	12:39	4.37	13:39	5.12	14:39	3.88	15:39	3.26
11:40	4.01	12:40	4.43	13:40	5.00	14:40	3.93	15:40	3.24
11:41	4.16	12:41	4.43	13:41	5.00	14:41	3.91	15:41	3.43
11:42	4.07	12:42	4.52	13:42	4.87	14:42	3.99	15:42	3.30
11:43	3.94	12:43	4.45	13:43	4.95	14:43	3.88	15:43	3.18
11:44	3.98	12:44	4.29	13:44	5.05	14:44	4.01	15:44	3.27
11:45	4.05	12:45	4.30	13:45	5.11	14:45	4.04	15:45	3.34
11:46	4.04	12:46	4.19	13:46	5.17	14:46	3.96	15:46	3.39
11:47	3.89	12:47	4.21	13:47	5.12	14:47	3.89	15:47	3.34
11:48	3.87	12:48	4.18	13:48	5.08	14:48	3.88	15:48	3.23
11:49	3.78	12:49	4.13	13:49	5.26	14:49	3.88	15:49	3.31
11:50	3.86	12:50	4.13	13:50	5.25	14:50	3.80	15:50	3.19
11:51	3.94	12:51	4.10	13:51	5.16	14:51	3.87	15:51	3.32
11:52	4.03	12:52	4.08	13:52	4.93	14:52	3.76	15:52	3.32
11:53	4.06	12:53	4.18	13:53	4.76	14:53	3.83	15:53	3.35
11:54	3.99	12:54	4.14	13:54	4.59	14:54	3.83	15:54	3.41
11:55	4.03	12:55	4.05	13:55	4.85	14:55	3.92	15:55	3.64
11:56	3.98	12:56	4.13	13:56	4.78	14:56	4.10	15:56	3.62
11:57	3.98	12:57	4.09	13:57	4.57	14:57	3.92	15:57	3.62
11:58	3.98	12:58	4.09	13:58	4.55	14:58	3.99	15:58	3.69
Avg.	**4.03**	**Avg.**	**4.56**	**Avg.**	**4.46**	**Avg.**	**3.96**	**Avg.**	**3.47**

CEMs Opacity Data

Client Name: Gulf NC Co.,Ltd.
Plant Name: GNC
Date: 16-Jun-23
Location: HRSG 12

Run No.1		Run No.2		Run No.3		Run No.4		Run No.5	
Time	Opacity (%)	Time	Opacity (%)	Time	Opacity (%)	Time	Opacity (%)	Time	Opacity (%)
10:30	3.27	11:30	2.40	12:30	2.17	13:30	3.15	14:30	2.72
10:31	3.25	11:31	2.24	12:31	2.25	13:31	3.10	14:31	2.93
10:32	3.11	11:32	2.21	12:32	2.24	13:32	3.21	14:32	2.76
10:33	3.18	11:33	2.35	12:33	2.29	13:33	3.17	14:33	2.87
10:34	3.25	11:34	2.37	12:34	2.27	13:34	3.29	14:34	2.87
10:35	3.28	11:35	2.52	12:35	2.28	13:35	3.33	14:35	2.84
10:36	3.13	11:36	2.37	12:36	2.24	13:36	3.54	14:36	2.78
10:37	3.20	11:37	2.43	12:37	2.17	13:37	3.59	14:37	2.76
10:38	3.09	11:38	2.19	12:38	2.03	13:38	3.35	14:38	2.67
10:39	3.08	11:39	2.35	12:39	2.17	13:39	3.32	14:39	2.66
10:40	3.05	11:40	2.30	12:40	2.32	13:40	3.15	14:40	2.62
10:41	2.98	11:41	2.20	12:41	2.21	13:41	3.25	14:41	2.71
10:42	3.05	11:42	2.31	12:42	2.12	13:42	3.13	14:42	2.75
10:43	3.01	11:43	2.26	12:43	2.12	13:43	3.21	14:43	2.82
10:44	3.08	11:44	2.21	12:44	2.18	13:44	3.13	14:44	2.79
10:45	3.06	11:45	2.32	12:45	2.23	13:45	3.15	14:45	2.73
10:46	3.03	11:46	2.49	12:46	2.32	13:46	3.18	14:46	2.80
10:47	2.94	11:47	2.48	12:47	2.45	13:47	3.16	14:47	2.88
10:48	2.94	11:48	2.31	12:48	2.28	13:48	3.22	14:48	3.02
10:49	2.90	11:49	2.29	12:49	2.10	13:49	2.98	14:49	2.83
10:50	2.85	11:50	2.36	12:50	2.32	13:50	3.11	14:50	2.89
10:51	2.85	11:51	2.28	12:51	2.24	13:51	3.23	14:51	3.11
10:52	2.77	11:52	2.24	12:52	2.39	13:52	3.09	14:52	2.74
10:53	2.86	11:53	2.24	12:53	2.48	13:53	3.17	14:53	2.86
10:54	3.01	11:54	2.21	12:54	2.36	13:54	3.04	14:54	2.66
10:55	2.80	11:55	2.32	12:55	2.36	13:55	3.04	14:55	2.74
10:56	3.00	11:56	2.30	12:56	2.37	13:56	3.10	14:56	2.78
10:57	2.91	11:57	2.23	12:57	2.46	13:57	3.11	14:57	2.77
10:58	2.82	11:58	2.35	12:58	2.46	13:58	2.88	14:58	2.78
10:59	2.75	11:59	2.19	12:59	2.53	13:59	2.95	14:59	2.56
11:00	2.85	12:00	2.45	13:00	2.61	14:00	2.92	15:00	2.60
11:01	2.81	12:01	2.29	13:01	2.68	14:01	3.11	15:01	2.83
11:02	2.76	12:02	2.35	13:02	2.55	14:02	3.19	15:02	2.69
11:03	2.70	12:03	2.26	13:03	2.60	14:03	2.99	15:03	2.78
11:04	2.85	12:04	2.29	13:04	2.64	14:04	2.89	15:04	2.90
11:05	2.89	12:05	2.27	13:05	2.78	14:05	2.88	15:05	2.95
11:06	2.92	12:06	2.20	13:06	2.78	14:06	2.89	15:06	2.87
11:07	2.90	12:07	2.08	13:07	2.89	14:07	3.08	15:07	2.81
11:08	2.90	12:08	2.25	13:08	2.93	14:08	2.74	15:08	2.87
11:09	2.82	12:09	2.23	13:09	2.87	14:09	2.85	15:09	2.93
11:10	2.84	12:10	2.26	13:10	3.01	14:10	2.76	15:10	2.89
11:11	2.81	12:11	2.44	13:11	3.30	14:11	2.85	15:11	2.90
11:12	2.69	12:12	2.32	13:12	3.20	14:12	2.83	15:12	2.84
11:13	2.55	12:13	2.36	13:13	3.29	14:13	2.82	15:13	2.85
11:14	2.74	12:14	2.24	13:14	3.20	14:14	2.82	15:14	2.70
11:15	2.73	12:15	2.24	13:15	3.10	14:15	2.85	15:15	2.72
11:16	2.53	12:16	2.22	13:16	3.29	14:16	2.76	15:16	2.82
11:17	2.49	12:17	2.23	13:17	3.08	14:17	2.75	15:17	2.70
11:18	2.54	12:18	2.16	13:18	3.01	14:18	2.72	15:18	2.60
Avg.	**2.91**	**Avg.**	**2.30**	**Avg.**	**2.54**	**Avg.**	**3.06**	**Avg.**	**2.79**

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA, LLC
8141 Eastern Road
Bldg a
Plumsteadville, PA 18949
Airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E04N99E3HA0002	Reference Number:	160-402138465-1
Cylinder Number:	ND11222	Cylinder Volume:	247.2 Cubic Feet
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2215 PSIG
PGVP Number:	A12021	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Jul 15, 2021

Expiration Date: Jul 15, 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 molar/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	80.00 PPM	82.51 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
CARBON MONOXIDE	80.00 PPM	79.74 PPM	G1	+/- 0.5% NIST Traceable	07/08/2021
NITRIC OXIDE	80.00 PPM	82.51 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
SULFUR DIOXIDE	80.00 PPM	79.75 PPM	G1	+/- 1.0% NIST Traceable	07/08/2021, 07/15/2021
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	110101130	KAL004538	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12389	D685925	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	200610-50	CC730426	99.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.8%	Oct 06, 2026
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 16, 2021
NTRM	160110224	KAL003808	97.89 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021

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

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 FTIR AUP2010245 CO	FTIR	Jun 24, 2021
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Jul 01, 2021
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Jun 30, 2021
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Jul 06, 2021

Triad Data Available Upon Request

NOTES:
Gross Weight: 48.0 Kg
Net Weight: 7.8 Kg

Approved for Release

THE LINDE GROUP

CERTIFICATE OF ANALYSIS

Customer Detail:
ALS Laboratory Group (Thailand)

Cylinder Description:
STEEL 47 L

Production Order Number: 90145553
Material Number: 478100-J-44
Certification Date: 07-Dec-2017
Expiry Date: 07-Dec-2025

The measurement of this reference material is traceable to SI through the reference standard which is traceable to Swiss National Standard of Mass. The Assay of this Standard has been performed in accordance with the EPA Traceability Protocol EPA-600/R-12/531 for the Assay and Certification of Gaseous Calibration Standards using procedure G1. The results are expressed on a mole/mole basis, unless otherwise specified. The reported uncertainty is based on a standard uncertainty multiplied by coverage factor k=2, providing a level of confidence of approximately 95%.

Certificate Number: 3982/17

Cylinder Number: 14465

Nominal Cylinder Content: 6.520 M³

Nominal Pressure: 145.0 Bar

Valve Outlet: CGA 590 BRASS

Analyst: Arissara T. ARISSARA THONGNURL

Approve: SUKANYA KAMUTHARAT

To Re-Order Please Quote: 478100-J-44

Comment:
- It is recommended that this product be not used below 5% of actual contents or should not be used when its gas pressure is below 150psig.
- Other impurities that detect by analytical condition of this mixture shall be report if it is more than 10% of minimum minor component.
- Keep and use in well-ventilated and secure area.

บริษัท ลินเด้ (ประเทศไทย) จำกัด (มหาชน)
ชั้น 15 อาคารทาวเวอร์ เอ 2/3 หมู่ 14 กม.ม่วงสามสาย กม. 6.5 ถนนลาดกระบัง
ถนนลาดกระบัง จ.สมุทรปราการ 10540 โทรศัพท์ (66) 2338-6100 โทรสาร (66) 2338-6333
โรงงานเวลโกรว : 105 หมู่ 5 ถนนสุขุมวิท ถนนบางกอก ต.ตลิ่งชัน 24180
โทรศัพท์ (66) 38.570-479-93 โทรสาร (66) 38.570-323

Linde (Thailand) Public Company Limited
15th Floor, Bangna Tower A, 2/3 Moo 14, Bangna Trad KM. 6.5 Road, Bangkaew
Bangplee, Samutprakarn 10540, Tel (66) 2338-6100 Fax (66) 2338-6333
Wellgrow Plant : 105 Moo 5, T.Bangsamak, A.Bangpakong, Chachoengsao 24180
Thailand, Tel (66) 38.570-479-93 Fax (66) 38.570-323

THE LINDE GROUP

CERTIFICATE OF ANALYSIS

Analytical Result

Component	Request Concentration	Certified Concentration	Certified Uncertainty	Method	Assay Date
Oxygen In Nitrogen	8.00 %	8.04 %	± 1% relative	(2) I-PB-354	04-Dec-2017

Reference Standard used in Assay

Reference Standard	Cylinder No.	Concentration	Expired Date
Oxygen In Nitrogen	113553SG	9.976± 0.02 %	26-Mar-2018

Analytical Instruments used in Assay

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Servomex 4100 O2 Analyzer	Paramagnetic	04-Dec-2017

Method of Analysis
1. Gas Chromatograph
2. Paramagnetic Oxygen Analyzer
3. Electrochemical Oxygen Analyser
4. Electrochemical Moisture Analyser
5. Total Hydrocarbon Analyzer
6. Other specified

Cylinder Number 14465
Production Order Number 90145553
Certifcation Date: 07-Dec-2017
Expiration Date: 07-Dec-2025

บริษัท ลินเด้ (ประเทศไทย) จำกัด (มหาชน)
ชั้น 15 อาคารทาวเวอร์ เอ 2/3 หมู่ 14 กม.ม่วงสามสาย กม. 6.5 ถนนลาดกระบัง
ถนนลาดกระบัง จ.สมุทรปราการ 10540 โทรศัพท์ (66) 2338-6100 โทรสาร (66) 2338-6333
โรงงานเวลโกรว : 105 หมู่ 5 ถนนสุขุมวิท ถนนบางกอก ต.ตลิ่งชัน 24180
โทรศัพท์ (66) 38.570-479-93 โทรสาร (66) 38.570-323

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Wellgrow Plant : 105 Moo 5, T.Bangsamak, A.Bangpakong, Chachoengsao 24180
Thailand, Tel (66) 38.570-479-93 Fax (66) 38.570-323

THE LINDE GROUP

CERTIFICATE OF ANALYSIS

Customer Detail:
ALS Laboratory Group (Thailand)

Cylinder Description:
STEEL 47 L

Production Order Number: 90145554
Material Number: 557200-J-44
Certification Date: 07-Dec-2017
Expiry Date: 07-Dec-2025

The measurement of this reference material is traceable to SI through the reference standard which is traceable to Swiss National Standard of Mass. The Assay of this Standard has been performed in accordance with the EPA Traceability Protocol EPA-600/R-12/531 for the Assay and Certification of Gaseous Calibration Standards using procedure G1. The results are expressed on a mole/mole basis, unless otherwise specified. The reported uncertainty is based on a standard uncertainty multiplied by coverage factor k=2, providing a level of confidence of approximately 95%.

Certificate Number: 3977/17

Cylinder Number: 94892

Nominal Cylinder Content: 6.560 M³

Nominal Pressure: 145.0 Bar

Valve Outlet: CGA 590 BRASS

Analyst: Arissara T. ARISSARA THONGNURL

Approve: SUKANYA KAMUTHARAT

To Re-Order Please Quote: 557200-J-44

Comment:
- It is recommended that this product be not used below 5% of actual contents or should not be used when its gas pressure is below 150psig.
- Other impurities that detect by analytical condition of this mixture shall be report if it is more than 10% of minimum minor component.
- Keep and use in well-ventilated and secure area.

บริษัท ลินเด้ (ประเทศไทย) จำกัด (มหาชน)
ชั้น 15 อาคารทาวเวอร์ เอ 2/3 หมู่ 14 กม.ม่วงสามสาย กม. 6.5 ถนนลาดกระบัง
ถนนลาดกระบัง จ.สมุทรปราการ 10540 โทรศัพท์ (66) 2338-6100 โทรสาร (66) 2338-6333
โรงงานเวลโกรว : 105 หมู่ 5 ถนนสุขุมวิท ถนนบางกอก ต.ตลิ่งชัน 24180
โทรศัพท์ (66) 38.570-479-93 โทรสาร (66) 38.570-323

Linde (Thailand) Public Company Limited
15th Floor, Bangna Tower A, 2/3 Moo 14, Bangna Trad KM. 6.5 Road, Bangkaew
Bangplee, Samutprakarn 10540, Tel (66) 2338-6100 Fax (66) 2338-6333
Wellgrow Plant : 105 Moo 5, T.Bangsamak, A.Bangpakong, Chachoengsao 24180
Thailand, Tel (66) 38.570-479-93 Fax (66) 38.570-323

THE LINDE GROUP

CERTIFICATE OF ANALYSIS

Analytical Result

Component	Request Concentration	Certified Concentration	Certified Uncertainty	Method	Assay Date
Oxygen In Nitrogen	16.0 %	16.0 %	± 1% relative	(2) I-PB-354	04-Dec-2017

Reference Standard used in Assay

Reference Standard	Cylinder No.	Concentration	Expired Date
Oxygen In Nitrogen	113553SG	9.976± 0.02 %	26-Mar-2018

Analytical Instruments used in Assay

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Servomex 4100 O2 Analyzer	Paramagnetic	04-Dec-2017

Method of Analysis
1. Gas Chromatograph
2. Paramagnetic Oxygen Analyzer
3. Electrochemical Oxygen Analyser
4. Electrochemical Moisture Analyser
5. Total Hydrocarbon Analyzer
6. Other specified

Cylinder Number 94892
Production Order Number 90145554
Certifcation Date: 07-Dec-2017
Expiration Date: 07-Dec-2025

บริษัท ลินเด้ (ประเทศไทย) จำกัด (มหาชน)
ชั้น 15 อาคารทาวเวอร์ เอ 2/3 หมู่ 14 กม.ม่วงสามสาย กม. 6.5 ถนนลาดกระบัง
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Thailand, Tel (66) 38.570-479-93 Fax (66) 38.570-323

SITHIPORN 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. : ACC23009
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No.: 34178121
ID No.: RYG_FS0213

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 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

REVIEW BY Nnakorn P.
APPROVED BY
NEXT CAL DATE 26/1/24

Received Date : 24 JANUARY 2023
Calibration Date : 26 JANUARY 2023
Date of Issue : 27 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(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.

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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	33461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23
Audio Analyzer	AVR-3360A	V744B6069	EF-0010-22	07-Feb-23

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).

T. Petch.

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	94.16	0.16	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1003.2	0.3	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
1.97	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 lavel of confidence of approximately 95 %.

End of Calibration Certificate

T. Petch.

SITHIPORN 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. : ACL22160
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00472132 / 169445 / 72466
ID No.: RYG_FS0304

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 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

REVIEW BY Nnakorn P.
APPROVED BY
NEXT CAL DATE 11/7/23

Received Date : 06 JULY 2022
Calibration Date : 11-18 JULY 2022
Date of Issue : 19 JULY 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(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.

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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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).

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

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.2

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	16.3
Flat	22.1

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	0.2	0.2	0.2	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-1.1	-1.1	-1.1	±5.0

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	0.1	0.1	0.1	±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	0.1	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	94.1	0.1	± 0.3

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	104.1	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	26.0	0.0	± 1.1
25.0	25.0	0.0	± 1.1

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	108.0	0.0	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, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.3	-1.1	±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

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.5	89.6	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 lavel of confidence of approximately 95 %

End of Calibration Certificate

SITHIPORN 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. : ACL22159
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00472130 / 157774 / 72464
ID No.: RYG_FS0303

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 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

REVIEW BY Nnakorn P.
APPROVED BY
NEXT CAL DATE 11/7/23

Received Date : 06 JULY 2022
Calibration Date : 11-18 JULY 2022
Date of Issue : 19 JULY 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by :
(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.

Cert. No. : ACL22159
Job No. : VC65AC0069
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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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).

Cert. No. : ACL22159
Job No. : VC65AC0069
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	✓	-	0.3	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

Cert. No. : ACL22159
Job No. : VC65AC0069
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
23.4

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

Frequency Weighting	Measured value (dB)
A - weight	15.4
C - weight	21.0
Flat	26.9

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	0.0	0.0	0.0	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-0.3	-0.2	-0.2	±5.0

Cert. No. : ACL22159
Job No. : VC65AC0069
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	-0.1	-0.2	-0.1	±2.0
125	-0.1	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	93.9	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	93.9	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	93.9	94.0	0.1	± 0.3

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.1	0.1	± 1.1
136.0	136.1	0.1	± 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	129.1	0.1	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.1	0.1	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.1	0.1	± 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	26.9	-0.1	± 1.1
26.0	26.0	0.0	± 1.1
25.0	25.0	0.0	± 1.1

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	108.0	0.0	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, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.6	-0.8	±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

11. Overload indication

Measured value (dB) Positive one-half cycle	Measured value (dB) Negative one-half cycle	Deviated Value (dB)	Acceptance Limits (dB)
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 lavel of confidence of approximately 95 %

End of Calibration Certificate

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
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TEL. 0-2717-3000-27 FAX 0-2719-9484

Cert.No.: 22CH1084
Page.: 1 of 2

Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	Mettler Toledo
Model :	Seven2Go
Serial No. :	C129171492
ID No. :	RYG_FS0549
Condition As-Received:	Used Item
Received Date :	17 August 2022
Calibration Date :	18 August 2022
Reference :	2208-0623DSC-1
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch 616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand
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 Lerngagtrakul
Approved by :	Approved Signatory
Issue Date :	22 August 2022

REVIEW BY Tanasit
APPROVED BY Supt S
NEXT CAL. DATE 18/08/23

(✓) Malee Butkruea
( ) Saithip Meangmai
( ) Warakorn Lerngagtrakul

The Uncertainties are for a confidence probability of approximately 95%

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A 0044346

Cert. No.: 22CH1084
Page.: 2 of 2

Condition of this calibration result

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	21E2682	25 Aug 2022

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	823320	20 June 2024
pH 6.985	CPA chem	794122	14 Feb 2023
pH 10.008	CPA chem	823323	20 June 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	Coverage factor
	pH	mV	mV	pH	(±mV)	k
pH Meter	4.00	177.48	178	4.00	0.58	2.00
S/N.: C129171492	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-178	10.00	0.58	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 (±)	Coverage factor k
pH Electrode	4.008	4.01	171	0.0086	2.05
S/N.: 1231783	6.985	7.00	-2	0.011	2.00
	10.008	10.00	-174	0.0092	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 %.

-o0o-

a 1121482

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NSC-TISI-TIS17025 CALIBRATION 0008

Cert. No.: 22LM112
Page.: 1 of 2

Certificate of Calibration

Equipment :	pH Meter with Sensor
Manufacturer :	Mettler Toledo
Model :	Seven2Go
Serial No. :	C129171492
ID No. :	RYG_FS0549
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140 Thailand
Location :	TPA On Site Calibration Laboratory
Received Order :	17 August 2022
Calibrated Date :	19 August 2022
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %
AC Line Voltage :	(220 ± 22) V
Calibrated by :	Kunchit Promprat
Approved by :	Approved Signatory

( ) Pornthippa Tameyakul
( ) Malee Butkruea
(✓) Suwit Imjai

Issue Date : 24 August 2022

The Uncertainties are for a confidence probability of approximately 95%

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A 0044522

Equipment : pH Meter with Sensor
Condition As-Received : Used Item
Reference : 2208-0623DSC-3

Cert. No.: 22LM112
Page.: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Digital Thermometer	1502A	A52847	21I1144	20 Oct 2022

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 1231783

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	120	24.999	25.1	0.101	0.16	2.00
30.0	120	30.001	30.1	0.099	0.16	2.00
40.0	120	40.004	40.1	0.096	0.16	2.00
50.0	120	50.003	50.1	0.097	0.16	2.00

UUC* : Unit Under Calibration

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

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a 1122902

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NSC-TISI-TIS17025 CALIBRATION 0008

Cert.No.: 22CH1733
Page.: 1 of 3

Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	Mettler Toledo
Model :	SevenExcellence
Serial No. :	B834291445
ID No. :	RYG_EN0152
Condition As-Received:	Used Item
Received Date :	21 December 2022
Calibration Date :	22 December 2022
Reference :	2212-0602DSC-1
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch 616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand
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) - CP-CH8 by comparison with standard thermometer
Calibrated by :	Warakorn Lerngagtrakul
Approved by :	Approved Signatory

REVIEW BY N.Banjit
APPROVED BY
22/12/23
NEXT CAL. DATE 22/06/24

(✓) Malee Butkruea
( ) Saithip Meangmai
( ) Warakorn Lerngagtrakul

Issue Date : 26 December 2022

The Uncertainties are for a confidence probability of approximately 95%

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A 0048758

Condition of this calibration result

1. Reference Standard Instrument : -

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023
2) Ref. Standard Thermometer	4982054	110RC044	22I1306	27 Oct 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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	826588	09 July 2024
pH 6.987	CPA chem	823322	20 June 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	Coverage factor
	pH	mV	mV	pH	(±mV)	k
pH Meter	4.000	177.48	177.3	4.000	0.058	2.00
S/N.: B834291445	7.000	0.00	-0.1	7.000	0.058	2.00
	10.000	-177.48	-177.5	10.000	0.058	2.00

Malu

a 1141167

Calibration Results

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 (±)	Coverage factor k
pH Electrode	4.008	4.011	185.2	0.0052	2.06
S/N.: 1475518	6.987	6.990	10.4	0.0088	2.00
	10.008	10.014	-166.5	0.0072	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;
- Model : InLab Expert Pro-ISM
- Serial No. : 1475518

Dimension of probe;
- Length : 120 mm.
- Diameter : 12 mm.
- Immersion Depth : 100 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °C)	Coverage factor k
25.0	25.001	24.9	-0.101	0.13	2.00

Remark : - UUC* = Unit Under Calibration

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

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Malu

a 1141166

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NSC-TISI-TIS17025 CALIBRATION 0008

Certificate of Calibration

Certificate No. : 22E4098
Page : 1 of 2

Equipment : pH Meter
Manufacturer: Mettler Toledo
Model : SevenExcellence
Serial No.: B834291445
ID No.: RYG_EN0152
Condition As-Received: Used Item
Received Date: 21 December 2022
Calibration Date: 23 December 2022

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Reference: 2212-0602DSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 10) %

Submitted by: ALS Laboratory Group (Thailand) Co.,Ltd. Rayong Branch
616/10 Moo 5, T.Maenam Khu, A.Pluakdaeng,
Rayong 21140, Thailand

Procedure used: Calibration were conducted using In-house calibration Procedure CP-E17 According to direct measurement method with Multi-Product Calibrator.

Condition of this result of calibration

1.Reference standards instuments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Multi-Product Calibrator	5500A	6315011	22E1431	05 May 2023

2.This result of calibration was made on requested at the point specified by customer.
3.The certificate is valid only to the item calibrated on date and place of calibration.
4.This Certification is traceable to the International System of Unit maintained at:-
-National Institute of Metrology Thailand (NIMT)

Calibrated by : Wutchareeporn Wongchutikrane
Issue Date : 26 December 2022

Approved Signatory :
[✓] Phalinee Prabpaipal
[ ] Nuntawat Khamchai
[ ] Pornthippa Tameyakul

B 0304803

Result of calibration :- (*) Without adjustment ( ) After adjustment

Function: DC voltage measuremer **Range:** 2000 mV

Standard Value (mV)	UUC* Reading (mV)	Error (mV)	Uncertainty (± µV)
-200.0000	-200.0	0.0	72
-150.0000	-150.0	0.0	69
-100.0000	-100.0	0.0	65
-50.0000	-50.0	0.0	62
0.0000	0.0	0.0	58
50.0000	50.0	0.0	62
100.0000	100.0	0.0	65
150.0000	150.0	0.0	69
200.0000	199.9	-0.1	72

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 %

***UUC= Unit Under Calibration.**

-o0o-

a 1140616

RYG_EN0002

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 , e-mail: service.thailand@sartorius.com

NSC-TISI-TIS 17025
CALIBRATION 0426

SARTORIUS

REVIEW BY Thanitall.
APPROVED BY
NEXT CAL. DATE 01/03/24

Certificate of Calibration

Model Number :	MSE224S-100-DU	Certificate No. :	23BCI0112
Description :	Analytical Balance	Issued Date :	Friday, March 03, 2023
Serial Number :	0026207038	Reference No. :	204833
ID No. :	RYG_EN0002		
Manufacturer :	Sartorius	Page No. :	1 of 2

Customer Name : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch)
616/10 Moo 5 T.Maenam Khu, A.Pluak Daeng, Rayong 21140, Thailand.

Calibrated Place : ALS Laboratory Group (Thailand) Co., Ltd.(Balance Room)
616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong.21140, Thailand.

Calibrated By : Mr.Chonchai Inthana
Calibration Date : Wednesday, March 01, 2023

Calibration Procedure No. : This calibration was conducted by Using in-house calibration procedure number (WI-003) Based on UKAS LAB 14 : 2019

Metrological data :
Capacity : 220 g Readability : 0.0001 g

Ambients Conditions:
Temperature : 23.6 °C ± 5.0 °C
Humidity : 60.0 % 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 form list of Sartorius Metrological Specifications.

Traceability:

Model Number	Description	Traceability	Cetificate 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	DKSH	C19220444	5-Sep-2023

This certificate relate and apply this equipment only.
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Mr.chonchai Intrhana(Technical Manager)

STAMP SARTORIUS ISO/IEC 17025:2017

SOP FM 33 03 February 2022

Sartorius (Thailand) Co., Ltd.
129 Rama 9 Road, Huaykwang, Huaykwang, Bangkok 10310
Tel: +66 2643 8361-6 Fax: +66 2643-8367, e-mail: service.thailand@sartorius.com

SARTORIUS

Certificate of Calibration

Model Number :	MSE224S-100-DU	Certificate No. :	23BCI0112
Description :	Analytical Balance	Issued Date :	Friday, March 03, 2023
Serial Number :	0026207038	Reference No. :	204833
ID No. :	RYG_EN0002		
Manufacturer :	Sartorius	Page No. :	2 of 2

Calibration Results : Without Adjustment

Repeatability

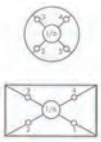
The reproducibility is the ability of a weighing instrument to display nearly identical readouts under constant test conditions when the same load within a measurement series is placed repeatedly on the weighing pan in the same manner. The standard deviation is used to express reproducibility quantitatively.

Nominal Value : (Low Load) 20 g	20.0000	199.9999
	20.0000	200.0000
Tolerance 0.0001 g	20.0000	199.9999
	20.0000	200.0000
	20.0000	199.9999
Nominal Value : (High Load) 200 g	20.0000	199.9999
	19.9999	200.0000
Tolerance 0.0001 g	20.0000	200.0000
	20.0000	199.9999
	20.0000	200.0000
Standard Deviation	0.00003	0.00005

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 maximim 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 : 100 g
Tolerance 0.0004 g



	Difference
1	–
2	-0.0001
3	-0.0001
4	0.0001
5	0.0002
6	-

Linearity

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

Tolerance 0.0002 g

Nominal Value (g)	Conventional Mass Value (g)	Displayed Value (g)	Deviation (g)	Uncertainty (g)
0.01	0.0100	0.0100	0.0000	0.00014
0.05	0.0500	0.0500	0.0000	0.00014
0.1	0.1000	0.1000	0.0000	0.00014
0.5	0.5000	0.5000	0.0000	0.00014
1	1.0000	1.0000	0.0000	0.00014
5	5.0000	5.0000	0.0000	0.00014
10	10.0000	10.0001	0.0001	0.00014
20	20.0000	20.0000	0.0000	0.00024
50	50.0000	50.0000	0.0000	0.00015
100	100.0000	99.9999	-0.0001	0.00019
200	200.0000	200.0000	0.0000	0.00032

End of Report

SOP FM 33 03 February 2022

RYG_EN0010

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NSC-TISI-TIS17025
CALIBRATION 0008

Cert. No.: 22TM1517
Page : 1 of 3

Certificate of Calibration

Equipment :	Hot Air Oven
Manufacturer :	Memmert
Model :	UFE 500
Serial No. :	G511.1572
ID No. :	RYG_EN0010
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5 T. Maenam Khu, A. Pluakdaeng, Rayong 21140 Thailand
Location :	Oven Room
Received Order :	20 October 2022
Calibration Date :	20 October 2022
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %
Calibrated by :	Man Pattanapongpaiboon

REVIEW BY Thanitall.
APPROVED BY
NEXT CAL. DATE 20/04/24

Approved by : Approved Signatory

( ) Pornthippa Tameyakul
(✓) Malee Butkruea
( ) Suwit Imjai

Issue Date : 2 November 2022

The Uncertainties are for a confidence probability of approximately 95%

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A 0046908

Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-2

Cert. No.: 22TM1517
Page : 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

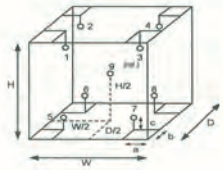
1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY49023932	22LM97	29 Jul 2023

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Environment during calibration	Beginning	Finished
Temp. (°C)	25	25
REL.Humid. (%)	54	59
AC Supply (Volt)	223	225



Probe Installation Details :

a =	5.0	cm
b =	5.0	cm
c =	5.0	cm

Dimension of Chamber :

D =	0.40	m
W =	0.56	m
H =	0.48	m
Capacity =	0.11	m³

Position :	Ref. Std. ID No.: @ Calibration Point (180) °C	(104) °C
1	21-16TC-01	20-16RTD-01
2	21-16TC-02	20-16RTD-02
3	21-16TC-03	20-16RTD-03
4	21-16TC-04	20-16RTD-04
5	21-16TC-05	22-16RTD-05
6	21-16TC-06	20-16RTD-06
7	21-16TC-07	20-16RTD-07
8	21-16TC-08	22-16RTD-08
9 (ref.)	21-16TC-09	22-16RTD-09

a 1132466

Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-2
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 22TM1517
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (±°C)	Coverage Factor *k*
104.0	104.0	104.0	0.076	0.52	0.60	0.42	2
180.0	180.0	180.0	0.13	0.88	1.2	1.1	2

Calibration Point	Measured Temperature (°C)								
	Position								
(°C)	1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.768	103.734	103.723	103.800	104.215	104.131	104.132	103.740	103.747
180.0	179.723	179.359	179.439	179.489	180.361	180.114	180.131	180.243	179.605

Average* : The average of 30 values in each position.
Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor
Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation
UUC* : Unit Under Calibration
Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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 %.

-o0o-

Malu .

a 1132465

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Cert.No.: 22TW34
Page.: 1 of 2

Certificate of Testing

REVIEW BY N.Bamrit
APPROVED BY D.
NEXT CAL. DATE 15/8/23

Equipment :	DO Meter
Manufacturer :	YSI
Model :	5000-115V
Serial No. :	15E102796
ID No. :	RYG_EN0032
Received Date :	11 February 2022
Test Date :	14 February 2022
Reference :	2202-0404DSC-4
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand
Laboratory Condition :	Temperature (25 ± 5) °C Humidity (50 ± 20) %
Test Procedure :	In - house method : CP-CH9 by Comparison Technique with Azide Modification Method
Tested by :	Walalak Sirithean
Approved by :	Saithip Approved Signatory

( ) Malee Butkruea
(✓) Saithip Meangmai
( ) Warakorn Lerngagtrakul

Issue Date : 18 February 2022

B 0281285

Cert.No.: 22TW34
Page.: 2 of 2

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 15E100464

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.02	8.02	0.0084

This report was certified only for the instrument we tested.It is allowable to use for study the system efficiency,The environmental impact control and present to organization it may concerned Intend to use for advertising and referral purpose is prohibited.This report may not be reproduced other in full,without written approval of the laboratory

-o0o-

Saithip

a 1094744

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Hac-MRA
NSC-TISI-TIS17025 CALIBRATION 0008

Cert. No.: 22LM12
Page.: 1 of 2

Certificate of Calibration

Equipment :	DO Meter with Sensor
Manufacturer :	YSI
Model :	5000-115V
Serial No. :	15E102796
ID No. :	RYG_EN0032
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branc 616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand
Location :	TPA On Site Calibration Laboratory
Received Order :	11 February 2022
Calibrated Date :	21 February 2022
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %
AC Line Voltage :	(220 ± 22) V
Calibrated by :	Kunchit Promprat
Approved by :	Malu . Approved Signatory

( ) Pornthippa Tameyakul
(✓) Malee Butkruea
( ) Suwit Imjai

Issue Date : 21 February 2022

The Uncertainties are for a confidence probability of approximately 95%

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A 0038008

Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2202-0404DSC-5

Cert. No.: 22LM12
Page.: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Digital Thermometer	1523	2188080	21I1273	22 Nov 2022

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 15E100464

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor *k*
20.00	45	20.001	19.88	-0.121	0.15	2.00

UUC* : Unit Under Calibration

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

-oOo-

a 1095714

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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NSC-TISI-TIS17025 CALIBRATION 0008

Certificate of Calibration

Cert. No.: 22TM317
Page.: 1 of 3

Equipment : Low Temp. Incubator
Manufacturer : Memmert
Model : IPP750
Serial No. : V818.0084
ID No. : RYG_EN0154

REVIEW BY N.Bamrit
APPROVED BY D
NEXT CAL. DATE 21/10/23

Submitted by : ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong 21140, Thailand
Location : BOD Room

Received Order : 22 April 2022
Calibration Date : 22 April 2022
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Man Pattanapongpaiboon

Approved by :
Approved Signatory

( ) Pornthippa Tameyakul
(✓) Malee Butkruea
( ) Suwit Imjai

Issue Date : 3 May 2022

The Uncertainties are for a confidence probability of approximately 95%

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A 0040735

Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2204-0146OC-1

Cert. No.: 22TM317
Page.: 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34970A	MY44031769	21LM12	02 Sep 2022

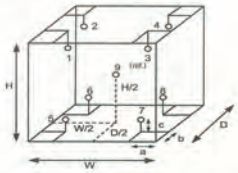
2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Environment during calibration	Beginning	Finished
Temp. (°C)	25	25
REL.Humid. (%)	54	58
AC Supply (Volt)	221	223



Position :	Ref. Std. ID No.:
1	9RTD-2/1
2	9RTD-2/2
3	9RTD-2/3
4	9RTD-2/4
5	9RTD-2/5
6	9RTD-2/6
7	9RTD-2/7
8	9RTD-2/8
9 (ref.)	9RTD-2/9

Probe Installation Details :

a = 10 cm
b = 10 cm
c = 10 cm

Dimension of Chamber :

D = 0.60 m
W = 1.0 m
H = 1.2 m
Capacity = 0.75 m^3

a 1106485

Equipment : Low Temp. Incubator
Condition As-Received : Used Item
Reference : 2204-0146OC-1

Cert. No.: 22TM317
Page.: 3 of 3

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (±°C)	Coverage Factor *k*
20.0	20.0	20.0	0.022	0.20	0.22	0.30	2

Calibration Point (°C)	Measured Temperature (°C) Position								
	1	2	3	4	5	6	7	8	9 (ref.)
20.0	20.209	20.174	20.199	20.110	20.075	20.062	20.027	20.069	20.030

Average* : The average of 30 values in each position.

Temperature stability : One-half of the greatest maximum difference of measured temperature at any one sensor.

Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.

UUC* : Unit Under Calibration

Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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 %.

-oOo-

a 1106484

RYG_EN0006

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ilac-MRA
NSC-TISI-TIS17025 CALIBRATION 0008

Cert. No.: 22TM1492
Page : 1 of 3

Certificate of Calibration

Equipment :	Hot Air Oven
Manufacturer :	Memmert
Model :	UM 400
Serial No. :	b495.0899
ID No. :	RYG_EN0006
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5, T. Maenam Khu, A. Pluakdaeng, Rayong 21140, Thailand
Location :	Oven Room
Received Order :	20 October 2022
Calibration Date :	20 October 2022
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %
Calibrated by :	Preecha Hlahib
Approved by :	Approved Signatory
Issue Date :	2 November 2022

REVIEW BY Thanitall.
APPROVED BY
NEXT CAL. DATE 20/04/24

( ) Pornthippa Tameyakul
(✓) Malee Butkruea
( ) Suwit Imjai

The Uncertainties are for a confidence probability of approximately 95%

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A 0046905

Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-1

Cert. No.: 22TM1492
Page : 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 according to direct measurement method with Data Acquisition which connected with Resistance Temperature Detector (RTD).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

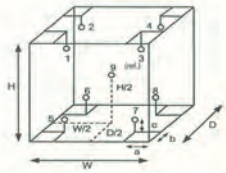
1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34970A	MY44035217	21LM30	23 Dec 2022

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Environment during calibration		
	Beginning	Finished
Temp. (°C)	28	29
REL.Humid. (%)	43	47
AC Supply (Volt)	220	221



Position :	Ref. Std. ID No.:
1	18-10RTD-01
2	18-10RTD-02
3	18-10RTD-03
4	18-10RTD-04
5	18-10RTD-05
6	18-10RTD-06
7	18-10RTD-07
8	18-10RTD-08
9 (ref.)	18-10RTD-09

Probe Installation Details :

a =	5.0	cm
b =	5.0	cm
c =	5.0	cm

Dimension of Chamber :

D =	0.33	m
W =	0.40	m
H =	0.40	m
Capacity =	0.053	m³

a 1132473

Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0376OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 22TM1492
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Uncertainty (±°C)	Coverage Factor *k*
70.0	70.0	70.0	0.079	0.47	0.77	0.42	2

Calibration Point (°C)	Measured Temperature (°C) Position								
	1	2	3	4	5	6	7	8	9 (ref.)
70.0	70.262	69.995	70.079	70.177	70.664	70.039	70.688	70.149	70.328

Average* : The average of 30 values in each position.
Temperature stability : One-half of the greatest maximum difference of measured temperature at any one senso
Temperature uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observatior
UUC* : Unit Under Calibration
Note : The reported uncertainty of measurement was included stability and excluded uniformity .

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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a 1132472

RYG_EN0061

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NSC-TISI-TIS17025 CALIBRATION 0008

Cert. No.: 22TM1491
Page : 1 of 3

Certificate of Calibration

Equipment :	Water Bath
Manufacturer :	Memmert
Model :	WNB22
Serial No. :	L513.0648
ID No. :	RYG_EN0061
Submitted by :	ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5, T. Maenam Khu, A. Pluakdaeng, Rayong 21140, Thailand
Location :	Wet Chemistry Lab
Received Order :	20 October 2022
Calibration Date :	20 October 2022
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %
Calibrated by :	Preecha Hlahib
Approved by :	Approved Signatory
Issue Date :	2 November 2022

REVIEW BY Thanitall.
APPROVED BY
NEXT CAL. DATE 20/04/24

( ) Pornthippa Tameyakul
(✓) Malee Butkruea
( ) Suwit Imjai

The Uncertainties are for a confidence probability of approximately 95%

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A 0046906

Equipment : Water Bath **Cert. No.:** 22TM1491
Condition As-Received : Used Item **Page :** 2 of 3
Reference : 2210-0376OC-4

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT04 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer (IPRT).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

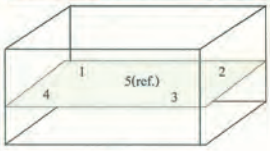
1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34970A	MY44035217	21LM30	23 Dec 2022

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

	Environmental		AC Voltage Supply
	(°C)	(%R.H.)	(Volt)
Beginning of Calibration	24	53	222
Finished of Calibration	24	50	221



Front

Position :	Ref. Std. S/N.:
1	N37P300726
2	N37P300727
3	N37P300728
4	N37P300729
5(ref.)	N37P300730

a 1132471

Equipment : Water Bath **Cert. No.:** 22TM1491
Condition As-Received : Used Item **Page :** 3 of 3
Reference : 2210-0376OC-4
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C) Position 1	2	3	4	5 (ref.)
85.0	85.0	85.0	84.527	84.563	84.628	84.516	84.580

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Uncertainty (± °C)	Coverage Factor *k*
85.0	0.12	0.081	0.18	2

Average* : The average of 30 values in each position.
Uniformity : The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time or at as close an observation time as possible to determine the temperature pattern or homogeneity within the chamber under steady-state conditions.
Stability : One-half of the greatest maximum difference of measured temperature at any one probe.
UUC* : Unit Under Calibration
Note : The reported uncertainty of measurement was included stability and excluded uniformity.

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 %.

-o0o-

a 1132470

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Metrological Center
SCI ECO Services Company Limited
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Saraburi Tel : +66 3627 3096 Fax : +66 3627 3100
Bangkok Tel : +668 9205 6851 , +669 8247 2360
Website : www.scieco.co.th E-Mail : calibrate@scg.com

NSC-TISI-TIS 17025 CALIBRATION 0244

Certificate No. T230116 **Page 1 of 4**

Certificate of Calibration

Equipment	: Chamber (Cooling Room)
Manufacturer	: MODULAR
Model	: IREVCOHCOO
Serial No.	: C00351459
Customer Code	: RYG_EN0184
ID No.	: T1939A5
Customer	: ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) 616/10 Moo 5 T.Maenam Khu, A.Pluakdaeng, Rayong 21140
Customer Location	: Laboratory
Date of Receipt	: 23 January 2023
Calibrated By	: Atiphong Rongrat (Technician)
Approved By	: _____ / Boonchai Suriyawong (Site Calibration Manager)
Date of Issue	: 07 FEB 2023

REVIEW BY
APPROVED BY
NEXT CAL. DATE 23/07/24

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

FM-L14/18/31/08-4

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NSC-TISI-TIS 17025 CALIBRATION 0244

Certificate No. T230116 **Page 2 of 4**

Calibration Report

Equipment : **Chamber (Cooling Room)**
Date of Calibration : **25 January 2023**
Environment : **Temperature : 23.4-24.9 °C**
Line Voltage : 221.4-230.2 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert 16 standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20 (based on ASTM E145-94 (Reapproved 2001) and AS2853-1986).
   All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .
2. Reference Standard Instrument

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN141-TN150	T222123	5 October 2023
TC	TYPE T	TN151-TN160	T222123	5 October 2023
DATA LOGGER	34970A	T150	T222123	5 October 2023

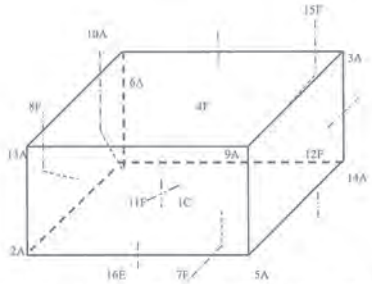
3. This certificate is traceable to :
   National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)
4. Condition of calibrated item : good
   Equipment Description :
   Time Constant : 1 Hour - Minute At 3 °C
   Fresh Air Damper ☐ Open ☐ Min. ☐ Medium ☐ Max.
   ☐ Close
   ☒ Not Available
5. Adjustment :
   (X) without adjustment ( ) after adjustment

Approved By. _____

FM-L14/17/19-REV.1

Certificate No. T230116

Calibration Report



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

1C = TN141	12F = TN152
2A = TN142	13A = TN153
3A = TN143	14A = TN154
4F = TN144	15F = TN155
5A = TN145	16E = TN156
6A = TN146	
7F = TN147	
8F = TN148	
9A = TN149	
10A = TN150	
11F = TN151	

Approved By.

SCG
Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.
NSC-TISI-TIS 17025 CALIBRATION 0394

Certificate No. T230116

Calibration Report

Measurement Results

Calibration Point	Average Standard Reading at each position (°C)											
	TN141	TN142	TN143	TN144	TN145	TN146	TN147	TN148	TN149	TN150	TN151	TN152
3.0	3.03	3.16	3.15	3.19	3.45	3.47	3.21	3.35	3.54	3.45	3.24	3.34
	TN153	TN154	TN155	TN156								
	3.28	3.22	3.28	3.21								

Chamber (Cooling Room)			Temperature Distribution			
Setting (°C)	Reading (°C)		Stability (±°C)	Uniformity (°C)	Uncertainty (±°C)	Coverage Factor k
	Min , Max	Average				
3.0	2.8 , 4.1	3.5	1.20	1.20	1.90	2.07

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By.

BKK_EL0037

Agilent Technologies

Agilent Technologies (Thailand) Limited
U CHU LIANG BLDG. 22/F UNIT A,D
968 RAMA 4 ROAD, SILOM, BANGRAK
Bangkok 10500 Thailand

Tel. +662 637 6363
Fax: +662 632 4334
Email: ccc-smt@agilent.com
Website: www.agilent.com/chem

Customer Contact:
ALS Laboratory Group (Thailand) Co Ltd
Head Office
104 Phatthanakan 40 Phatthanakan Rd
Khwaeng Phatthanakan Khet Suan
TAX ID : 0105540004859
Chanattagarn.lmchom@alsglobal.com
27603068

SERVICE REPORT

Customer Purchase Order Number:	**Customer Number:** 70371013
Service Request:	**Service Request Date:**
Service Order: 6006033911	**Service Confirmation:** 6904800024

Invoice To:
ALS Laboratory Group (Thailand) Co Ltd
Head Office
104 Phatthanakan 40 Phatthanakan Rd
Khwaeng Phatthanakan Khet Suan

REVIEW BY Thitipong S.
APPROVED BY Sawitri N.
NEXT CAL DATE 19 Sep 2024

Delivery Site:
ALS Laboratory Group (Thailand) Co Ltd
Head Office
104 Phatthanakan 40 Phatthanakan Rd
Khwaeng Phatthanakan Khet Suan

Direct Inquiries to:
Contact Name: Customer Contact Center
Contact E-mail: ccc-smt@agilent.com
Contact Telephone: +662 637 6363
Contact Fax: +662 632 4334

Location:
Room
Bldg
Lab
Dept

products | applications | software | services

Learn more about Agilent's Special Offers, Products, Services and our full range of laboratory productivity solutions optimized for your applications and workflows. Visit us at www.agilent.com/chem

Agilent Technologies (Thailand) Limited, Head Office
U Chu Liang Bldg, 22/F Unit A,D
968 Rama 4 Road, Silom, Bangrak,
Bangkok 10500 Thailand
Tax ID : 0105542008218

Citibank N.A, Bangkok Branch
399 Interchange 21 Building, Sukhumvit Road, Klongtoey Nua Sub-district, Wattana District, Bangkok 10110 Thailand
Acc. No: 012-4452-007 ,
THB:Krung Thai Bank PCL
Siam Square Br.,416/1-2 Rama I Rd.,Pathumwan, BKK 10330 Thailand

ORIGINAL

Service Confirmation Number: 6904800024
Service Confirmation Date: 20.03.2023

Service Instrument:

Model Number	Model Description	Serial Number	System Handle	Parent Asset
SYS-IO-5100	ICP-OES 5100/5110 System			
G8010A	Agilent 5100 SVDV ICP-OES Spectrometer	MY16010005	ICP OES 5100	SYS-IO-5100
G8410A	SPS 4 Autosampler	AU15440764	ICP OES 5100	SYS-IO-5100

Service Items:

Item	Service/Part #	Description	Qty	Entitlement	Service Start	Service End
1000	EQQ	Enterprise Operational Qualification	1.00	Agreement Entitlement - 100 % covered	20.03.2023	20.03.2023

Additional Information:

Service Confirmation Number: 0004800024
Service Confirmation Date: 20.03.2023

Service Information:

Problem Description: WU-S-OQ-I0-5100-5001143313		
Service Provided: Complete OOHW 5100ICPOES Equipment ID: BKK_EL0037, all tests passed		
Service Overview Code: Reason Code: Scheduled Service Diagnosis Code: Scheduled Service Resolution Code: Scheduled Service		
Reported Hours: 4.0	**Travel Hours:** 2.0	
Customer Field Service Representative Name: Kanyakorn Sukpathrajarern	**Customer Field Service Representative Signature:**	**Date:** 20 Mar 2023
Customer Name: Thitima Boonpeng	**Customer Signature:** Thitima B.	**Date:** 20 Mar 2023
Additional Comments:		

Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110
Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109
Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T220730

Certificate of Calibration

Equipment	: HEATING BLOCK
Manufacturer	: Environmental Express
Model	: SC 196
Serial No.	: 6974CECW3285
Customer Code	: BKK_EL0054
ID No.	: T5306A3
Customer	: ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250
Customer Location	: Acid Digestion Lab
Date of Receipt	: 30 March 2022
Calibrated By	: Watcharapon Sangtong (Technician)
Approved By	: _____ / Sujjar Naknakred (Site Calibration Manager)
Date of Issue	: 12 APR 2022

REVIEW BY Tattaporn C.
APPROVED BY Sujjar N.
NEXT CAL. DATE 7/10/23

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110
Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109
Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T220730

Calibration Report

Equipment	: HEATING BLOCK
Date of Calibration	: 7 April 2022
Environment	: Temperature : 21.8-23.1 °C Line Voltage : 221.6-226.3 V Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert nine standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20.
   All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .
2. Reference Standard Instrument :

Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN221-TN230	T210008	08 June 2022
TC	TYPE T	TN231-TN240	T210008	08 June 2022
DATA LOGGER	34970A	T149	T210008	08 June 2022

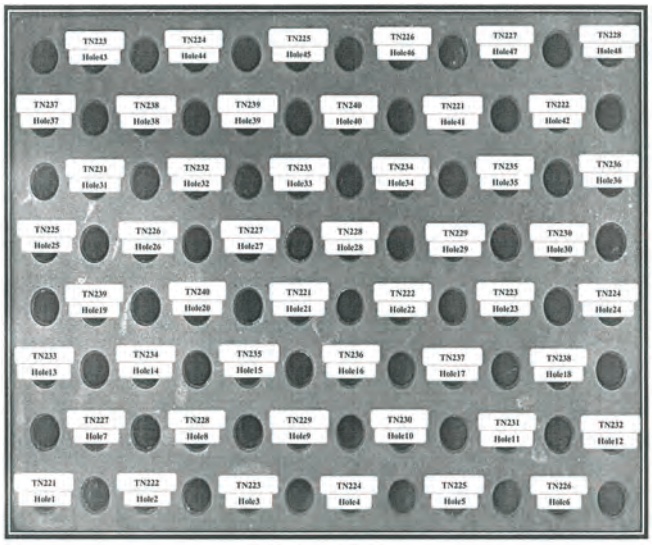
3. This certificate is traceable to :
   National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)
4. Condition of calibrated item : good
   Equipment Description :
   Time Constant 2 Hour 25 Minute At 95 °C
   Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
   ☐ Close
   ☒ Not Available
5. Adjustment :
   ( ) without adjustment (X) after adjustment

Approved By._____

Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110
Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109
Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Certificate No. T220730

Calibration Report



FRONT CONTROL

Approved By. _____

Metrological Center

SCI ECO Services Company Limited

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

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		TN221	TN222	TN223	TN224	TN225	TN226
CAL POINT	Max	93.60	93.82	94.05	94.20	94.36	94.26
95	Min	93.07	93.26	93.51	93.66	93.82	93.71
	Average	93.33	93.54	93.78	93.93	94.09	93.98
R2 Hole7-Hole12		TN227	TN228	TN229	TN230	TN231	TN232
	Max	94.59	94.79	94.63	94.55	94.82	95.00
	Min	94.05	94.25	94.08	93.97	94.26	94.44
	Average	94.32	94.52	94.36	94.26	94.54	94.72
R3 Hole13-Hole18		TN233	TN234	TN235	TN236	TN237	TN238
	Max	95.03	94.54	94.78	94.84	95.06	94.73
	Min	94.46	93.98	94.20	94.28	94.49	94.18
	Average	94.74	94.26	94.49	94.56	94.78	94.45
R4 Hole19-Hole24		TN239	TN240	TN221	TN222	TN223	TN224
	Max	94.89	94.82	95.73	95.85	95.73	96.10
	Min	94.33	94.26	95.51	95.62	95.51	95.85
	Average	94.61	94.54	95.62	95.73	95.62	95.97
R5 Hole25-Hole30		TN225	TN226	TN227	TN228	TN229	TN230
	Max	96.28	96.39	96.37	96.54	96.19	96.04
	Min	96.01	96.10	96.02	96.20	95.89	95.71
	Average	96.15	96.24	96.20	96.37	96.04	95.88
R6 Hole31-Hole36		TN231	TN232	TN233	TN234	TN235	TN236
	Max	96.84	96.97	97.03	96.48	96.33	95.76
	Min	96.53	96.65	96.71	96.08	95.98	95.43
	Average	96.68	96.81	96.87	96.28	96.16	95.60
R7 Hole37-Hole42		TN237	TN238	TN239	TN240	TN221	TN222
	Max	96.46	96.15	96.19	96.06	96.95	97.09
	Min	96.13	95.84	95.85	95.72	96.64	96.78
	Average	96.30	95.99	96.02	95.89	96.80	96.93
R8 Hole43-Hole48		TN223	TN224	TN225	TN226	TN227	TN228
	Max	96.91	96.58	96.13	96.19	96.34	96.19
	Min	96.55	96.21	95.80	95.87	96.03	95.88
	Average	96.73	96.40	95.96	96.03	96.18	96.03

Approved By. _____

Metrological Center

SCI ECO Services Company Limited

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

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Calibration Report

Measurement Results

Calibration Point		Average Standard Reading at each position (°C)					
R1 Hole1-Hole6		TN221	TN222	TN223	TN224	TN225	TN226
CAL POINT	Max	104.47	104.65	104.79	105.31	105.47	105.46
105	Min	104.15	104.27	104.45	104.98	105.14	105.20
	Average	104.31	104.46	104.62	105.15	105.31	105.33
R2 Hole7-Hole12		TN227	TN228	TN229	TN230	TN231	TN232
	Max	105.55	105.73	105.65	105.84	105.97	106.07
	Min	105.28	105.43	105.35	105.52	105.68	105.83
	Average	105.42	105.58	105.50	105.68	105.82	105.95
R3 Hole13-Hole18		TN233	TN234	TN235	TN236	TN237	TN238
	Max	106.14	106.06	105.81	106.05	105.81	105.87
	Min	105.85	105.81	105.55	105.80	105.53	105.64
	Average	106.00	105.94	105.68	105.92	105.67	105.75
R4 Hole19-Hole24		TN239	TN240	TN221	TN222	TN223	TN224
	Max	105.86	105.60	104.44	104.51	104.28	104.78
	Min	105.61	105.37	104.27	104.35	104.12	104.61
	Average	105.74	105.48	104.35	104.43	104.20	104.69
R5 Hole25-Hole30		TN225	TN226	TN227	TN228	TN229	TN230
	Max	104.94	104.93	104.97	105.08	104.68	104.69
	Min	104.77	104.75	104.76	104.90	104.51	104.49
	Average	104.85	104.84	104.86	104.99	104.60	104.59
R6 Hole31-Hole36		TN231	TN232	TN233	TN234	TN235	TN236
	Max	105.44	105.45	105.61	104.95	104.84	104.42
	Min	105.27	105.27	105.44	104.76	104.66	104.25
	Average	105.36	105.36	105.53	104.86	104.75	104.33
R7 Hole37-Hole42		TN237	TN238	TN239	TN240	TN221	TN222
	Max	105.17	104.70	104.59	104.51	105.22	105.53
	Min	105.00	104.53	104.41	104.35	105.04	105.37
	Average	105.08	104.62	104.50	104.43	105.13	105.45
R8 Hole43-Hole48		TN223	TN224	TN225	TN226	TN227	TN228
	Max	105.61	105.45	105.10	104.77	104.87	105.02
	Min	105.44	105.28	104.92	104.60	104.70	104.85
	Average	105.53	105.37	105.01	104.69	104.79	104.93

Approved By. _____

Metrological Center

SCI ECO Services Company Limited

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

Telephone : +66 2 586 5792-4 Fax : +66 2 586 5109

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

Calibration Report

Measurement Results:

HEATING BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C) Min , Max	Reading (°C) Average	Stability (±°C)	Uncertainty (±°C)
100.0	100.0 , 100.4	100.1	0.29	0.83
105.0	105.0 , 105.4	105.1	0.20	0.79

* The quoted uncertainty exclude " uniformity "

The calibration result apply only the above calibrated item.

The result of test was found accurate as shown on date and place of test only.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By. _____

Metrological Center

SCI ECO Services Company Limited

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

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

Bangkok Tel : +668 9205 6851 , +669 8247 2360

Website : www.scieco.co.th E-Mail : calibrate@scg.co.th

NSC-TISI-TIS 17025 CALIBRATION 3244

Certificate of Calibration

Equipment	:	Chamber (Cold Room)
Manufacturer	:	KOLDTECH
Model	:	KM 320
Serial No.	:	TBN-1012061/05
Customer Code	:	BKK_EN0167
ID No.	:	T2463A3
Customer	:	ALS Laboratory Group (Thailand) Co.,Ltd. 104 Phatthanakan 40, Phatthanakan Rd., Khwaeng Phatthanakan, Khet Suan Luang, Bangkok 10250
Customer Location	:	Environmental Laboratory
Date of Receipt	:	27 June 2022
Calibrated By	:	Sujjar Naknakred (Site Calibration Manager)
Approved By	:	_____ / Boonchai Suriyawong (Site Calibration Manager)
Date of Issue	:	04 JUL 2022

REVIEW BY Sirilak P.
APPROVED BY KL AL
NEXT CAL. DATE 30/12/23

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

This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation Scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the Metrological Center.

Certificate No. T221644

Calibration Report

Equipment : **Chamber (Cold Room)**
Date of Calibration : **30 June - 1 July 2022**
Environment : **Temperature : 18.9-23.7 °C**
Line Voltage : 222.9-226.5 V
Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. This equipment was calibrated by insert nine standard thermocouples type T into its chamber , the other one standard thermocouples type T use for ambient temperature measurement . The calibration was done in according to WI-T20 (based on ASTM E145-94 (Reapproved 2001) and AS2853-1986).
   All data show below were final values and the initial data from customer request . The temperature scale used was based on ITS - 90 .
2. Reference Standard Instrument :

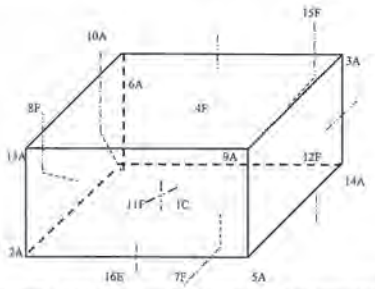
Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN161-TN170	T210009	30 July 2022
TC	TYPE T	TN171-TN180	T210009	30 July 2022
DATA LOGGER	34970A	T149	T210009	30 July 2022

3. This certificate is traceable to :
   National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244)
4. Condition of calibrated item : good
   Equipment Description :
   Time Constant 3 Hour - Minute At 3 °C
   Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
   ☐ Close
   ☒ Not Available
5. Adjustment :
   ( ) without adjustment (X) after adjustment

Approved By.

Certificate No. T221644

Calibration Report



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

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

11F	=	TN171
12F	=	TN172
13A	=	TN173
14A	=	TN174
15F	=	TN175
16E	=	TN176

Approved By.

Certificate No. T221644

Calibration Report

Measurement Results:

Calibration Point	Average Standard Reading at each position (°C)									
	TN161	TN162	TN163	TN164	TN165	TN166	TN167	TN168	TN169	TN170
3	2.71	2.82	2.75	2.89	2.95	3.68	3.02	2.96	3.03	2.85
	TN171	TN172	TN173	TN174	TN175	TN176				
	2.97	3.02	2.89	3.04	2.97	3.33				

Chamber (Cold Room)			Temperature Distribution				
Setting (°C)	Reading (°C)		Average (°C)	Stability (±°C)	Uniformity (°C)	Uncertainty (±°C)	Coverage Factor k
	Min , Max	Average					
3.0	2.9 , 4.0	3.2	2.99	1.05	1.30	1.66	2.00

* The quoted uncertainty exclude " uniformity "
The calibration result apply only the above calibrated item.
The result of test was found accurate as shown on date and place of test only.
The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k which for a t-distribution, providing a level of confidence of approximately 95 % .

Approved By.

BKK_EN0130

REVIEW BY Autcharawan S.
APPROVED BY Sarawut M.
NEXT CAL DATE 11 Jan 24

ARCHEMICA

Certificate of Calibration

ICS-2100: Anion (ID#488)

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

ICS-2100 S/N: 11080010
AS-HV S/N: 5050A23120

For

ALS Laboratory Group (Thailand) Co., Ltd.

Operator Signature: Date: Jan 11, 2023
(Mr.Nutdanai Laekhwan)
Application Chemist

SITHIPORN 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. : ACC22023
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 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

REVIEW BY Nnakorn P.
APPROVED BY
NEXT CAL DATE 31/8/23

Received Date : 22 AUGUST 2022
Calibration Date : 31 AUGUST 2022
Date of Issue : 02 SEPTEMBER 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(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.

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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	33461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23
Audio Analyzer	AVR-3360A	V744B6069	EF-0010-22	07-Feb-23

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).

T. Petch.

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	94.04	0.04	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 (%)
1.70	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 lavel of confidence of approximately 95 %

End of Calibration Certificate

T. Petch.

SITHIPORN 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. : ACL23039
Pages : 1 of 9

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-21/ Microphone UC-52 / Preamplifier NH-21
Serial No.: 01133046 / 157226 / 09873
ID No.: RYG_FS0006

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 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

REVIEW BY Nnakorn P.
APPROVED BY
NEXT CAL DATE 13/1/24

Received Date : 06 JANUARY 2023
Calibration Date : 13-18 JANUARY 2023
Date of Issue : 19 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(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.

Calibration Procedure : CP-AC-02

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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	8846A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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).

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

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
22.0

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

Frequency Weighting	Measured value (dB)
A - weight	21.4
C - weight	21.9
Flat	24.2

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	1.7	1.7	1.7	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-5.0	-4.9	-4.9	±5.0

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	-0.1	-0.1	-0.1	±1.5
250	-0.1	-0.1	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.1	0.1	0.1	±2.0
4000	0.1	0.1	0.1	±3.0
8000	0.1	0.1	0.2	±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

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
135.0	134.9	-0.1	± 1.1
134.0	133.9	-0.1	± 1.1
133.0	132.9	-0.1	± 1.1
132.0	131.9	-0.1	± 1.1
131.0	130.9	-0.1	± 1.1
129.0	128.9	-0.1	± 1.1
124.0	123.9	-0.1	± 1.1
119.0	118.9	-0.1	± 1.1
114.0	113.9	-0.1	± 1.1
109.0	108.9	-0.1	± 1.1
104.0	103.9	-0.1	± 1.1
99.0	98.9	-0.1	± 1.1
94.0	94.0	0.0	± 1.1
89.0	88.9	-0.1	± 1.1
84.0	83.9	-0.1	± 1.1
79.0	78.9	-0.1	± 1.1
74.0	73.9	-0.1	± 1.1
69.0	68.9	-0.1	± 1.1
64.0	63.9	-0.1	± 1.1
59.0	58.9	-0.1	± 1.1
54.0	53.9	-0.1	± 1.1
49.0	49.0	0.0	± 1.1
44.0	43.9	-0.1	± 1.1
39.0	38.7	-0.3	± 1.1

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	94.0	94.0	0.0	±0.5
120	94.0	94.0	0.0	±0.5
110	94.0	94.0	0.0	±0.5
100	94.0	94.0	0.0	±0.5
90	94.0	94.0	0.0	±0.5

Level linearity on each level range

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	43.0	43.0	0.0	±0.5
120	33.0	33.0	0.0	±0.5

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	128.0	0.0	±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	136.1	-0.3	±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

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.4	89.1	-0.3	±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

SITHIPORN 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

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-21/ Microphone UC-52 / Preamplifier NH-21
Serial No.: 00376364 / 71486 / 23142
ID No.: RYG_FS0012

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 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

CHECKED BY Nuakorn P.
APPROVED BY
NEXT CAL. DATE 16/12/23

Received Date : 07 DECEMBER 2022
Calibration Date : 16-20 DECEMBER 2022
Date of Issue : 21 DECEMBER 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(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.

Calibration Procedure : CP-AC-02

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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	8846A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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).

T. Petch.

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

T. Petch.

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise
2.1 Normal test

Measured Value (dB)
24.0

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

Frequency Weighting	Measured value (dB)
A - weight	22.2
C - weight	21.9
Flat	21.6

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)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.0	0.1	0.1	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.2	0.4	0.4	±5.0

T. Petch.

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	-0.2	0.0	0.0	±2.0
125	-0.1	0.0	0.0	±1.5
250	-0.1	0.0	0.0	±1.5
500	-0.1	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.1	±2.0
4000	0.0	0.1	0.1	±3.0
8000	0.0	0.2	0.2	±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	94.1	0.1	± 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

T. Petch.

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
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

T. Petch.

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	94.0	94.0	0.0	±0.5
120	94.0	94.0	0.0	±0.5
110	94.0	94.0	0.0	±0.5
100	94.0	94.0	0.0	±0.5
90	94.0	94.0	0.0	±0.5

Level linearity on each level range

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	43.0	43.0	0.0	±0.5
120	33.0	33.0	0.0	±0.5

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	108.0	0.0	1.5 ; -5.0
	2	8	117.0	117.0	0.0	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	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

T. Petch.

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	136.0	-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

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.4	89.2	-0.2	±1.5

T. Petch.

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 lavel of confidence of approximately 95 %

End of Calibration Certificate

T. Petch.

SITHIPORN 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

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-21/ Microphone UC-52 / Preamplifier NH-21
Serial No.: 00509355 / 143845 / 32731
ID No.: RYG_FS0015

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 ± 3) °C
Pressure : (101,3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %.

REVIEW BY Nanakorn P.
APPROVED BY
NEXT CAL. DATE 14/5/23

Received Date : 17 MAY 2022
Calibration Date : 24-27 MAY 2022
Date of Issue : 30 MAY 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(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.

Calibration Procedure : CP-AC-02

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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	8846A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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).

T. Petch.

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

T. Petch.

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
21.7

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

Frequency Weighting	Measured value (dB)
A - weight	21.5
C - weight	22.6
Flat	25.5

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	0.3	0.4	0.4	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.1	-1.0	-0.9	±5.0

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	0.0	±2.0
125	-0.1	0.0	0.0	±1.5
250	-0.1	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	0.1	0.1	0.1	±2.0
4000	0.1	0.1	0.1	±3.0
8000	0.1	0.2	0.2	±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

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
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	113.9	-0.1	± 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	49.1	0.1	± 1.1
44.0	44.1	0.1	± 1.1
39.0	39.4	0.4	± 1.1

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	94.0	94.0	0.0	±0.5
120	94.0	94.0	0.0	±0.5
110	94.0	94.0	0.0	±0.5
100	94.0	94.0	0.0	±0.5
90	94.0	94.0	0.0	±0.5

Level linearity on each level range

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	43.0	43.0	0.0	±0.5
120	33.0	33.0	0.0	±0.5

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	128.0	0.0	±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	136.3	-0.1	±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

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.4	89.3	-0.1	±1.5

T. Petchu.

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

T. Pet.

SITHIPORN 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. : ACL22162
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 01122567 / 143473 / 22605
ID No.: RYG_FS0016

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 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

REVIEW BY Nathakorn P.
APPROVED BY
NEXT CAL. DATE 11/4/23

Received Date : 06 JULY 2022
Calibration Date : 11-18 JULY 2022
Date of Issue : 19 JULY 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petchu.
(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.

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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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).

T. Petch.

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

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.7

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

Frequency Weighting	Measured value (dB)
A - weight	12.6
C - weight	18.7
Flat	24.5

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	0.2	0.2	0.2	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-1.0	-0.9	-0.9	±5.0

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	0.0	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	0.0	0.0	±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	0.1	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

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	53.9	-0.1	± 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	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

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	134.0	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	98.9	-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	136.0	-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	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.7	89.5	-0.2	±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 lavel of confidence of approximately 95 %

End of Calibration Certificate

SITHIPORN 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

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 01122578 / 143486 / 22620
ID No.: RYG_FS0017

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 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

REVIEW BY Nnakorn P.
APPROVED BY
NEXT CAL.DATE 3/1/24

Received Date : 14 DECEMBER 2022
Calibration Date : 03-05 JANUARY 2023
Date of Issue : 06 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :
(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.

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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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).

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

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
17.1

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

Frequency Weighting	Measured value (dB)
A - weight	16.6
C - weight	22.6
Flat	28.1

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	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.6	0.7	0.7	±5.0

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	-0.1	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	0.1	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

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	132.9	-0.1	± 1.1
132.0	131.9	-0.1	± 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	28.9	-0.1	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.0	0.0	± 1.1
25.0	25.0	0.0	± 1.1

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	134.0	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	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	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, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±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

T. Petch.

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.5	89.5	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 lavel of confidence of approximately 95 %

End of Calibration Certificate

T. Petch.

SITHIPORN 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

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 01122579 / 172172 / 74022
ID No.: RYG_FS0018

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 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

REVIEW BY Nathakorn P.
APPROVED BY
NEXT CAL DATE 3/1/2024

Received Date : 14 DECEMBER 2022
Calibration Date : 03-05 JANUARY 2023
Date of Issue : 06 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(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.

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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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).

T. Petch.

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

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.1

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

Frequency Weighting	Measured value (dB)
A - weight	12.0
C - weight	20.1
Flat	26.6

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)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.0	0.1	0.1	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.1	0.1	0.1	±5.0

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	0.1	±2.0
4000	0.0	0.1	0.1	±3.0
8000	0.1	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	94.1	0.1	± 0.3

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	114.1	0.1	± 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	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.8	-0.2	± 1.1

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	107.9	-0.1	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	108.0	0.0	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, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±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

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.5	89.5	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 lavel of confidence of approximately 95 %

End of Calibration Certificate

SITHIPORN 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

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-21/ Microphone UC-52 / Preamplifier NH-21
Serial No.: 00465461 / 108081 / 19513
ID No.: RYG_FS0007

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 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

REVIEW BY Nawakorn P.
APPROVED BY
NEXT CAL DATE 13/1/24

Received Date : 06 JANUARY 2023
Calibration Date : 13-18 JANUARY 2023
Date of Issue : 19 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :
(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.

Calibration Procedure : CP-AC-02

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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	8846A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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).

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

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
23.5

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

Frequency Weighting	Measured value (dB)
A - weight	22.2
C - weight	21.6
Flat	22.2

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	0.2	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.1	0.2	0.2	±5.0

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	0.0	±2.0
125	-0.1	-0.1	-0.1	±1.5
250	-0.1	-0.1	-0.1	±1.5
500	-0.1	-0.1	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.1	0.1	0.0	±2.0
4000	0.1	0.0	0.0	±3.0
8000	0.1	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

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
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

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	94.0	94.0	0.0	±0.5
120	94.0	94.0	0.0	±0.5
110	94.0	94.0	0.0	±0.5
100	94.0	94.0	0.0	±0.5
90	94.0	94.0	0.0	±0.5

Level linearity on each level range

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
130	43.0	43.0	0.0	±0.5
120	33.0	32.6	-0.4	±0.5

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	134.0	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	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	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, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.9	-0.5	±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	135.0	-0.4	±2.0
Negative half cycle	135.4	135.0	-0.4	±2.0

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.4	89.3	-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

SITHIPORN 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

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 01122607 / 145554 / 34373
ID No.: RYG_FS0019

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 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

REVIEW BY Nathakorn P.
APPROVED BY
NEXT CAL. DATE 13/1/24

Received Date : 06 JANUARY 2023
Calibration Date : 13-18 JANUARY 2023
Date of Issue : 19 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :
(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.

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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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).

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

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.7

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	16.5
Flat	22.4

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	0.6	0.6	0.6	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-2.3	-2.3	-2.3	±5.0

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	-0.1	0.0	±2.0
125	0.0	0.1	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

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	104.1	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	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	27.0	0.0	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.8	-0.2	± 1.1

T. Petch.

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	108.0	0.0	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

T. Petch.

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.6	89.7	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 lavel of confidence of approximately 95 %

End of Calibration Certificate

SITHIPORN 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. : ACL22194
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00597168 / 179117 / 87524
ID No.: RYG_FS0438

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 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

REVIEW BY Nathakorn P.
APPROVED BY
NEXT CAL. DATE 4/9/23

Received Date : 06 SEPTEMBER 2022
Calibration Date : 07-09 SEPTEMBER 2022
Date of Issue : 14 SEPTEMBER 2022

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.

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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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).

T. Rotch.

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

T. Rotch.

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.1

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	18.1
Flat	23.8

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	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	1.7	1.8	1.8	±5.0

T. Rotch.

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	0.1	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	0.1	±2.0
4000	0.1	0.1	0.1	±3.0
8000	0.1	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	94.1	0.1	± 0.3

T. Rotch.

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	114.1	0.1	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.1	0.1	± 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	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

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, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±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

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.5	89.5	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 lavel of confidence of approximately 95 %

End of Calibration Certificate

SITHIPORN 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. : ACL22195
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00597169 / 180411 / 88181
ID No.: RYG_FS0439

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 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

REVIEW BY Nnakorn P.
APPROVED BY
NEXT CAL. DATE 4/9/23

Received Date : 06 SEPTEMBER 2022
Calibration Date : 07-09 SEPTEMBER 2022
Date of Issue : 14 SEPTEMBER 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by :
(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.

Cert. No. : ACL22195
Job No. : VC65AC0081
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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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).

Cert. No. : ACL22195
Job No. : VC65AC0081
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	✓	-	0.3	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

Cert. No. : ACL22195
Job No. : VC65AC0081
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.1

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

Frequency Weighting	Measured value (dB)
A - weight	13.1
C - weight	19.3
Flat	24.8

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	0.0	0.0	± 1.0
8000	1.2	1.3	1.2	±5.0

Cert. No. : ACL22195
Job No. : VC65AC0081
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	-0.1	-0.1	-0.1	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±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	0.1	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

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	53.9	-0.1	± 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	26.0	0.0	± 1.1
25.0	25.0	0.0	± 1.1

T. Petch.

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	128.0	0.0	±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	136.3	-0.1	±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	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

T. Petch.

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.5	89.6	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 lavel of confidence of approximately 95 %

End of Calibration Certificate

T. Petch.

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

451-451/1 Sirinthorn Rd.,Bangbumru, Bangplud Bangkok 10700 THAILAND.
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NSC-TISI-TIS 17025 CALIBRATION 0394

Cert. No. : ACL22227
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42A/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00623388 / 198635 / 26416
ID No.: -

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 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

REVIEW BY Nnakorn P.
APPROVED BY
NEXT CAL. DATE 12/10/23

Received Date : 28 SEPTEMBER 2022
Calibration Date : 12-17 OCTOBER 2022
Date of Issue : 18 OCTOBER 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petch.
(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.

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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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).

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

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	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	11.6
C - weight	17.4
Flat	23.2

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	0.2	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.8	0.9	0.9	±5.0

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	0.0	±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	93.9	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	93.9	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	94.1	0.1	± 0.3

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	114.1	0.1	± 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	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

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, Lcpeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	±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

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 lavel of confidence of approximately 95 %

End of Calibration Certificate

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

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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. : ACL23083
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00734225 / 157777 / 22653
ID No.: RYG_FS0030

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 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 24 JANUARY 2023
Calibration Date : 25-26 JANUARY 2023
Date of Issue : 27 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :
(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.

Cert. No. : ACL23083
Job No. : VC66AC0031
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 :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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).

T. Retch.

Cert. No. : ACL23083
Job No. : VC66AC0031
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	✓	-	0.3	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

T. Retch.

Cert. No. : ACL23083
Job No. : VC66AC0031
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
19.1

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

Frequency Weighting	Measured value (dB)
A - weight	13.1
C - weight	19.1
Flat	24.9

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	0.3	0.3	0.3	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-1.1	-1.1	-1.0	±5.0

T. Retch.

Cert. No. : ACL23083
Job No. : VC66AC0031
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	-0.1	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	94.1	0.1	± 0.3

T. Retch.

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	38.9	-0.1	± 1.1
34.0	34.0	0.0	± 1.1
30.0	29.9	-0.1	± 1.1
29.0	28.9	-0.1	± 1.1
28.0	27.9	-0.1	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

T. Petch.

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	136.0	-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	133.1	0.1	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

T. Petch.

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	137.1	-0.1	±0.3

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

End of Calibration Certificate

T. Petch.

JNAC JIRANATE ASSOCIATES CO.,LTD.
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

ilac-MRA NAC - 1051 - TS 17025 CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CL-018-66
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer.: Delta OHM
Model: HD32.2
Serial No: 15006718
ID No: RYG_FS0223

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

Received date: 23 Jan 2023
Calibration date: 03 Feb 2023
Issue date: 06 Feb 2023

Reference Used During Calibration
1.Standard Temperature Probe Model: STS-100 A500, Serial No.: 667682-09, Due date: 23 Mar 2023
2.Digital Temperature Indicator Model: DTI-1000-A MK II, Serial No.: 671407-00591 Due date: 22 July 2023

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

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

Traceability
The measurement results are traceable to the international system of units (SI) through National Institute of Metrology Thailand (NIMT) Certificate number: TT-0034-22, Certificate number: ER-0092-22

REVIEW BY Pitanatorn P.
APPROVED BY
NEXT CAL. DATE 3/2/24

Calibrated by
☑ Mr. Sorawit Thachalad
☐ Miss Jittraporn Lertsomphol

JNAC JIRANATE ASSOCIATES CO.,LTD.

Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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

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 No. : CL-018-66

Result of Calibration: ☑ Without Adjustment ☐ With Adjustment

Calibration Range: 20 – 40 °C

Function:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 18009588.
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
60	20.062	20.1	0.0	0.099
60	25.054	25.1	0.0	0.099
60	30.042	30.1	0.1	0.099
60	35.031	35.1	0.0	0.14
60	40.014	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015496.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.062	20.2	0.1	0.099
70	25.053	25.2	0.1	0.099
70	30.042	30.1	0.1	0.099
70	35.029	35.1	0.1	0.099
70	40.016	40.0	0.0	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 20019638.
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.062	20.2	0.1	0.099
110	25.053	25.2	0.1	0.099
110	30.042	30.2	0.2	0.099
110	35.031	35.3	0.3	0.099
110	40.013	40.3	0.3	0.099

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

★ End of Certificate ★

JIRANATE ASSOCIATES CO.,LTD.

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. : 22PH448

Equipment : Lux Meter
Manufacturer: PEAK METER
Model : PM6612L
Serial No.: H12A-D16371
ID No.: RYG_FS0538
Condition As-Received: Used Item
Received Date: 31 August 2022
Calibration Date: 02 September 2022

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.

Reference: 2208-1093WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %

Submitted by: ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakan 40, Phatthanakan Rd.,
Khwaeng Phatthanakan, Khet Suan Luang,
Bangkok 10250 Thailand

Procedure used: Calibration were conducted using In-house calibration procedure CP-PH01 by measuring against luminous-intensity standard lamp (source-based method) According to the inverse square law measurement method.

Condition of this result of calibration

1.Reference standards instuments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) High-accuracy Irradiance Standard	OL-FEL-U	F-1471	TP-1037-21	18 Oct 2022
2) Photometry & Encorder	LMguide 9,6 m	120RC003	61-140006-1	30 Apr 2023

2.This result of calibration was made on requested at the point specified by customer.
3.Test Equipment : Programmable Voltage/Current Source (Model : OL83A, S/N : 09220284).
4.Test Equipment : Illuminance Meter (Model : 51002, S/N : 080129).
5.The certificate is valid only to the item calibrated on date and place of calibration.
6.This Certification is traceable to the International System of Unit maintained at:-
-National Institute of Metrology Thailand (NIMT)

REVIEW BY Nipakorn P.
APPROVED BY
NEXT CAL. DATE 2/9/23

Calibrated by : Nivat Nitas
Issue Date : 06 September 2022

Approved Signatory :
[ ] Phalinee Prabpaipal
[ ] Chatchawan Khunpiluek
[✓] Nuntawat Khamchai

B 0296367

Cert. No.: 22PH448

Result of calibration:- ( ) Without adjustment (*) After adjustment
Function : Illuminance Measurement **Range :** Autorange

Standard Value (lx)	Before Adjust UUC* Reading (lx)	After Adjust UUC* Reading (lx)	Error (lx)	Uncertainty (± lx)
0	0.00	0.00	0.00	0.060
15	-	15.06	0.06	0.22
100	-	100.7	0.7	1.5
500	-	498	-2	7.3
1000	914	995	-5	15
2000	-	2024	24	30
3000	-	2940	-60	45
4000	-	3960	-40	59
5000	4580	5000	0	74

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 %

Before adjustment light source factor setting mode : L0 = 1.121
After adjustment light source factor setting mode : L0 = 1.227
UUC* = Unit Under Calibration.

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