ภาคผนวก ง

เอกสารรับรองการสอบเทียบเครื่องมือ

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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Ambient	Total Suspended Particulate	High Volume	RYG_FS0179	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0292	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0176	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0175	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0173	-	-	On site Calibration
Ambient	Total Suspended Particulate	High Volume	RYG_FS0177	-	-	On site Calibration
Ambient	Total Suspended Particulate	Digital Balance	RYG_EN0001	23-Mar-22	23-Mar-23	12
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0398	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0189	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0294	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0183	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0187	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0400	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	High Volume	RYG_FS0186	-	-	On site Calibration
Ambient	Particulate Matter (PM-10)	Digital Balance	RYG_EN0001	23-Mar-22	23-Mar-23	12
Ambient	Arsenic	High Volume	RYG_FS0174	-	-	On site Calibration
Ambient	Arsenic	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Ambient	Cadmium	High Volume	RYG_FS0174	-	-	On site Calibration
Ambient	Cadmium	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Ambient	Lead	High Volume	RYG_FS0174	-	-	On site Calibration
Ambient	Lead	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Ambient	Mercury	High Volume	RYG_FS0174	-	-	On site Calibration
Ambient	Mercury	CVAFS	BKK_EL0011	7-Jun-22	6-Jun-23	12
Ambient	Nitrogen Dioxide	NO_2 Analyzer	RYG_FS0461	1-Jul-22	1-Jan-23	6
Ambient	Nitrogen Dioxide	NO_2 Analyzer	BKK_FS1064	1-Jul-22	1-Jan-23	6
Ambient	Nitrogen Dioxide	NO_2 Analyzer	RYG_FS0272	1-Jul-22	1-Jan-23	6
Ambient	Nitrogen Dioxide	NO_2 Analyzer	RYG_FS0252	1-Jul-22	1-Jan-23	6
Ambient	Nitrogen Dioxide	NO_2 Analyzer	RYG_FS0453	1-Jul-22	1-Jan-23	6
Ambient	Nitrogen Dioxide	NO_2 Analyzer	RYG_FS0459	1-Jul-22	1-Jan-23	6
Ambient	Nitrogen Dioxide	NO_2 Analyzer	RYG_FS0463	1-Jul-22	1-Jan-23	6
Ambient	Sulfur Dioxide	SO_2 Analyzer	RYG_FS0460	1-Jul-22	1-Jan-23	6
Ambient	Sulfur Dioxide	SO_2 Analyzer	RYG_FS0266	1-Jul-22	1-Jan-23	6
Ambient	Sulfur Dioxide	SO_2 Analyzer	RYG_FS0271	1-Jul-22	1-Jan-23	6
Ambient	Sulfur Dioxide	SO_2 Analyzer	RYG_FS0251	1-Jul-22	1-Jan-23	6
Ambient	Sulfur Dioxide	SO_2 Analyzer	RYG_FS0452	1-Jul-22	1-Jan-23	6
Ambient	Sulfur Dioxide	SO_2 Analyzer	RYG_FS0458	1-Jul-22	1-Jan-23	6
Ambient	Sulfur Dioxide	SO_2 Analyzer	RYG_FS0462	1-Jul-22	1-Jan-23	6
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0412	29-Jul-21	27-Jan-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0089	13-Jul-21	11-Jan-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0143	23-Feb-21	24-Aug-22	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0413	29-Jul-21	27-Jan-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	BKK_FS0141	7-Jun-21	6-Dec-22	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0414	29-Jul-21	27-Jan-23	18
Ambient	Wind Speed / Wind Direction	Wind Speed / Wind Direction	RYG_FS0530	14-Jul-21	12-Jan-23	18
Stack	Arsenic	Console Control Unit	BKK_FS0527	12-Jul-22	12-Jan-23	6
Stack	Arsenic	Console Control Unit	BKK_FS0518	12-Jul-22	12-Jan-23	6
Stack	Arsenic	Flue gas Analyzer	RYG_FS0465	19-Jan-22	19-Jan-23	12
Stack	Arsenic	Flue gas Analyzer	RYG_FS0564	9-Dec-21	9-Dec-22	12
Stack	Arsenic	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Stack	Cadmium	Console Control Unit	BKK_FS0527	12-Jul-22	12-Jan-23	6
Stack	Cadmium	Console Control Unit	BKK_FS0518	12-Jul-22	12-Jan-23	6
Stack	Cadmium	Flue gas Analyzer	RYG_FS0465	19-Jan-22	19-Jan-23	12
Stack	Cadmium	Flue gas Analyzer	RYG_FS0564	9-Dec-21	9-Dec-22	12
Stack	Cadmium	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Stack	Lead	Console Control Unit	BKK_FS0527	12-Jul-22	12-Jan-23	6
Stack	Lead	Console Control Unit	BKK_FS0518	12-Jul-22	12-Jan-23	6
Stack	Lead	Flue gas Analyzer	RYG_FS0465	19-Jan-22	19-Jan-23	12
Stack	Lead	Flue gas Analyzer	RYG_FS0564	9-Dec-21	9-Dec-22	12
Stack	Lead	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18

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รายการเครื่องมือที่ใช้ในการวิเคราะห์ / ทดสอบ

Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Stack	Mercury	Console Control Unit	BKK_FS0527	12-Jul-22	12-Jan-23	6
Stack	Mercury	Console Control Unit	BKK_FS0518	12-Jul-22	12-Jan-23	6
Stack	Mercury	Flue gas Analyzer	RYG_FS0465	19-Jan-22	19-Jan-23	12
Stack	Mercury	Flue gas Analyzer	RYG_FS0564	9-Dec-21	9-Dec-22	12
Stack	Mercury	CVAFS	BKK_EL0011	7-Jun-22	6-Jun-23	12
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0527	12-Jul-22	12-Jan-23	6
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS0507	3-Jul-22	3-Jan-23	6
Stack	Total Suspended Particulate	Console Control Unit	BKK_FS1093	3-Jul-22	3-Jan-23	6
Stack	Total Suspended Particulate	Flue gas Analyzer	RYG_FS0465	19-Jan-22	19-Jan-23	12
Stack	Total Suspended Particulate	Flue gas Analyzer	BKK_FS1156	10-Dec-21	10-Dec-22	12
Stack	Total Suspended Particulate	Digital Balance	BKK_EN0002	25-Feb-22	25-Feb-23	12
Stack	PM10	Console Control Unit	BKK_FS0527	12-Jul-22	12-Jan-23	6
Stack	PM10	Flue gas Analyzer	RYG_FS0465	19-Jan-22	19-Jan-23	12
Stack	PM10	Digital Balance	RYG_EN0004	23-Mar-22	23-Mar-23	12
Stack	Volatile Organic Compounds	Console Control Unit	BKK_FS0527	12-Jul-22	12-Jan-23	6
Stack	Volatile Organic Compounds	Flue gas Analyzer	RYG_FS0465	19-Jan-22	19-Jan-23	12
Stack	Volatile Organic Compounds	Field Rotameter	BKK_FS1039	1-Jul-22	1-Oct-22	3
Stack	Volatile Organic Compounds	GC-MSD	BKK_EN0119	1-Oct-21	1-Apr-23	18
Stack (CEMs)	Oxides of Nitrogen	Analyzer , System calibration, S	-	-	-	-
Stack (CEMs)	Sulfur Dioxide	Analyzer , System calibration, S	-	-	-	-
Workplace	Total Dust	Field Rotameter	RYG_FS0198	1-Jul-22	1-Oct-22	3
Workplace	Total Dust	Field Rotameter	RYG_FS0198	1-Oct-22	1-Jan-23	3
Workplace	Total Dust	Digital Balance	RYG_EN0004	23-Mar-22	23-Mar-23	12
Noise	Leq 24 hrs	Sound Calibrator	RYG_FS0213	26-Apr-22	26-Apr-23	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0026	21-Jan-22	21-Jan-23	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0387	13-Sep-21	13-Sep-22	12
Noise	Leq 24 hrs	Sound Calibrator	RYG_FS0216	31-Aug-22	31-Aug-23	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0027	10-Jan-22	10-Jan-23	12
Noise	Leq 24 hrs	Sound Level Meter	RYG_FS0031	20-Jun-22	20-Jun-23	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0496	10-Jan-22	10-Jan-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0022	21-Jan-22	21-Jan-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0029	24-May-22	24-May-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0030	21-Jan-22	21-Jan-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0303	11-Jul-22	11-Jul-23	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0496	10-Jan-22	10-Jan-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0024	4-Oct-21	4-Oct-22	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0025	21-Jan-22	21-Jan-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0301	13-Sep-21	13-Sep-22	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0302	11-Jul-22	11-Jul-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0304	11-Jul-22	11-Jul-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0300	11-Jul-22	11-Jul-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0431	21-Jan-22	21-Jan-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0387	13-Sep-21	13-Sep-22	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0388	13-Sep-21	13-Sep-22	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0216	31-Aug-22	31-Aug-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0303	11-Jul-22	11-Jul-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0300	11-Jul-22	11-Jul-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0384	26-Aug-22	26-Aug-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0437	7-Sep-22	7-Sep-23	12
Noise	Leq 8 hrs	Sound Calibrator	RYG_FS0216	31-Aug-22	31-Aug-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0301	18-Oct-22	18-Oct-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0302	11-Jul-22	11-Jul-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0304	11-Jul-22	11-Jul-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0491	10-Jan-22	10-Jan-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0492	10-Jan-22	10-Jan-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0493	10-Jan-22	10-Jan-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0494	10-Jan-22	10-Jan-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0495	10-Jan-22	10-Jan-23	12
Noise	Leq 8 hrs	Sound Level Meter	RYG_FS0381	26-Aug-22	26-Aug-23	12

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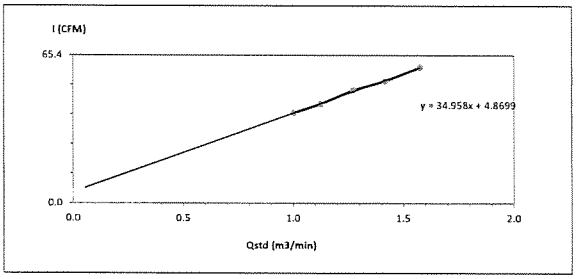
Sample Name	Parameter	Equipment Name	ID No.	Calibrated Date	Next Cal	Freq. Calibrate (Months)
Noise	Noise Dose, TWA	Dose Badge Reader	RYG_FS0440	7-Sep-21	7-Sep-22	12
Noise	Noise Dose, TWA	Dose Badge Reader	RYG_FS0210	7-Sep-21	7-Sep-22	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0231	3-Aug-22	3-Aug-23	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0232	3-Aug-22	3-Aug-23	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0231	3-Aug-22	3-Aug-23	12
Heat	Heat Stress	Heat Stress Monitor	RYG_FS0356	16-Feb-22	16-Feb-23	12
Illuminance	Illuminance	Lux Meter	RYG_FS0471	08-Apr-22	08-Apr-23	12
Rayong Lab	pH at 25 °C	pH meter	RYG_EN0183	17-Mar-22	17-Mar-23	12
Rayong Lab	Sulfate	Spectrophotometer	RYG_EN0037	27-Sep-22	27-Mar-24	18
Rayong Lab	Sulfide	Chamber (Cold Room)	RYG_EN0184	22-Feb-22	22-Feb-23	12
Rayong Lab	Turbidity	Chamber (Cold Room)	RYG_EN0184	22-Feb-22	22-Feb-23	12
Rayong Lab	Dissolved Oxygen	Chamber (Cold Room)	RYG_EN0184	22-Feb-22	22-Feb-23	12
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	Total Suspended Solids	Electronic Balance	RYG_EN0002	23-Mar-22	23-Mar-23	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	23-Mar-22	23-Mar-23	12
Rayong Lab	Total Dissolved Solids 180°C	Hot Air Oven	RYG_EN0010	20-Oct-22	20-Apr-24	18
Rayong Lab	Conductivity	Conductivity meter	RYG_EN0029	23-Feb-22	24-Aug-23	18
Rayong Lab	Residual Chlorine	pH ISE Meter	RYG_EN0183	17-Mar-22	17-Mar-23	12
Rayong Lab	Salinity	Conductivity meter	RYG_EN0029	23-Feb-22	24-Aug-23	18
Rayong Lab	Oil & Grease	Electronic Balance	RYG_EN0002	23-Mar-22	23-Mar-23	12
Rayong Lab	Oil & Grease	Hot Air Oven	RYG_EN0006	20-Oct-22	20-Apr-24	18
Rayong Lab	Oil & Grease	Water Bath	RYG_EN0061	20-Oct-22	20-Apr-24	18
Rayong Lab	Temperature	Digital Termometer with Probe	RYG_EN0065	6-Jan-22	5-Jul-23	18
Water Lab	TPH C_6-C_9	Gas Chromatography (MSD)	BKK_EN0059	21-Jun-22	21-Dec-23	18
Water Lab	TPH C_{10}-C_{16}	Gas Chromatography (FID)	BKK_EN0103	20-Oct-21	20-Apr-23	18
Water Lab	TPH C_{16}-C_{36}	Gas Chromatography (FID)	BKK_EN0103	20-Oct-21	20-Apr-23	18
Water Lab	TPH C_{10}-C_{36}	Gas Chromatography (FID)	BKK_EN0103	20-Oct-21	20-Apr-23	18
Water Lab	Iron	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	18
Water Lab	Iron	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Iron	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Lead	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	18
Water Lab	Lead	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Lead	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Arsenic	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	18
Water Lab	Arsenic	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Arsenic	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Cadmium	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	18
Water Lab	Cadmium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Cadmium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Selenium	ICP-MS	BKK_EL0043	30-Sep-21	29-Mar-23	18
Water Lab	Selenium	Hot Block	BKK_EL0054	7-Apr-22	7-Oct-23	18
Water Lab	Selenium	Chamber (Cold Room)	BKK_EN0167	30-Jun-22	30-Dec-23	18
Water Lab	Mercury	CVAFS	BKK_EL0011	7-Jun-22	6-Jun-23	12
Coal	Lead	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Coal	Arsenic	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Coal	Cadmium	ICP-OES	BKK_EL0037	13-Sep-21	12-Mar-23	18
Coal	Mercury	CVAFS	BKK_EL0011	7-Jun-22	6-Jun-23	12

High Volume Air Sampler Calibration Worksheet

Project Site :	GHECO-ONE COMPANY LIMITED	Barometric Pressure (mm Hg) :	755
Calibrate Location :	โรงพยาบาลส่งเสริมสุขภาพตำบลมาบตาพุด	Temperature (°C) :	30
Calibrate Date :	15-Aug-22	High Volume ID :	RYG_FS0179
CalibrationSheet No.:	C-1S0BZZ-RYG_FS0179	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0205	High Volume S/N :	4805
Calibrator Model :	TE-5028A	Calibrator Slope :	1.53016
Calibrator S/N :	1166	Calibrator Intercept :	-0.0468

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression	
1	2.2	1.0049	40	Slope :	34.9582
2	2.8	1.1277	44	Intercept :	4.8699
3	3.6	1.2724	50	Correlation Coefficient :	0.9987
4	4.5	1.4171	54		
5	5.6	1.5754	60		



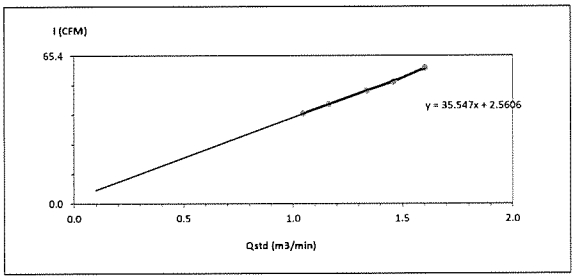
Calibrated by _____ Approved by : _____

(Mr.Apichart Wilars) (Mr. Noppong Juntarupan)
Field Scientist (1) Enviro Field Coordinator Scientist (3)

High Volume Air Sampler Calibration Worksheet

Project Site :	GHECO-ONE COMPANY LIMITED	Barometric Pressure (mm Hg) :	755
Calibrate Location :	สนง. มิตรฯ บางตาหุด	Temperature (°C) :	30
Calibrate Date :	15-Aug-22	High Volume ID :	RYG_FS0292
CalibrationSheet No.:	C-150822-RYG_FS0292	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0205	High Volume S/N :	5497
Calibrator Model :	TE-5028A	Calibrator Slope :	1.53016
Calibrator S/N :	1166	Calibrator Intercept :	-0.0468

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.4	1.0475	40	Slope : 35.5471
2	3.0	1.1657	44	Intercept : 2.5606
3	4.0	1.3387	50	Correlation Coefficient : 0.9989
4	4.8	1.4621	54	
5	5.8	1.6025	60	



Calibrated by _____ (Mr.Apichart Wilars) Field Scientist (1)

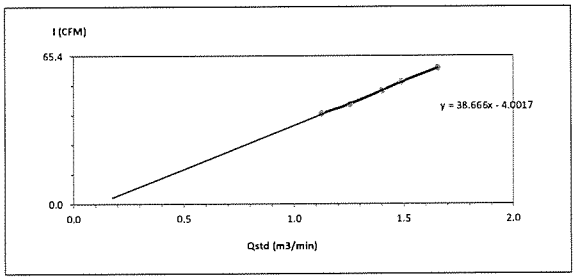
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

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

High Volume Air Sampler Calibration Worksheet

Project Site :	GHECO-ONE COMPANY LIMITED	Barometric Pressure (mm Hg) :	755
Calibrate Location :	ชุมชนตลาดวน-อ่าวประดู่	Temperature (°C) :	30
Calibrate Date :	15-Aug-22	High Volume ID :	RYG_FS0176
CalibrationSheet No.:	C-150822-RYG_FS0176	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0205	High Volume S/N :	4802
Calibrator Model :	TE-5028A	Calibrator Slope :	1.53016
Calibrator S/N :	1166	Calibrator Intercept :	-0.0468

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.8	1.1277	40	Slope : 38.6663
2	3.5	1.2553	44	Intercept : -4.0017
3	4.4	1.4018	50	Correlation Coefficient : 0.9988
4	5.0	1.4912	54	
5	6.2	1.6553	60	



Calibrated by _____ (Mr.Apichart Wilars) Field Scientist (1)

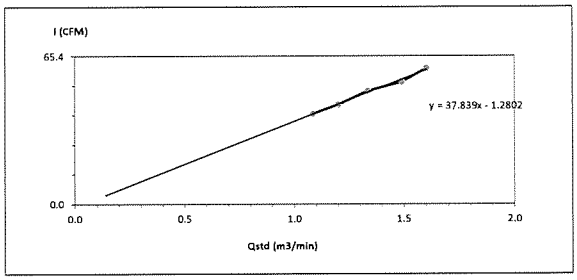
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

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

High Volume Air Sampler Calibration Worksheet

Project Site :	GHECO-ONE COMPANY LIMITED	Barometric Pressure (mm Hg) :	755
Calibrate Location :	วัดมาบปลุด	Temperature (°C) :	30
Calibrate Date :	15-Aug-22	High Volume ID :	RYG_FS0175
CalibrationSheet No.:	C-150822-RYG_FS0175	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0205	High Volume S/N :	4801
Calibrator Model :	TE-5028A	Calibrator Slope :	1.53016
Calibrator S/N :	1166	Calibrator Intercept :	-0.0468

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.6	1.0884	40	Slope : 37.8390
2	3.2	1.2023	44	Intercept : -1.2802
3	4.0	1.3387	50	Correlation Coefficient : 0.9957
4	5.0	1.4912	54	
5	5.8	1.6025	60	



Calibrated by _____ (Mr.Apichart Wilars) Field Scientist (1)

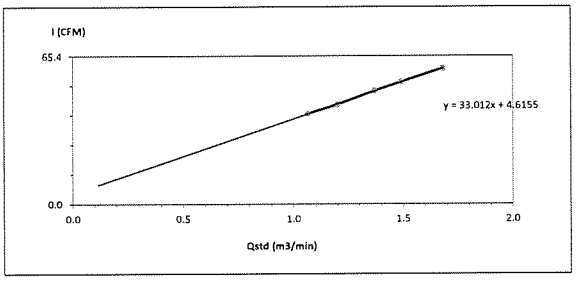
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

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

High Volume Air Sampler Calibration Worksheet

Project Site :	GHECO-ONE COMPANY LIMITED	Barometric Pressure (mm Hg) :	755
Calibrate Location :	ชุมชนซอยศิริ	Temperature (°C) :	30
Calibrate Date :	15-Aug-22	High Volume ID :	RYG_FS0173
CalibrationSheet No.:	C-150822-RYG_FS0173	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0205	High Volume S/N :	4799
Calibrator Model :	TE-5028A	Calibrator Slope :	1.53016
Calibrator S/N :	1166	Calibrator Intercept :	-0.0468

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.5	1.0682	40	Slope : 33.0117
2	3.2	1.2023	44	Intercept : 4.6155
3	4.2	1.3706	50	Correlation Coefficient : 0.9997
4	5.0	1.4912	54	
5	6.4	1.6810	60	



Calibrated by _____ (Mr.Apichart Wilars) Field Scientist (1)

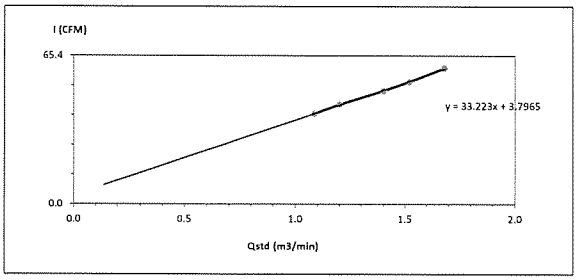
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

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

High Volume Air Sampler Calibration Worksheet

Project Site :	GHECO-ONE COMPANY LIMITED	**Barometric Pressure (mm Hg) :**	755
Calibrate Location :	ชุมชนตุลาวิวอมะราด	**Temperature (°C) :**	30
Calibrate Date :	15-Aug-22	**High Volume ID :**	RYG_FS0177
CalibrationSheet No.:	C-150822-RYG_FS0177	**High Volume Model :**	TE-5170D
Calibrator ID:	RYG_FS0205	**High Volume S/N :**	4803
Calibrator Model :	TE-5028A	**Calibrator Slope :**	1.53016
Calibrator S/N :	1166	**Calibrator Intercept :**	-0.0468

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression	
1	2.6	1.0884	40	Slope :	33.2228
2	3.2	1.2023	44	Intercept :	3.7965
3	4.4	1.4018	50	Correlation Coefficient :	0.9992
4	5.2	1.5198	54		
5	6.4	1.6810	60		



Calibrated by _____ (Mr.Apichart Wilars) 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

PENTA CALIBRATION

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

Certificate of Calibration

Represent to Certificate of Calibration ,PTC/07/22102

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

NSC-TISI-TIS17025 CALIBRATION 0324

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

REVIEW BY Thanthall.
APPROVED BY
NEXT CAL. DATE 23/03/23

Environment Condition:

Temperature	23.9 °C	±	0.3 °C
Humidity	58.1 %RH	±	4.4 %RH
Air density	1.17	kg/m^3	

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

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

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

Date Received: March 23, 2022
Calibration Date: March 23, 2022
Issued Date: March 25, 2022
Calibration By: Mr. Rungroje Metakul

PENTA CALIBRATION CO.,LTD.

(Mr.Kriangsak Kalasri) Reviewed by

Approved By : (Mr. Keattisak Kerdto) Laboratory Manager

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

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

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

PTC-FMC-07-03 2 Feb 2020

PENTA CALIBRATION

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

Represent to Certificate of Calibration ,PTC/07/22102

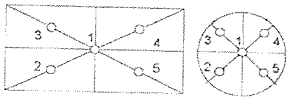
Certificate No : PTC/07/22102 Page: 2 of 2

Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

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



Eccentricity test 50 (g)

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

Repeatability Test : Weight to be 1/2 ≤ L_1 ≤ Maximum capacity

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

Nominal test value (g)	Standard Deviation
100	0.00009

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

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

Note: Weight of adjust - (g)

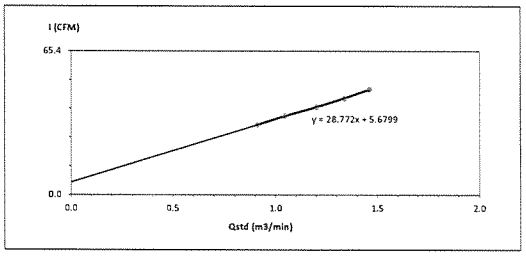
The End of Certificate

PTC-FMC-07-03 2 Feb 2020

High Volume Air Sampler Calibration Worksheet

Project Site :	GHECO-ONE COMPANY LIMITED	**Barometric Pressure (mm Hg) :**	755
Calibrate Location :	โรงพยาบาลส่งเสริมสุขภาพตำบลมาบตาพุด	**Temperature (°C) :**	30
Calibrate Date :	15-Aug-22	**High Volume ID :**	RYG_FS0398
CalibrationSheet No.:	C-150822-RYG_FS0398	**High Volume Model :**	TE-5009X
Calibrator ID:	RYG_FS0205	**High Volume S/N :**	5684
Calibrator Model :	TE-5028A	**Calibrator Slope :**	1.53016
Calibrator S/N :	1166	**Calibrator Intercept :**	-0.0468

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression	
1	1.8	0.9135	32	Slope :	28.7720
2	2.4	1.0475	36	Intercept :	5.6799
3	3.2	1.2023	40	Correlation Coefficient :	0.9993
4	4.0	1.3387	44		
5	4.8	1.4621	49		



Calibrated by _____ (Mr.Apichart Wilars) Field Scientist (1)

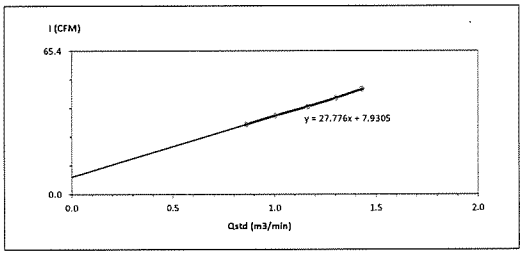
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

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

High Volume Air Sampler Calibration Worksheet

Project Site :	GHECO-ONE COMPANY LIMITED	Barometric Pressure (mm Hg) :	755
Calibrate Location :	สนง.บิดมา มาบตาพุด	Temperature (°C) :	30
Calibrate Date :	15-Aug-22	High Volume ID :	RYG_FS0189
CalibrationSheet No.:	C-150822-RYG_FS0189	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0205	High Volume S/N :	4797
Calibrator Model :	TE-5028A	Calibrator Slope :	1.53016
Calibrator S/N :	1166	Calibrator Intercept :	-0.0468

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	1.6	0.8639	32	Slope : 27.7765
2	2.2	1.0049	36	Intercept : 7.9305
3	3.0	1.1657	40	Correlation Coefficient : 0.9992
4	3.8	1.3060	44	
5	4.6	1.4323	48	



Calibrated by _____ (Mr.Apichart Wilars) Field Scientist (1)

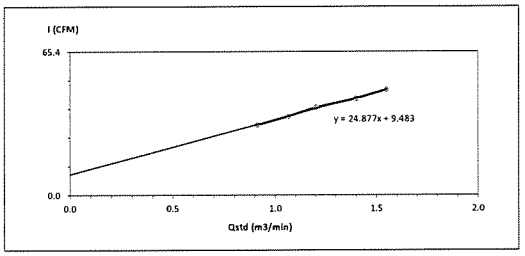
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

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

High Volume Air Sampler Calibration Worksheet

Project Site :	GHECO-ONE COMPANY LIMITED	Barometric Pressure (mm Hg) :	755
Calibrate Location :	ชุมชนตลาดวน-อ่าวประดู่	Temperature (°C) :	30
Calibrate Date :	15-Aug-22	High Volume ID :	RYG_FS0294
CalibrationSheet No.:	C-150822-RYG_FS0294	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0205	High Volume S/N :	5501
Calibrator Model :	TE-5028A	Calibrator Slope :	1.53016
Calibrator S/N :	1166	Calibrator Intercept :	-0.0468

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	1.8	0.9135	32	Slope : 24.8765
2	2.5	1.0682	36	Intercept : 9.4830
3	3.2	1.2023	40	Correlation Coefficient : 0.9983
4	4.4	1.4018	44	
5	5.4	1.5479	48	



Calibrated by _____ (Mr.Apichart Wilars) Field Scientist (1)

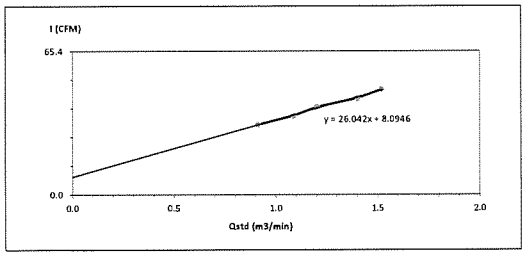
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

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

High Volume Air Sampler Calibration Worksheet

Project Site :	GHECO-ONE COMPANY LIMITED	Barometric Pressure (mm Hg) :	755
Calibrate Location :	วัดมาบปลาด	Temperature (°C) :	30
Calibrate Date :	15-Aug-22	High Volume ID :	RYG_FS0183
CalibrationSheet No.:	C-150822-RYG_FS0183	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0205	High Volume S/N :	4791
Calibrator Model :	TE-5028A	Calibrator Slope :	1.53016
Calibrator S/N :	1166	Calibrator Intercept :	-0.0468

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	1.8	0.9135	32	Slope : 26.0416
2	2.6	1.0884	36	Intercept : 8.0946
3	3.2	1.2023	40	Correlation Coefficient : 0.9968
4	4.4	1.4018	44	
5	5.2	1.5198	48	



Calibrated by _____ (Mr.Apichart Wilars) Field Scientist (1)

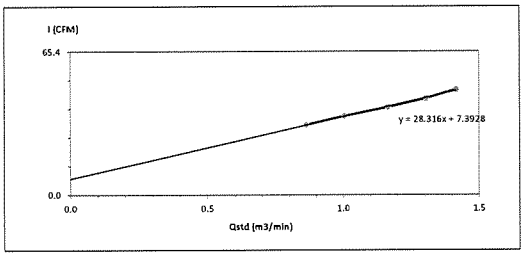
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

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

High Volume Air Sampler Calibration Worksheet

Project Site :	GHECO-ONE COMPANY LIMITED	Barometric Pressure (mm Hg) :	755
Calibrate Location :	ชุมชนหนองแฟบ	Temperature (°C) :	30
Calibrate Date :	15-Aug-22	High Volume ID :	RYG_FS0187
CalibrationSheet No.:	C-150822-RYG_FS0187	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0205	High Volume S/N :	4795
Calibrator Model :	TE-5028A	Calibrator Slope :	1.53016
Calibrator S/N :	1166	Calibrator Intercept :	-0.0468

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	1.6	0.8639	32	Slope : 28.3165
2	2.2	1.0049	36	Intercept : 7.3928
3	3.0	1.1657	40	Correlation Coefficient : 0.9982
4	3.8	1.3060	44	
5	4.5	1.4171	48	



Calibrated by _____ (Mr.Apichart Wilars) Field Scientist (1)

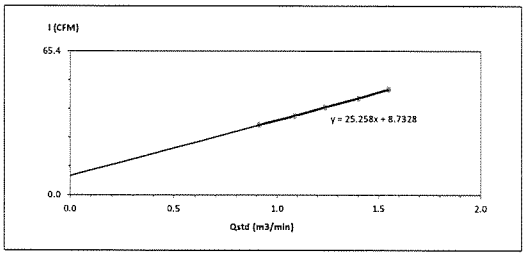
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

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

High Volume Air Sampler Calibration Worksheet

Project Site :	GHECO-ONE COMPANY LIMITED	Barometric Pressure (mm Hg) :	755
Calibrate Location :	ชุมชนบ่อยศรี	Temperature (°C) :	30
Calibrate Date :	15-Aug-22	High Volume ID :	RYG_FS0400
CalibrationSheet No.:	C-150822-RYG_FS0400	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0205	High Volume S/N :	5691
Calibrator Model :	TE-5028A	Calibrator Slope :	1.53016
Calibrator S/N :	1166	Calibrator Intercept :	-0.0468

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	1.8	0.9135	32	Slope : 25.2583
2	2.6	1.0884	36	Intercept : 8.7328
3	3.4	1.2379	40	Correlation Coefficient : 0.9996
4	4.4	1.4018	44	
5	5.4	1.5479	48	



Calibrated by _____ (Mr.Apichart Wilars) Field Scientist (1)

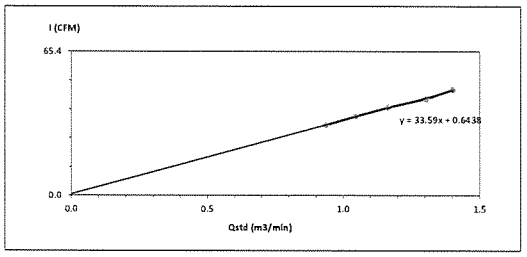
Approved by : _____ (Mr. Noppong Juntarupan) Enviro Field Coordinator Scientist (3)

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

High Volume Air Sampler Calibration Worksheet

Project Site :	GHECO-ONE COMPANY LIMITED	Barometric Pressure (mm Hg) :	755
Calibrate Location :	ชุมชนกุดรังนะพาด	Temperature (°C) :	30
Calibrate Date :	15-Aug-22	High Volume ID :	RYG_FS0186
CalibrationSheet No.:	C-150822-RYG_FS0186	High Volume Model :	TE-5009X
Calibrator ID:	RYG_FS0205	High Volume S/N :	4794
Calibrator Model :	TE-5028A	Calibrator Slope :	1.53016
Calibrator S/N :	1166	Calibrator Intercept :	-0.0468

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	1.9	0.9372	32	Slope : 33.5905
2	2.4	1.0475	36	Intercept : 0.6438
3	3.0	1.1657	40	Correlation Coefficient : 0.9987
4	3.8	1.3060	44	
5	4.4	1.4018	48	



Calibrated by _____ (Mr.Apichart Wilars) Field Scientist (1)

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

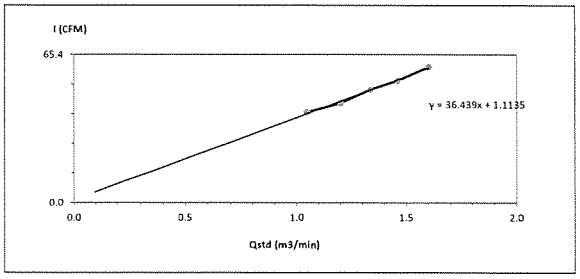
FORM NO.: F 06-074 REVISION NO.: - ISSUE DATE: 14/03/16

BKK_EL0037

High Volume Air Sampler Calibration Worksheet

Project Site :	GHECO-ONE COMPANY LIMITED	Barometric Pressure (mm Hg) :	755
Calibrate Location :	ชุมชนหนองแฟบ	Temperature (°C) :	30
Calibrate Date :	15-Aug-22	High Volume ID :	RYG_FS0174
CalibrationSheet No.:	C-150822-RYG_FS0174	High Volume Model :	TE-5170D
Calibrator ID:	RYG_FS0205	High Volume S/N :	4800
Calibrator Model :	TE-5028A	Calibrator Slope :	1.53016
Calibrator S/N :	1166	Calibrator Intercept :	-0.0468

Test No.	Delta H_2O (inch)	Q_{std} (m^3/min)	I : Chart (CFM)	Linear Regression
1	2.4	1.0475	40	Slope : 36.4386
2	3.2	1.2023	44	Intercept : 1.1135
3	4.0	1.3387	50	Correlation Coefficient : 0.9965
4	4.8	1.4621	54	
5	5.8	1.6025	60	



Calibrated by _____ (Mr.Apichart Wilars) 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

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Agilent CrossLab Compliance Services

Certificate of System Qualification

ES-OQ

System ID:	MY16010005
Organization Name:	ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location:	104 Phatthanakan 40 Phatthanakan Rd., Bangkok 10250
Date:	September 13, 2021 5:49:11 PM
EQP Name:	AgilentRecommended
EQP Revision:	ES.02.50
Overall Qualification Status:	Pass

Preparation

Pass

Instrument Tests

Pass

Autosampler Operation

Pass

REVIEW BY Thitiya B.
APPROVED BY Sauton N.
NEXT CAL. DATE 12 Mar 23

REVIEW BY Sudarat N.
APPROVED BY Sudarat N.
NEXT CAL. DATE 06/06/2023

Maintenance Protocol

Atomic Fluorescence Spectrometer
mercur / mercur plus

Serial-No.: 17001244 Customer-No.: COM-002

Date: 9/06/2022 Carried out by: Mr. Siphen Pak-on

Maintenance with following Operational Qualification (OQ) ☐
(requires a separate OQ protocol)

Company	บริษัท 1011001015 [illegible] กรุ๊ป (ประเทศไทย) จำกัด
User	[illegible]
Department	Lab
Street	104 [illegible] 40 [illegible]
Zip Code, City	[illegible] 10250
Country	ประเทศไทย
Phone	
Fax	
E-mail	

Maintenance works basic unit

tightness visual check inside the Mercur	☑
visual check if gold-traps are broken	☑
visual check if spectrometer is contaminated	☑
reactor cleaning	☑
check pump-hose, if necessary change it	☑
check drying-hose, output gas-liquid-separator	☑
test Bubble-Sensor	☑
check gas flows	☑
check volume flows, reagents	☑
recording stray light values	☑
measurement with 30 ng/l	☑

Maintenance works Autosampler Serial No.: 701 939

lubricate the dosing-winding (Teflon-grease-spray)	☑
clean the dosing cylinder, if necessary exchange it	☑
lubricate the winding system of the height drive with some drops of oil	☑
check the toothed belt	☑
check the position of the mechanical stopper (height: 13mm)	☑
check the pump rate of mixing pump (<14s AS52, typ.7s/<20s AS52S, typ.10s)	☑
check the pump rate of washing cup	☑
check the electrical hose connections for good contact	☑
check the connectors of the magnetic valves	☑
check the dosing hose for buckling, if necessary exchange it	☑

Device parameter		nominal value	actual value
visual check general tightness inside the Mercur		o.k.: ☑	changed: ☐
visual check Goldtraps		o.k.: ☑	changed: ☐
visual check spectrometer			
	cuvette	o.k.: ☑	changed: ☐
	lens	o.k.: ☑	changed: ☐
check pump hoses		o.k.: ☑	changed: ☐
check hoses and hose connectors		o.k.: ☑	changed: ☐
check and clean reactor		o.k.: ☑	changed: ☐
check drying hose output Gas-liquid-seperator		o.k.: ☑	changed: ☐
check bubble-sensor		o.k.: ☑	not o.k.: ☐
Check gasflow			
	Argon pressure valve 4	1.2 – 1.5 bar	1.5 bar
	Valve 1	10 Nl/h or 0.166 NL/min	0.167 NL/min
	Valve 2	50 Nl/h or 0.833 NL/min	0.83 NL/min
	Valve 3	5 Nl/h or 0.083 NL/min	0.083 NL/min
	Valve 4	10 Nl/h or 0.166 NL/min	0.166 NL/min
Check liquid flow			
	Acid	2.5ml/min ± 1 ml	1.5 ml/min
	Red.-agent	2.5ml/min ± 1 ml	1.5 ml/min
	Sample	10ml/min ± 2 ml	10 ml/min.
Adventitious light - values	(V)	from file	
	100	0	0
	200	0	0
	300	0	0
	350	0	0
	400	1	1
	450	2	2
	500	6	6
	550	13	14
	575	19	20
	600	27	28

analytikjena

Device parameter		nominal value	actual value
Analytical parameters			
Conditions.: max.conc.: 10µg/L	PMT-voltage: 404 V		
	Blank-solution		Int 0.0005
	without enrichment / FBR 30 ng/L	Int > 0.0015	Int_1 0.0022
		RSD < 3 %	RSD 1.12 %
Conditions.: max.conc.: 1.7µg/L	PMT-voltage: 395 V		
	Blank-solution		Int 0.0018
	with enrichment / FBR 30 ng/L	Int > 0.008	Int_2 0.0104
		RSD < 3 %	RSD 0.89 %
	Fok.- factor (Int_2 / Int_1)	> 3,5	4
Comments			

Mr. Sriokai Fak-on
Signature Technician

Signature Customer

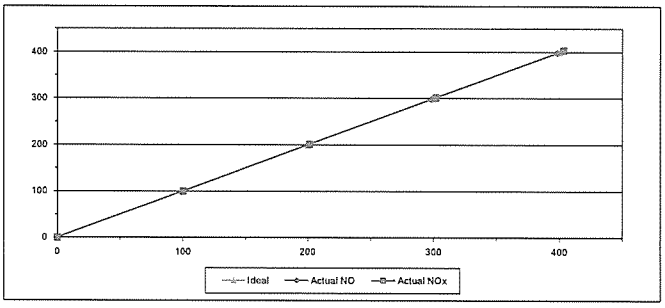
Bangkok, 7/06/2022.
Place, Date (DD/MM/YYYY)

06/06/2022
Place, Date (DD/MM/YYYY)

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	T95HWM41	Equipment ID	RYG_FS0461
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	98.70	-1.30	-1.30	100.10	0.10	0.10
2	200.00	201.00	1.00	0.50	201.40	1.40	0.70
3	300.00	298.30	-1.70	-0.57	302.10	2.10	0.70
4	400.00	398.40	-1.60	-0.40	403.50	3.50	0.88
AVERAGE (%)				-0.33			0.50



Calibrated By

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

Approved By

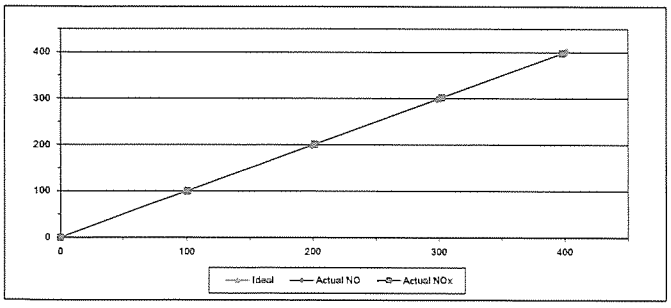
(Mr.Sarayuth Jittranont)
Assistant General Manager

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

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	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



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(Mr.Jirawut Sakam)
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Approved By

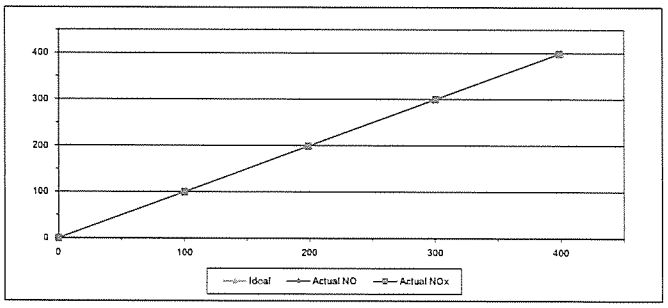
(Mr.Sarayuth Jittranont)
Assistant General Manager

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

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	7AV89544	Equipment ID	RYG_FS0272
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	99.10	-0.90	-0.90	100.10	0.10	0.10
2	200.00	198.60	-1.40	-0.70	199.00	-1.00	-0.50
3	300.00	298.70	-1.30	-0.43	300.50	0.50	0.17
4	400.00	398.00	-2.00	-0.50	398.70	-1.30	-0.33
AVERAGE (%)				-0.50			-0.09



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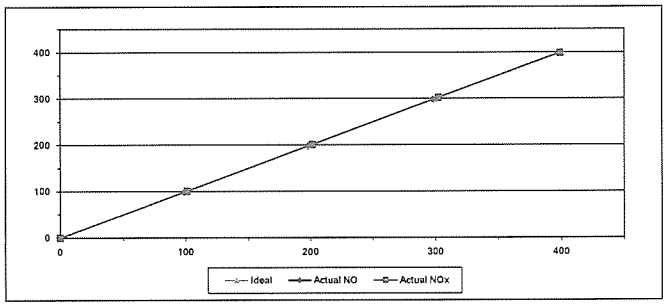
ALS Laboratory Group
FORM NO.: F 06-056 REVISION NO.: - ISSUE DATE: 02/04/12

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	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



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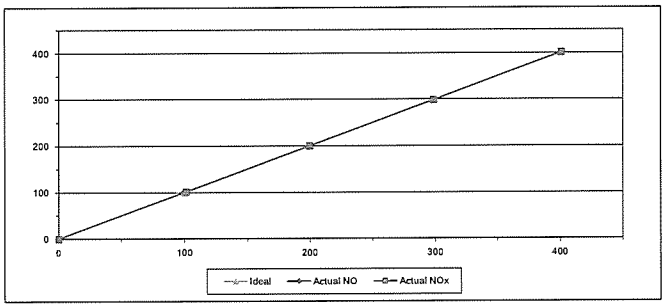
ALS Laboratory Group

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

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	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



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Assistant General Manager

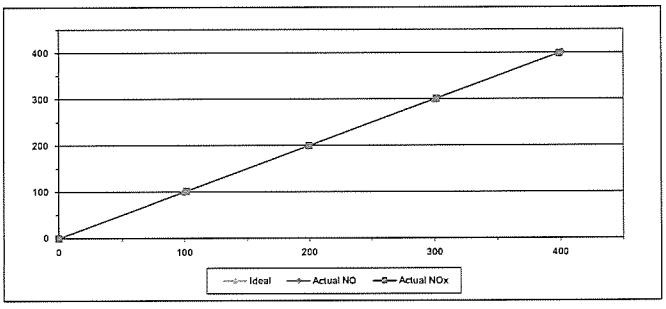
ALS Laboratory Group

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

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	NV0ER3YH	Equipment ID	RYG_FS0459
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	99.50	-0.50	-0.50	101.80	1.80	1.80
2	200.00	198.70	-1.30	-0.65	199.70	-0.30	-0.15
3	300.00	301.10	1.10	0.37	301.50	1.50	0.50
4	400.00	401.30	1.30	0.33	398.90	-1.10	-0.28
AVERAGE (%)				-0.08			0.39



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Assistant General Manager

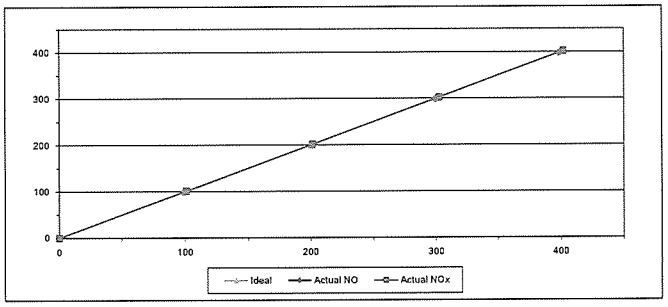
ALS Laboratory Group

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

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	Equipment Name	NOx Analyzer
Manufacturer	HORIBA	Model	APNA-370
Serial No.	R06K0177	Equipment ID	RYG_FS0463
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	101.10	1.10	1.10
2	200.00	201.80	1.80	0.90	201.50	1.50	0.75
3	300.00	299.40	-0.60	-0.20	302.60	2.60	0.87
4	400.00	398.10	-1.90	-0.47	401.90	1.90	0.47
AVERAGE (%)				-0.18			0.66



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(Mr.Sarayuth Jittranont)
Assistant General Manager

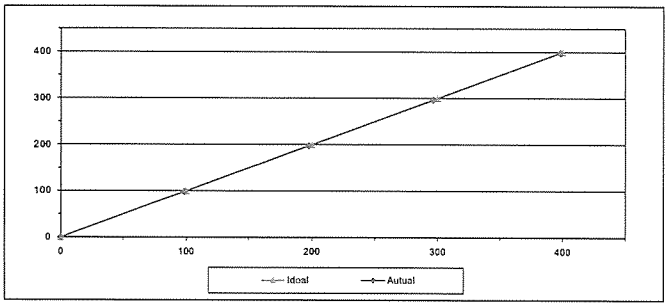
ALS Laboratory Group

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

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	VABF9LSH	Equipment ID	RYG_FS0460
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	98.70	-1.30	-1.30
2	200.00	197.80	-2.20	-1.10
3	300.00	296.50	-3.50	-1.17
4	400.00	398.30	-1.70	-0.42
AVERAGE (%)				-0.78



Calibrated By

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Approved By

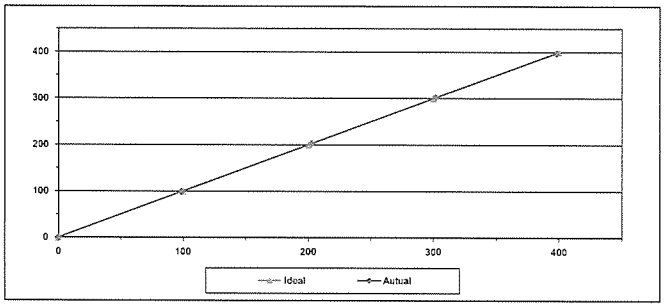
(Mr.Sarayuth Jittranont)
Assistant General Manager

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

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	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 Sakam)
Field Environmental Scientist (3)

Approved By

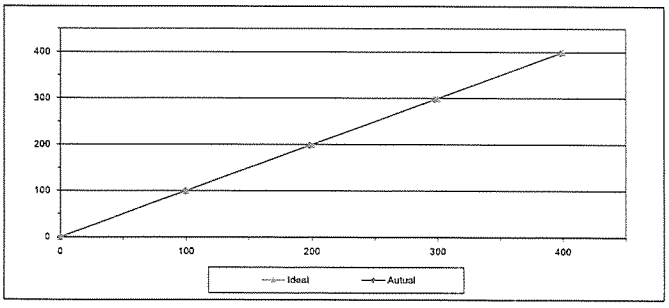
(Mr.Sarayuth Jittranont)
Assistant General Manager

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

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	1092NYKM	Equipment ID	RYG_FS0271
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	99.50	-0.50	-0.50
2	200.00	198.20	-1.80	-0.90
3	300.00	297.60	-2.40	-0.80
4	400.00	398.00	-2.00	-0.50
AVERAGE (%)				-0.52



Calibrated By

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

Approved By

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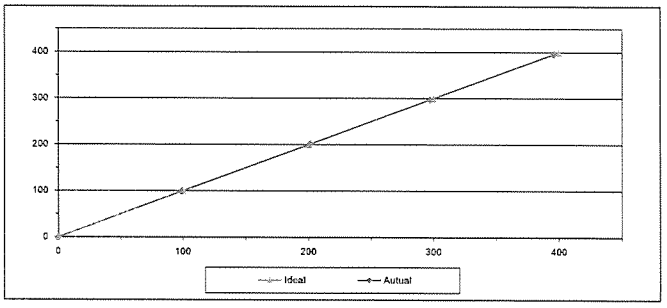
Assistant General Manager

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

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	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



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Approved By

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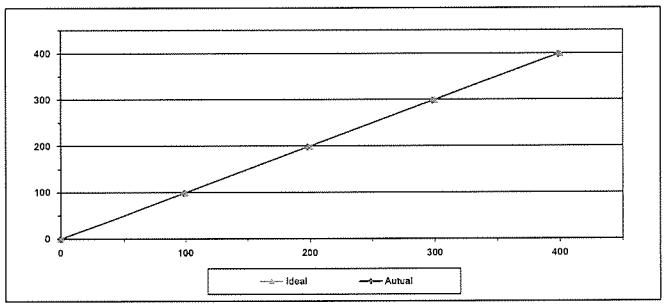
Assistant General Manager

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

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	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 (%)				-0.88



Calibrated By

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Approved By

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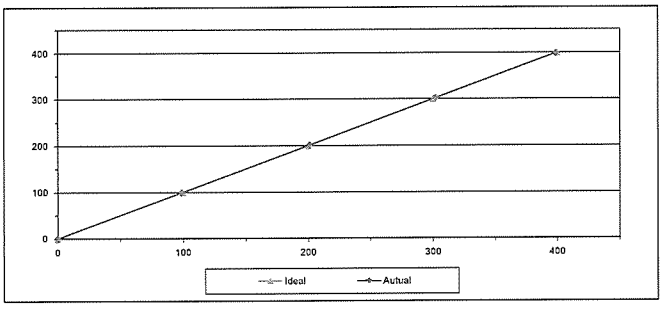
Assistant General Manager

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

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	Equipment Name	SO2 Analyzer
Manufacturer	HORIBA	Model	APSA-370
Serial No.	PAUY0T7A	Equipment ID	RYG_FS0458
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	201.10	1.10	0.55
3	300.00	302.30	2.30	0.77
4	400.00	398.60	-1.40	-0.35
AVERAGE (%)				-0.01



Calibrated By

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Field Environmental Scientist (3)

Approved By

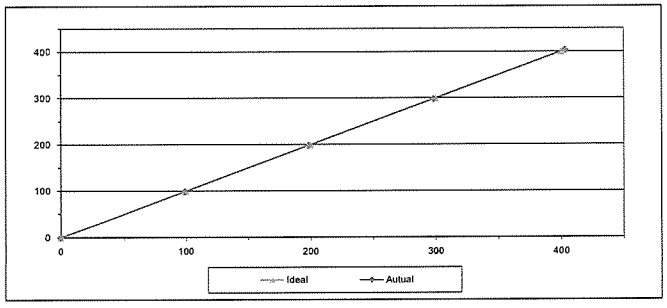
(Mr.Sarayuth Jittranont)
Assistant General Manager

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

MULTIPOINT CALIBRATION REPORT

Calibration Date	1-Jul-22	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 Sakam)
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

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

CERTIFICATE OF CALIBRATION

Certificate No: WS-12072201
Page 1 of 2 pages

REVIEW BY
APPROVED BY
NEXT CAL. DATE 27/1/23

Measurement Item	: Cup anemometer with data logger
Manufacturer	: Data logger: Novalynx : Cup anemometer: Novalynx
Model/Type	Data logger: 200 WS 285B Cup anemometer: WS 02P
Serial Number	Data logger: A5374 Cup anemometer:
ID No.	Data logger: RYG FS0412 Cup anemometer:
Customer	ALS laboratory group (Thailand) co., ltd : 104 Prachinnarain 40 Prachinnarain Rd. Khwaeng Bang Sue, Khet Bang Sue, Bangkok 10800 Thailand
Test Conditions	: Wind tunnel cross test section area 900 cm² : Anemometer frontal area 100 cm² : Diameter of measuring pipe mm : Blockage ratio of test object 0.111 []
Test Conditions	: Air temperature 23.9 ±0.6 °C : Air pressure 1007.7 ±0.4 hPa : Relative air humidity 57.7 ±3.5 %RH
Calibration Procedure	Calibration was carried out based on: IEC 61400-12 : 2013, 2005 Power Performance Measurements of Electricity Producing Wind Turbines; MS/ENCT Anemometer Calibration Procedure : Version 2, 2009.
Traceability	This calibration documents the traceable to national standard. Which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology, Thailand (NIMT).
Measurement Date	: Jul. 29, 2021.
Issued Date	: Jul. 29, 2021

Calibrated by:
☑ Mr. Sorasit Thadhasa
☐ Miss Orathai Wiwatchaiya

JIRANATE ASSOCIATES CO., LTD.

Approved Signatory:
Mr. Pariya Boonchanon
Technical Support
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WS-12072021

Result of calibration: ☑ Without adjustment ☐ With adjustment
Calibration in the range of 1 – 16 m/s at a calibration interval of 1 m/s.
The results of calibration and associated measurement uncertainties are reported in the table below.

V_{std} Reading m/s	V_{UUC} Reading m/s	Error (m/s)	Uncertainty (%)
2.075	2.0	-0.1	2.5
4.150	4.1	0.1	1.3
5.98	6.0	0.0	0.98
8.01	8.1	0.1	0.63
10.03	10.1	0.1	0.77
12.02	12.2	0.2	0.65
13.96	14.3	0.3	0.41
16.03	16.4	0.4	0.59
14.98	15.3	0.3	0.49
13.00	13.2	0.2	0.61
11.01	11.1	0.1	0.62
8.97	9.0	0.0	0.97
7.01	7.0	0.0	0.81
5.156	5.1	-0.1	0.98
2.980	3.1	0.1	1.7
1.037	0.9	-0.1	5.4

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TSI/TSI INC	0963/9145	July 16, 2020	MA-0035-20	5 – 30 m/s
2	Precision Differential Pressure Meter	Zogtat	DPM2500	July 16, 2020	MA-0035-20	5 – 30 m/s
3	Air velocity transducer (hot wire)	TSI INC	8455-17	July 20, 2020	MA-0035/MA-20	0 – 5 m/s
4	Temperature	Zogtat	DSR THP	March 30, 2021	DL-027.04	30 – 70°C
5	Relative humidity	Zogtat	DSR THP	March 30, 2021	RH-03032021	0 – 100 %RH
6	Atmospheric pressure	Zogtab	DSR THP	March 30, 2021	BP-01032021	500 – 1100 hPa
7	Wind tunnel	DSSDM	MP33CD			0 – 20 Hz

End of certificate of calibration

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Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

CERTIFICATE OF CALIBRATION

Certificate No.: WD-12072021

Measurement Item : Wind direction sensor with data logger.

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

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

Serial Number : Data logger: A5374.
: Wind direction sensor: -.

ID No : Data logger: RVG_FS0412.
: Wind direction sensor: -

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

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

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

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

Traceability:
The measurement results are traceable to the international system of units (SI) through Certificate No: OC503-07-0045, Certificate No: HW503/0044.

Measurement Date : Jul. 29, 2021.
Issued Date : Jul. 29, 2021.

Performed by
☑ Mr. Sorawit Thachatad
☐ Miss Orathai Wiwatwitaya

JIRANATE ASSOCIATES CO., LTD.

Approved Signatory.....
Mr. Pornya Boonchanden
Technical Support
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WD-12072021

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	42	-3	3.0
3		90	90	87	-3	3.0
4		135	135	133	-2	3.0
5		180	180	178	-2	3.0
6		225	225	226	1	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	42	-3	3.0
11		90	90	87	-3	3.0
12		135	135	133	-2	3.0
13		180	180	178	-2	3.0
14		225	225	226	1	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

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

End of Certificate of Calibration

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CERTIFICATE OF CALIBRATION

Certificate No: WS-04072021

Measurement Item : Cup anemometer with data logger.

Manufacturer : Data logger: Novalynx
: Cup anemometer: Novalynx

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

Serial Number : Data logger: A4987.
: Cup anemometer: -

ID No : Data logger: RVG_FS0369
: Cup anemometer: -

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

REVIEW BY
APPROVED BY
NEXT CAL. DATE 11/1/23

Test Conditions
Wind tunnel cross test section area 0.09 m²
Anemometer frontal area 0.09 m²
Diameter of mounting pipe mm
Blockage ratio of test object 0.111 [-]

Test Conditions
Air temperature 24.0 ±0.8 °C
Air pressure 1005.9 ±0.4 hPa
Relative air humidity 63.3 ±3.5 %RH

Calibration Procedure: Calibration was carried out base on:
IEC 61400-12-1 ED.1: 2005-Power Performance Measurements of Electricity Producing Wind Turbines;
MCASP-07 Anemometer Calibration Procedure – Version 2, 2006.

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

Measurement Date : Jul. 13, 2021.
Issued Date : Jul. 14, 2021

Performed by
☑ Mr. Sorawit Thachatad
☐ Miss Orathai Wiwatwitaya

JIRANATE ASSOCIATES CO., LTD.

Approved Signatory:
Mr. Pornya Boonchanden
Technical Support
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WS-04072021

Result of calibration: ☑ Without adjustment ☐ With adjustment

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

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

V_{STD} Reading m/s	V_{UUC} Reading m/s	Error (m/s)	Uncertainty (%)
2.084	1.8	-0.3	2.7
4.112	4.0	0.1	1.4
6.00	6.0	0.0	1.2
8.02	8.1	0.1	0.70
10.02	10.1	0.1	0.63
11.98	12.0	0.0	0.57
13.98	14.2	0.2	0.49
16.02	16.5	0.5	0.53
15.03	15.4	0.4	0.60
12.99	13.3	0.3	0.63
11.02	11.1	0.1	0.66
9.02	9.1	0.1	0.63
7.02	7.1	0.1	0.77
5.177	5.0	-0.2	0.97
3.027	3.0	0.0	1.7
1.563	0.6	-0.6	6.4

UUC*: Unit Under Calibration

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

Appendix I: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TESTO INC	06352145	July 16, 2020	MW-0035-20	5 - 30 m/s
2	Precision Differential Pressure Meter	Zogac	DPM2500	July 16, 2020	MW-0035-20	5 - 30 m/s
3	Air velocity transducer (hot wire)	TSI INC	8455-12	July 20, 2020	MW-0035M-20	0 - 5 m/s
4	Temperature	Zogac	DSP-THP	March 30, 2021	CL-027-04	-30 - 70°C
5	Relative humidity	Zogac	DSP-THP	March 30, 2021	RH03032021	0 - 100 %RH
6	Atmospheric pressure	Zogac	DSP-THP	March 30, 2021	BP01032021	500 - 1100 hPa
7	Wind turbine	GSSCW	MP3300			0 - 55 m/s

End of certificate of calibration

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CERTIFICATE OF CALIBRATION

Certificate No.: WD-04072021

Measurement Item : Wind direction sensor with data logger.

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

Model/Type : Data logger: 200-WS-250L.
: Wind direction sensor: WS-02P.

Serial Number : Data logger: A4987
: Wind direction sensor: -

ID No : Data logger: RYG_FS0089.
: Wind direction sensor: -

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

Environmental Condition:

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

Measurement Method:

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

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

Traceability:

The measurement results are traceable to the International system of units (SI) through Certificate No.: 00563-07-0045, Certificate No.: KW563/0044

Measurement Date : Jul 14, 2021.
Issued Date : Jul 14, 2021.

JNAC JIRANATE ASSOCIATES CO., LTD.

Performed by
☑ Mr. Sorasak Thachalad
☐ Miss Orathai Wiwatwittaya

Approved Signatory:
Mr. Pornya Boonchaoen,
Technical Support
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WD-04072021

Result of calibration: ☐ Without adjustment ☑ With adjustment

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

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	0	0	0	3.0
2		45	45	42	-3	3.0
3		90	90	88	-2	3.0
4		135	135	133	-2	3.0
5		180	180	181	1	3.0
6		225	225	228	3	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	0	0	0	3.0
10		45	45	42	-3	3.0
11		90	90	88	-2	3.0
12		135	135	133	-2	3.0
13		180	180	181	1	3.0
14		225	225	228	3	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

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

End of Certificate of Calibration

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CERTIFICATE OF CALIBRATION

Certificate No.: [illegible]

Measurement Item: [illegible]

Manufacturer: [illegible]

Model/Type: [illegible]

Serial Number: [illegible]

Customer: [illegible]

Environmental Condition: [illegible]

Measurement Method: [illegible]

Traceability: [illegible]

Measurement Date: [illegible]
Issued Date: [illegible]

REVIEW BY: W. Pookiate
APPROVED BY: [illegible]
NEXT CAL. DATE: 14/8/22

Performed by
[illegible]

JNAC JIRANATE ASSOCIATES CO., LTD.

Approved Signatory: [illegible]

[illegible]

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Continuation of Certificate of Calibration Number

Certificate No. WS-01032021
Page 2 of 2 pages

Result of calibration: ☐ without adjustment ☑ With adjustment

Calibrated in the range [illegible] at a calibration interval of 45°

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

No.	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty (±°)
[illegible]	[illegible]	0/360	358	354	[illegible]	[illegible]
[illegible]		45	47	47	[illegible]	[illegible]
[illegible]		90	90	90	[illegible]	[illegible]
[illegible]		135	136	130	[illegible]	[illegible]
[illegible]		180	182	[illegible]	[illegible]	[illegible]
[illegible]		225	226	228	[illegible]	[illegible]
[illegible]		270	270	272	[illegible]	[illegible]
[illegible]		315	315	312	[illegible]	[illegible]
[illegible]	[illegible]	0/360	360	359	[illegible]	[illegible]
[illegible]		45	45	45	[illegible]	[illegible]
[illegible]		90	90	90	[illegible]	[illegible]
[illegible]		135	135	140	[illegible]	[illegible]
[illegible]		180	180	[illegible]	[illegible]	[illegible]
[illegible]		225	225	228	[illegible]	[illegible]
[illegible]		270	270	[illegible]	[illegible]	[illegible]
[illegible]		315	315	319	[illegible]	[illegible]

*UUC: [illegible] The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor [illegible] which gives a level of confidence of approximately 95%.

End of Certificate of Calibration

JIRANATE ASSOCIATES CO., LTD.

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CERTIFICATE OF CALIBRATION

Certificate No. WS-01032021
Page 1 of 2 pages

REVIEW BY N. Pattuk
APPROVED BY
NEXT CAL. DATE 24/6/22

Measurement Item: [illegible] anemometer with data logger

Manufacturer: [illegible]

Model/Type: [illegible] WS-25LB
[illegible] WS-02F

Serial Number: [illegible]
[illegible]

Customer: [illegible] Co., Ltd.
[illegible]

Test Conditions: Wind tunnel cross flow section area 900 [illegible]
Anemometer frontal area 100 [illegible]
Diameter of mounting pipe [illegible]
Blockage ratio of test object [illegible]

Test Conditions: Air temperature 34.6 ±0.6 °C
Air pressure 1007.4 ±0.4 kPa
Relative air humidity 52.4 ±3.0 %RH

Calibration Procedure: Calibration was carried out based on:
IEC 61400-12-1 ED.1: 2005 Power Performance Measurements of Electricity Producing Wind Turbines.
NIMASNET Anemometer Calibration Procedure – Version 2, 2002.

Traceability: The calibration equipments are traceable to national standard which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).

Measurement Date: Jul 29, 2021.
Issued Date: Jul 29, 2021.

Calibrated by

Approved Signatory

JIRANATE ASSOCIATES CO., LTD.

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Continuation of Certificate of Calibration Number

Certificate No. [illegible]
Page [illegible] of [illegible]

Result of calibration: ☑ [illegible] ☐ [illegible]

[illegible] Reading m/s	[illegible] Reading m/s	Error m/s	Uncertainty %
[illegible]	[illegible]	[illegible]	3.8
[illegible]	[illegible]	[illegible]	1.3
[illegible]	[illegible]	[illegible]	0.57
[illegible]	[illegible]	[illegible]	0.84
[illegible]	[illegible]	[illegible]	0.69
[illegible]	[illegible]	[illegible]	0.53
[illegible]	[illegible]	[illegible]	0.57
[illegible]	[illegible]	[illegible]	0.87
[illegible]	[illegible]	[illegible]	0.71
[illegible]	[illegible]	[illegible]	0.72
[illegible]	[illegible]	[illegible]	0.57
[illegible]	[illegible]	[illegible]	0.73
[illegible]	[illegible]	[illegible]	1.2
[illegible]	[illegible]	[illegible]	1.1
[illegible]	[illegible]	[illegible]	1.7
[illegible]	[illegible]	[illegible]	2.2

*UUC: [illegible]

Apparatus [illegible]

No.	Device	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Remark
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

End of Continuation of Calibration

JIRANATE ASSOCIATES CO., LTD.

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CERTIFICATE OF CALIBRATION

Certificate No. WS-13072021
Page 1 of 2 pages

REVIEW BY
APPROVED BY
NEXT CAL. DATE 27/7/23

Measurement Item: Cup anemometer with data logger.

Manufacturer: Data logger: Novalynx
Cup anemometer: Novalynx.

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

Serial Number: Data logger: A5375
Cup anemometer:

ID. No: Data logger: RHG_FS0413
Cup anemometer: -

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

Test Conditions: Wind tunnel cross flow section area 900 [illegible]
Anemometer frontal area 100 [illegible]
Diameter of mounting pipe [illegible]
Blockage ratio of test object [illegible]

Test Conditions: Air temperature 34.6 ±0.6 °C
Air pressure 1007.4 ±0.4 kPa
Relative air humidity 52.4 ±3.0 %RH

Calibration Procedure: Calibration was carried out based on:
IEC 61400-12-1 ED.1: 2005 Power Performance Measurements of Electricity Producing Wind Turbines.
NIMASNET Anemometer Calibration Procedure – Version 2, 2002.

Traceability: The calibration equipments are traceable to national standard which realize the unit of measurements according to the international system of units (SI) through National Institute of Metrology Thailand (NIMT).

Measurement Date: Jul 29, 2021.
Issued Date: Jul 29, 2021.

Recorded by
☒ Mr. Somsak Thongkaew
☐ Miss Chanthi Wiwatchai

Approved Signatory
Mr. Pattiya Bonnchanyen
Technical Support
and Calibration Manager

JIRANATE ASSOCIATES CO., LTD.

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Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

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

V_{ref} Reading m/s	V_{UUC} Reading m/s	Error (m/s)	Uncertainty (%)
2.067	2.0	-0.1	2.4
4.128	4.1	0.0	1.2
6.03	6.1	0.1	0.97
7.99	8.0	0.0	0.84
10.05	10.1	0.1	0.69
12.03	12.2	0.2	0.72
13.99	14.3	0.3	0.47
15.98	16.4	0.4	0.35
16.03	16.3	0.3	0.38
12.99	13.1	0.1	0.69
11.01	11.1	0.1	0.67
9.01	9.0	0.0	0.87
6.99	7.1	0.1	0.81
5.177	5.1	-0.1	0.92
2.972	3.1	0.1	1.6
1.044	0.9	-0.1	5.3

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TSI/TSI INC	0632/145	July 16, 2020	MW 0035-20	5 - 30 m/s
2	Pressure Differential Pressure Meter	Zeptat	DP-M2600	July 16, 2020	MW 0035-20	5 - 30 m/s
3	Air velocity transducer (hot wire)	TSI INC	8455-12	July 20, 2020	MW 0036A-20	0 - 5 m/s
4	Temperature	Zeptat	DSR-THP	March 30, 2021	DL-C27-66	-30 - 70°C
5	Relative humidity	Zeptat	DSR-THP	March 30, 2021	RH0333/2021	0 - 100 %RH
6	Atmospheric pressure	Zeptat	DSR-THP	March 30, 2021	BP 01032021	600 - 1100 hPa
7	Wind turbine	DSSOM	MP3300			0 - 50 m/s

End of certificate of calibration

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CERTIFICATE OF CALIBRATION

Certificate No.: WD-13072021
Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

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

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

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

ID No : Data logger: RIG_FS0413.
: Wind direction sensor: -

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

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

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

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

Traceability:
The measurement results are traceable to the International system of units (SI) through Certificate No: 00563-07-0045, Certificate No: KWS63/0044.

Measurement Date : Ju. 29, 2021.
Issued Date : Ju. 29, 2021.

Performed by
☑ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya

JIRANATE ASSOCIATES CO., LTD

Approved Signatory.....
Mr. Pariya Booncharoen.
Technical Support
and Calibration Manager

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

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

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

End of Certificate of Calibration

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CERTIFICATE OF CALIBRATION

Certificate No: WS 01062021
Page 1 of 2 pages

Measurement Item : Cup anemometer with data logger

Manufacturer : Data logger: Novalynx
: Cup anemometer: Novalynx

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

Serial Number : Data logger: A4461
: Cup anemometer: -

ID No : Data logger: BKK_FS0141.
: Cup anemometer: -

REVIEW BY
APPROVED BY
NEXT CAL. DATE 6/12/22

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

Test Conditions
: Wind tunnel cross test section area 900 cm^2
: Anemometer frontal area 100 cm^2
: Diameter of mounting pipe - mm
: Blockage ratio of test object 0.111 %

Test Conditions
: Air temperature 29.7 ±0.6 °C
: Air pressure 1010.3 ±0.4 hPa
: Relative air humidity 53.7 ±3.5 %RH

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

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

Measurement Date : Jun 07, 2021.
Issued Date : Jun 07, 2021

Calibrated by
☑ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya

JIRANATE ASSOCIATES CO., LTD

Approved Signatory.....
Mr. Pariya Booncharoen
Technical Support
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WS-01062021

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

V_{ref} Reading m/s	V_{UUC}* Reading m/s	Error (m/s)	Uncertainty (±)
2.055	2.0	0.1	2.6
4.124	4.0	-0.1	1.2
5.99	6.0	0.0	1.01
8.00	8.0	0.0	0.74
9.99	10.1	0.1	0.60
11.96	12.2	0.2	0.67
14.02	14.4	0.4	0.45
15.03	15.6	0.6	0.35
15.01	15.3	0.3	2.8
12.99	13.3	0.3	0.41
10.99	11.2	0.2	0.53
9.01	9.3	0.3	1.2
7.05	7.0	0.0	0.77
5.121	5.0	0.1	0.88
3.048	3.0	0.0	1.8
1.058	1.0	0.1	5.3

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TOSTO INC.	003021/45	July 16, 2020	MW-0035-20	5 - 30 m/s
2	Precision Differential Pressure Meter	Zoglab	DPM2500	July 16, 2020	MW-0035-20	5 - 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	July 20, 2020	MA-0036M-20	0 - 5 m/s
4	Temperature	Zoglab	DDR-THP	March 30, 2021	C.-027-64	30 - 70°C
5	Relative humidity	Zoglab	DDR-THP	March 30, 2021	RH-C3032021	0 - 100 %RH
6	Atmospheric pressure	Zoglab	DDR-THP	March 30, 2021	BP-01C32021	500 - 1100 hPa
7	Wind tunnel	ESECM	MP23CD			0 - 55 m/s

End of certificate of calibration

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CERTIFICATE OF CALIBRATION

Certificate No: WD-01062021

Measurement Item : Wind direction sensor with data logger.

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

Model/Type : Data logger: WS-250L.
: Wind direction sensor: WS-02F.

Serial Number : Data logger: A4481.
: Wind direction sensor: -

ID No : Data logger: BKK_FS0141.
: Cup anemometer: -

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

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

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

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

Traceability:
The measurement results are traceable to the international system of units (SI) through Certificate No.: C0563-07-0045, Certificate No: KW963/0044

Measurement Date : Jun 07, 2021.
Issued Date : Jun 07, 2021.

Performed by
☑ Mr. Sorawit Thacholad
☐ Miss Orathai Wiwatwittaya

JIRANATE ASSOCIATES CO.,LTD.

Approved Signatory:
Mr. Pairoya Booncharoen,
Technical Support
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WD-01062021

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	0	0	0	3.0
2		45	45	42	3	3.0
3		90	90	90	0	3.0
4		135	135	136	1	3.0
5		180	180	182	2	3.0
6		225	225	227	2	3.0
7		270	270	273	3	3.0
8		315	315	314	-1	3.0
9	Counter Clockwise	0/360	0	0	0	3.0
10		45	45	42	-3	3.0
11		90	90	90	0	3.0
12		135	135	136	1	3.0
13		180	180	182	2	3.0
14		225	225	227	2	3.0
15		270	270	273	3	3.0
16		315	315	314	-1	3.0

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

End of Certificate of Calibration

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CERTIFICATE OF CALIBRATION

Certificate No: WS-14072021

Measurement Item : Cup anemometer with data logger

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

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

Serial Number : Data logger: A4316
Cup anemometer: -

ID No : Data logger: RYB_FS0414
Cup anemometer: -

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

REVIEW BY
APPROVED BY
NEXT CAL. DATE 24/1/23

Test Conditions
Wind tunnel cross test section area 900 cm²
Anemometer frontal area 120 cm²
Diameter of mounting pipe mm
Blockage ratio of test object 0.133 %

Test Conditions
Air temperature 29.2 ±0.6 °C
Air pressure 1005.6 ±0.4 hPa
Relative air humidity 51.4 ±3.6 %RH

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

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

Measurement Date : Jul 29, 2021.
Issued Date : Jul 29, 2021.

Performed by
☑ Mr. Sorawit Thacholad
☐ Miss Orathai Wiwatwittaya

JIRANATE ASSOCIATES CO.,LTD.

Approved Signatory:
Mr. Pairoya Booncharoen
Technical Support
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WS-14072021

Result of calibration: ☑ Without adjustment ☐ With adjustment

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

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

V_{UUC} Reading m/s	V_{Lidar} Reading m/s	Error (m/s)	Uncertainty (%)
2.057	1.8	-0.3	3.1
4.135	4.0	-0.1	1.5
6.02	6.0	0.0	2.1
7.99	8.0	0.0	0.74
10.00	10.1	0.1	0.69
11.99	12.0	0.0	0.72
13.98	14.2	0.2	0.48
15.98	16.2	0.2	0.77
14.99	15.2	0.2	0.49
13.00	13.1	0.1	0.52
11.01	11.0	0.0	0.94
9.01	9.0	0.0	0.81
6.99	7.0	0.0	2.0
5.180	5.1	-0.1	0.96
2.987	3.0	0.0	2.0
1.034	0.8	-0.2	6.3

UUC*: Unit Under Calibration

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TESTO INC.	66352145	July 16, 2020	MW-0035.20	5 - 30 m/s
2	Precision Differential Pressure Meter	Zeglab	DPM2500	July 16, 2020	MW-0035.20	5 - 30 m/s
3	Air velocity transducer (hot wire)	TSI INC.	8455-12	July 20, 2020	MW-0036AA-20	0 - 5 m/s
4	Temperature	Zeglab	DSR THP	March 30, 2021	DL-027-64	-30 - 70 C
5	Relative humidity	Zeglab	DSR THP	March 30, 2021	RH-0303/2021	0 - 100 %RH
6	Atmospheric pressure	Zeglab	DSR THP	March 30, 2021	BP-0103/2021	500 - 1100 hPa
7	Wind tunnel	OSSDIV	MP3303	-	-	0 - 50 m/s

End of certificate of calibration

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CERTIFICATE OF CALIBRATION

Certificate No: WD-14072021

Measurement Item : Wind direction sensor with data logger.

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

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

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

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

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

Environmental Condition:

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

Measurement Method:

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

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

Traceability:

The measurement results are traceable to the international system of units (SI) through Certificate No: CC563-07-0045, Certificate No: KW563/0044

Measurement Date : Jul. 29, 2021.
Issued Date : Jul. 29, 2021.

Performed by
☑ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya

JIRANATE ASSOCIATES CO., LTD.

Approved Signatory:
Mr. Pannya Boonchanon
Technical Support
and Calibration Manager

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Continuation of Certificate of Calibration Number

Certificate No: WD-14072021

Result of calibration: ☐ Without adjustment ☑ With adjustment

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

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	46	43	-2	3.0
3		90	90	87	-3	3.0
4		135	135	132	-3	3.0
5		180	180	179	-1	3.0
6		225	225	228	3	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	46	43	-2	3.0
11		90	90	87	-3	3.0
12		135	135	132	-3	3.0
13		180	180	179	-1	3.0
14		225	225	228	3	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

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

End of Certificate of Calibration

JIRANATE ASSOCIATES CO., LTD.

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CERTIFICATE OF CALIBRATION

Certificate No: WS-09072021

Measurement Item : Cup anemometer with data logger

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

Model/Type : Data logger: 110-WS-25DL-D
: Cup anemometer: WS-02P

Serial Number : Data logger: A5369
: Cup anemometer: WS2-014

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

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

Test Conditions
: Wind tunnel cross test section area 900 cm^2
: Anemometer frontal area 100 cm^2
: Diameter of mounting pole - mm
: Blockage ratio of test object 0.111 %

Test Conditions
: Air temperature 23.4 ±0.8 °C
: Air pressure 1006.2 ±0.4 hPa
: Relative air humidity 57.3 ±3.5 %RH

Calibration Procedure: Calibration was carried out base on
IEC 61400-12-1 Ed.1.0 2005/Power Performance Measurements of Electricity Producing Wind Turbines.
MCASNCT Anemometer Calibration Procedure - Version 2, 2009

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

Measurement Date : Jul. 14, 2021
Issued Date : Jul. 15, 2021

REVIEW BY Monakan P.
APPROVED BY
NEXT CAL. DATE 12/1/23

Calibrated by
☑ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya

JIRANATE ASSOCIATES CO., LTD.

Approved Signatory:
Mr. Pannya Boonchanon
Technical Support
and Calibration Manager

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

V_{STD} Reading m/s	V_{UUC} Reading m/s	Error (m/s)	Uncertainty (±)
2.069	1.9	0.2	2.5
4.122	4.0	0.1	1.2
6.02	6.0	0.0	0.95
7.97	8.0	0.0	0.84
9.98	10.0	0.0	0.59
12.02	12.1	0.1	0.47
13.99	14.2	0.2	0.46
15.98	16.2	0.2	0.55
14.99	15.2	0.2	0.39
13.00	13.1	0.1	0.45
11.02	11.1	0.1	0.53
8.99	9.0	0.0	0.70
6.98	7.0	0.0	0.96
5.112	5.0	0.1	1.2
2.976	3.0	0.0	1.6
1.023	0.9	0.1	5.3

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

Appendix 1: Instrumentations

NO	Sensor	Manufacturer	Model/Type	Calibration Date	Certificate Report Number	Range
1	Pitot static	TESTO INC	04352145	July 16, 2020	MW-0035-20	5 - 30 m/s
2	Precision Differential Pressure Meter	Zeglatt	DPW2000	July 16, 2020	MW-0035-20	5 - 30 m/s
3	Air velocity transducer (hot wire)	TSI INC	8455-12	July 20, 2020	MW-0036A-20	0 - 5 m/s
4	Temperature	Zeglatt	DSR-THP	March 30, 2021	CL-027-64	30 - 70 °C
5	Relative humidity	Zeglatt	DSR-THP	March 30, 2021	RH-0303-2021	0 - 100 %RH
6	Atmospheric pressure	Zeglatt	DSR-THP	March 30, 2021	BP-0103-2021	500 - 1100 hPa
7	Wind turbine	DSSCM	MT33SD		-	0 - 50 Hz

End of certificate of calibration

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

CERTIFICATE OF CALIBRATION

Certificate No: WD-08072021
Page 1 of 2 pages

Measurement Item : Wind direction sensor with data logger.

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

Model/Type : Data logger: 110-WS-25DL-D.
: Wind direction sensor: WS-02P.

Serial Number : Data logger: A5660.
: Wind direction sensor: WSD-014

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

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

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

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

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

Traceability:
The measurement results are traceable to the International system of units (SI) through Certificate No: 00563-07-0045, Certificate No: RWS63/0044.

Measurement Date : Jul. 14, 2021.
Issued Date : Jul. 15, 2021.

JIRANATE ASSOCIATES CO., LTD.

Performed by
☑ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya

Approved Signatory:
Mr. Pannya Booncharoen
Technical Support
and Calibration 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

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

NO	Turning Direction	Nominal Angle (°)	Standard Reading (°)	UUC* Reading (°)	Error (°)	Uncertainty ±(°)
1	Clockwise	0/360	360	359	-1	3.0
2		45	45	42	-3	3.0
3		90	90	87	-3	3.0
4		135	135	134	-1	3.0
5		180	180	182	2	3.0
6		225	225	228	3	3.0
7		270	270	273	3	3.0
8		315	315	318	3	3.0
9	Counter Clockwise	0/360	360	359	-1	3.0
10		45	45	42	-3	3.0
11		90	90	87	-3	3.0
12		135	135	134	-1	3.0
13		180	180	182	2	3.0
14		225	225	228	3	3.0
15		270	270	273	3	3.0
16		315	315	318	3	3.0

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

End of Certificate of Calibration

JIRANATE ASSOCIATES CO., LTD.

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Watthapra, Bangkokyai,Bangkok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

NSC - TEL - 0013025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CL-050-64
Page 1 of 2

Equipment Name : Data Logger with Temperature Sensor
Manufacturer : Novalynx
Model : 110-WS-25
Serial No. : A5660
ID No. : -

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 : 12 JUL 2021
Calibration date : 13 JUL 2021
Issue date : 13 JUL 2021

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

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-0036-21, Certificate number : ER-0032-21

Calibrated by
☐ Mr. Sorawit Thachalad
☑ Miss Orathai Wiwatwittaya

JIRANATE ASSOCIATES CO., LTD.

Approved Signatory:
Mr. Pannya Booncharoen
Technical Support
And Calibration Manager

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63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Wathapra, 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˚C - 40 ˚C

Function:

This equipment was connected with temperature sensor Model : HMP60 S/N : T0210901

Dimension : Diameter 12mm. Length 80 mm.

Immersion Depth (mm)	Standard Reading (˚C)	UUC Reading (˚C)	Error (˚C)	Uncertainty (˚C)
60	20.050	19.7	-0.3	0.080
60	24.875	24.5	-0.4	0.13
60	29.864	29.5	-0.4	0.080
60	34.829	34.3	-0.5	0.080
60	39.831	39.4	-0.5	0.95

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 ✲

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

CALIBRATION REPORT

Calibration No. : RH-02072021
Page 1 of 1 Pages

Measurement Item : Relative humidity with data logger.

Manufacturer : Data logger: Novalynx.
: Relative humidity sensor: Novalynx.

Model/Type : Data logger: 110-WS-250L-D.
: Relative humidity sensor: HMP60.

Serial Number : Data logger: A5669.
: Relative humidity sensor: T0210901.

ID No. : Data logger: -
: Relative humidity sensor: -

Customer : ALS laboratory group (Thailand) co., ltd.
104 Phaithanakan 40, Phaithanakan 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:

The Relative humidity with data logger, Unit Under Calibration (UUC) was calibrated by comparison method with the equilibrium of standard salt solution CH_3COOK; Potassium Acetate, $Mg(No_3)_2$ Magnesium Nitrate, KCl Potassium Chloride to determine the errors.

Measurement Date : Jul. 14, 2021
Issued Date : Jul. 14, 2021

Measurement Results:

The results of calibration are reported in table below

Standard salt solution.	Standard (%RH)	$UUC_{(reading)}$	Error
CH_3COOK, Potassium Acetate	22.51	22.2	-0.3
$Mg(No_3)_2$ Magnesium Nitrate	52.89	52.3	-0.6
KCl Potassium Chloride	84.34	83.8	-0.5

Performed by
☑ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwitaya

Approved Signatory: Orathai (Miss)
Mr. Pariya Boonchareon.
Technical Support
and Calibration Manager

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

CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 12 Jul 22
Next Cal. Date : 12 Jan 23

Barometric Pressure (mm.Hg) : 755
Relative Humidity (%) : 70.0
Temperature (C°) : 30.0

Console Control Meter Data

Calibration No. : C-120722-BKK_FS0527
Dry Gas Meter No. : BKK_FS0527
Serial No. : 1508053
Model No. : XC-572-V

Reference Dry Gas Meter Data

Serial No. : 1607009
Model No. : SK25EXSR-OC6
Correction Factor (Yr) : 1.0060
Next Calibration Date : 7 Oct 22

ΔH (mm.H2O)	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	11.28	150.00	0.00	150.00	30.0	264368.6	264222.0	146.60	30.0	30.0	30.0	1.0278	39.1830
25	8.83	150.00	0.00	150.00	31.0	264526.8	264380.0	146.80	31.0	31.0	31.0	1.0254	40.1496
50	6.32	150.00	0.00	150.00	31.0	264685.2	264539.0	146.20	31.0	31.0	31.0	1.0271	41.1361
100	4.45	150.00	0.00	150.00	31.0	264839.0	264693.0	146.00	31.0	31.0	31.0	1.0236	40.7867
150	3.67	150.00	0.00	150.00	31.0	265095.0	264912.0	147.00	31.0	31.0	31.0	1.0118	41.6143
											Avg.	1.0232	40.5743

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: Nathapol Jiengwareewong
(Mr.Natthapol Jiengwareewong)
Field Specialist(1)

Form NO. FS-002 REVISION NO. 1 ISSUE DATE 9/1/19

ALS

DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	12 Jul 22	Ambient Temperature (°C) :	30
Calibration sheet No. :	C-120722-BKK_FS0528	Relative Humidity (%) :	70
Digital Temperature ID	BKK_FS0508	Reference Temperature ID. :	BKK_FS0609
Console Serial No. :	1503017	Serial No. :	7688004
Console Model :	XC-572-V	Model :	FLUKE 714
		Next Calibrate :	26 Jul 23

Location	Reference Temperature °C	Digital Temperature °C	Error °C	Remark
Stack	0	2	2	
	25	24	-1	
	50	51	1	
	100	103	3	
	150	151	1	
	200	202	2	
	250	251	1	
	300	301	1	
	500	503	3	
	1000	1001	1	
	1200	1202	2	
Probe	100	101	1	
	125	126	1	
	150	153	3	
Oven	100	101	1	
	125	126	1	
	150	151	1	
Filter	100	102	2	
	125	125	0	
	150	152	2	
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 : Nathapol Jiengwareewong
(Mr.Natthapol Jiengwareewong)
Field Specialist(1)

Form 281-048 (02/08/02)

Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK_FS0531
Lab test duct Number : 258-1-13-01
Calibration Sheet No. : C-120722-BKK_FS0531

Calibration Date : 12 Jul 22
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	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
			$\overline{C}p$	0.842	0.842

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

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

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

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

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

Form 281-046 (04/03/02)

Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK_FS0532
Lab test duct Number : 258-1-13-01
Calibration Sheet No. : C-120722-BKK_FS0532

Calibration Date : 12 Jul 22
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	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
			$\overline{C}p$	0.842	0.842

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

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

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

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

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

Form 281-046 (04/03/02)

PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date 12 Jul 22
Calibration Sheet No. : C-120722-BKK_FS0533

Nozzle Set ID. : BKK_FS0533
Vernier Caliper ID. : BKK_FS0626

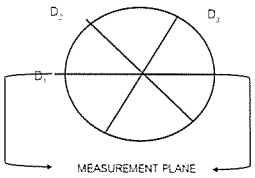
Nozzle ID #	Nozzle Diameter (mm.)			Hi - Lo	$(D_1 + D_2 + D_3)/3$
	D_1	D_2	D_3	ΔD	D_{avg}
1	0.318	0.318	0.318	0.000	0.318
2	0.475	0.475	0.475	0.000	0.475
3	0.635	0.635	0.635	0.000	0.635
4	0.792	0.792	0.792	0.000	0.792
5	0.952	0.952	0.952	0.000	0.952
6	1.110	1.110	1.110	0.000	1.110
7	1.270	1.270	1.270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

Where :

D_1, D_2, D_3 = 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 ≤ 0.100 mm.

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



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

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

Form No. QS 281-028 (13/01/03)

CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 12 Jul 22
Next Cali. Date : 12 Jan 23

Barometric Pressure (mm.Hg) : 755
Relative Humidity (%) : 70.0
Temperature (°C) : 30.0

Console Control Meter Data
Calibration No. : C-120722-BKK_FS0518
Dry Gas Meter No. : BKK_FS0518
Console Serial No. : 1504025
Console Model No. : XC-572-V

Reference Dry Gas Meter Data
Serial No. : A20033240
Model No. : DGM-SK25RM-QS8
Correction Factor (Yr) : 1.0160
Next Calibration Date : 27 May 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 : Dry gas 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	12.41	150.00	0.00	150.00	31.0	153638.0	153587.0	151.00	29.0	29.0	29.0	1.0012	47.6984
25	9.38	150.00	0.00	150.00	31.0	154092.0	153951.0	151.00	29.0	29.0	29.0	1.0002	45.6970
50	6.61	150.00	0.00	150.00	31.0	154164.0	154013.0	151.00	29.0	29.0	29.0	0.9978	45.2959
100	4.65	150.00	0.00	150.00	32.0	154330.0	154177.0	153.00	30.0	30.0	30.0	0.9900	44.9783
120	4.17	150.00	0.00	150.00	32.0	154616.0	154463.0	153.00	30.0	30.0	30.0	0.9781	43.4966
											Avg.	0.9915	45.4374

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.5,SEC.5.3 & 7

Calibrated by: (Mr.Tanakorn Kulchart)
Field Scientist (1)

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

DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	12-Jul-22	Ambient Temperature (°C) :	30
Calibration sheet No. :	C-120722-BKK_FS0519	Relative Humidity (%) :	70
Digital Temperature ID	BKK_FS0519	Reference Temperature ID. :	BKK_FS1144
Console Serial No. :	1504025	Serial No. :	201090000013
Console Model :	XC-572-V	Model :	Digicon-CC-VT-MS
		Next Calibrate :	31 Jan 23

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

Calibrated by : (Mr.tinnakorn Kulchart)
Field Scientist (1)

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

Pitot Tube Calibration Data

Pitot Tube Identification Number :	BKK_FS0522	Calibration Date :	12 Jul 22
Lab test duct Number :	258-1-13-01	Standard Pitot ID :	BKK_FS0441
Calibration Sheet No. :	C-120722-BKK_FS0522	Cp Standard :	0.99

Type S Pitot Tube Coefficient Data

	Type s pitot tube Leg A,B	Standard pitot tube (ΔP, mm.H_2O)	Type s pitot tube (ΔP, mm.H_2O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
			$\overline{C}p$	0.842	0.842

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

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

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

Calibrated by : (Mr.Tinnakorn Kulchart)
Field Scientist ()

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

Form ZB1-046 (04/03/02)

Pitot Tube Calibration Data

Pitot Tube Identification Number :	BKK_FS0523	Calibration Date :	12 Jul 22
Lab test duct Number :	258-1-13-01	Standard Pitot ID :	BKK_FS0441
Calibration Sheet No. :	C-120722-BKK_FS0523	Cp Standard :	0.99

Type S Pitot Tube Coefficient Data

	Type s pitot tube Leg A,B	Standard pitot tube (ΔP, mm.H_2O)	Type s pitot tube (ΔP, mm.H_2O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
			$\overline{C}p$	0.842	0.842

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

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

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

Calibrated by : (Mr.tinnakorn Kulchar)
Field Scientist (1)

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

Form ZB1-046 (04/03/02)

PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date	12 Jul 22	Nozzle Set ID. :	BKK_FS0524
Calibration Sheet No. :	C-120722-BKK_FS0524	Vernier Caliper ID. :	BKK_FS0626

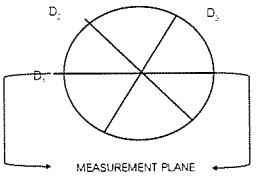
Nozzle ID #	Nozzle Diameter (cm.)			Hi - Lo	$(D_1 + D_2 + D_3) / 3$
	D_1	D_2	D_3	ΔD	D_{avg}
1	0.318	0.318	0.318	0.000	0.318
2	0.475	0.475	0.475	0.000	0.475
3	0.635	0.635	0.635	0.000	0.635
4	0.792	0.792	0.792	0.000	0.792
5	0.952	0.952	0.952	0.000	0.952
6	1.110	1.110	1.110	0.000	1.110
7	1.270	1.270	1.270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

Where :

D_1, D_2, D_3 = 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 : (Mr.tinnakorn Kulcha)
Field Scientist (1)

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

Form No. QS ZB1-025 (13/01/03)

ENTECH
Difference For Greater Value

Calibration Certificate

Certificate No: G 650023
Date of issue : 21-Jan-22

Instrument description	:	Flue gas Analyzer
Instrument model	:	Testo 340
Instrument serial no.	:	62150585
ID no. or control no.	:	RYG_FS0465
Manufacturer	:	testo SE
Probe description	:	-
Probe model	:	-
Probe serial	:	-
Customer name	:	ALS LABORATORY GROUP (THAILAND) CO.,LTD.
Customer address	:	104 Phatthanakan 40, Phatthanakan Road, Khwaeng Phatthanakan, Khet Suan Luang, Bangkok, 10250 Thailand
Total pages of certificate	:	3 Pages
Receiving no.	:	L-220082
Receiving date.	:	14-Jan-22
Parameter of calibration	:	Gas Calibration(Oxygen 2.501,10.00,21.00 %vol, Carbon Monoxide 60.97,309.9,1003 ppm, Nitric Oxide 10.08,150.9,320.6 ppm, Sulphur Dioxide 50.04,100.9,601.1 ppm)
Condition of UUC.	:	Used
Ambient condition	:	All of the Measurment ware caried out the stabilized labotary Temperature : 23 ±5 °C Humidity : 55 ± 15 %RH
Calibration place	:	17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210
Calibration procedure no.	:	WI-CL-28-C

REVIEW BY Nonskom P.
APPROVED BY
NEXT CAL. DATE 14/1/23

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

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

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

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

Date of calibration : 19-Jan-22

Mr. Sedtawut Nuealthong
Calibration Technician

Mrs. Nongluck Wongsettee
Technical Manager

ENTECH INDUSTRIAL SOLUTION CO.,LTD.
17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel 0-2779-8888 Fax 0-2779-8899 info@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O2) 2.501 % Vol	2431/19	Linde	16-Jul-23
Oxygen (O2) 10.00 % Vol	2453/19	Linde	18-Jul-23
Oxygen (O2) 21.00 % Vol	2426/19	Linde	16-Jul-23
Carbon monoxide (CO) 60.97 ppm	2842/21	Linde	24-Jun-23
Carbon monoxide (CO) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide (CO) 1003 ppm	2029/21	Linde	23-Apr-23
Nitric Oxide (NO) 10.08 ppm	3241/21	Linde	25-Jul-23
Nitric Oxide (NO) 150.9 ppm	2857/21	Linde	27-Jun-23
Nitric Oxide (NO) 320.6 ppm	2944/21	Linde	2 Jul 23
Sulphur Dioxide (SO2) 50.04 ppm	3205/21	Linde	25-Jul-23
Sulphur Dioxide (SO2) 100.9 ppm	4942/20	Linde	20-Nov-22
Sulphur Dioxide (SO2) 601.1 ppm	3204/21	Linde	20-Jul-23

Measured room conditions

Temperature : 22.5 °C Humidity : 56.2 %RH Pressure : 1018.3 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 600 ml/min Gas pressure : 1021.9 mbar

Calibration Results Before Adjustment (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.501	2.47	-0.031	0.20
O2 (%Vol)	10.00	9.89	-0.11	0.40
O2 (%Vol)	21.00	21.12	0.12	0.80
CO (ppm)	60.97	83	2.03	2.8
CO (ppm)	309.9	314	4.1	11
CO (ppm)	1003	1016	13	34
NO (ppm)	10.08	8	-2.08	3.0
NO (ppm)	150.9	162	11.1	5.0
NO (ppm)	320.6	345	24.4	10
SO2 (ppm)	50.04	38	-12.04	5.0
SO2 (ppm)	100.9	92	-8.9	5.0
SO2 (ppm)	601.1	593	-8.1	14

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Tax ID : 0105536035591 www.entech.co.th

Calibration Results After Adjustment (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O2 (%Vol)	2.501	2.47	-0.031	0.20
O2 (%Vol)	10.00	9.89	-0.11	0.40
O2 (%Vol)	21.00	21.11	0.12	0.80
CO (ppm)	60.97	83	2.03	2.8
CO (ppm)	309.9	314	4.1	11
CO (ppm)	1003	1016	13	34
NO (ppm)	10.08	9	-1.08	3.0
NO (ppm)	150.90	150	-0.9	5.0
NO (ppm)	320.6	318	-2.6	10
SO2 (ppm)	50.04	48	-2.04	5.0
SO2 (ppm)	100.9	101	0.1	5.0
SO2 (ppm)	601.1	604	2.9	14

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

End of Report

ENTECH INDUSTRIAL SOLUTION CO.,LTD.
17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Laksi, Bangkok 10210 THAILAND Tel 0-2779-8888 Fax 0-2779-8899 info@entech.co.th
Tax ID : 0105536035591 www.entech.co.th

Calibration certificate Kalibrier-Zertifikat

4319339

Object Gegenstand	Controlunit 1350	Measuring Box testo 350
Manufacturer Hersteller	TESTO SE & Co. KGaA	TESTO SE & Co. KGaA
Type description Typ	0632 3511	0632 3510
Serial no. Serien Nr.	03580182	62985049
Inventory no. Invertar Nr.	---	---
Test equipment no. Prüfmittel Nr.	---	---
Equipment no. Equipment Nr.	14672444	14674793
Location Standort	---	---
Customer Auftraggeber	ALS Laboratory Group (Thailand) Co., Ltd Eastern Seaboard Industrial Estate TH-21140 A. Pluakdaeng,Rayong, Thailand	
Customer ID no. Kunden Nr.	1031994	
Order no. Auftrags Nr.	10842828 / 0520 0055	
Date of calibration Datum der Kalibrierung	09.12.2021	
Date of the recommended re-calibration Datum der empfohlenen Rekalibrierung	09.12.2022	

Hereby we confirm that the performing calibration laboratory is working with a management system according to ISO 9001:2015 and ISO/IEC 17025:2018. Accreditation certificates can be found under www.testotis.de. The measuring installations used for calibration are regularly calibrated and traceable to the national standards of the German Federal Physical Technical Institute (PTB) or other national standards. Should no national standards exist, the measuring procedure corresponds with the technical regulations and norms valid at the time of the measurement. The documents established for this procedure are available for viewing. All the necessary measured data can be found on this calibration certificate.

Hiermit bestätigen wir, dass das durchführende Kalibrierlabor ein Managementsystem nach ISO 9001:2015, sowie ISO/IEC 17025:2018 eingeführt hat. Die Urkunden finden Sie auf www.testotis.de. Die für die Kalibrierung verwendeten Messeinrichtungen werden regelmäßig kalibriert und sind rückführbar auf die nationalen Normale der Physikalisch Technischen Bundesanstalt (PTB) Deutschlands oder auf andere nationale Normale. Wo keine nationalen Normale existieren, entspricht das Messverfahren den derzeit gültigen technischen Regeln und Normen. Die für diesen Vorgang eingefertigte Dokumentation kann eingesehen werden. Alle erforderlichen Messdaten sind in diesem Kalibrier-Zertifikat aufgelistet.

Conformity statement Konformitätsaussage

[X] Measured value(s) within the allowable deviation[1]. Messwert(e) innerhalb der zulässigen Abweichung[1].

[ ] Measured value(s) outside of the allowable deviation[1]. Messwert(e) außerhalb der zulässigen Abweichung[1].

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[1]) The expanded measurement uncertainty was calculated according to EA-4-02 M:2013 with a coverage probability of approx. 95% and contains the uncertainty of the reference, the method and the uncertainty of the unit under test. The statement of conformity is based on the decision rule "Vertrauensniveau 50" (confidence level 50).

[1]: Die erweiterte Messunsicherheit wurde nach EA-4-02 M:2013 mit einer Überdeckungswahrscheinlichkeit von etwa 95% berechnet und enthält die Unsicherheit der Referenz, des Verfahrens sowie die Unsicherheit des Prüflings. Die Konformitätsaussage erfolgt nach der Entscheidungsregel "Vertrauensniveau 50".

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

Dieses Kalibrierschein darf nur vollständig weiterverwendet werden. Auszüge oder Änderungen bedürfen der Genehmigung des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine ohne Unterschrift und Stempel haben keine Gültigkeit.

Seal Stempel KIRCHZARTEN testo INDUSTRIAL SERVICES

Supervisor Fachverantwortlicher
Martin Förderer

Technician Bearbeiter
Johannes Wängler

testo

Calibration certificate Kalibrier-Zertifikat

4319339

Measuring equipment Messeinrichtungen

Index	Reference Referenz	Traceability Rückführung	Next cal. Rekal.	Certificate-no. Zertifikat-Nr.	Eq.-no. Eq.-Nr.
a	Test gas medium 1 Prüfgas Medium 1	SCS-SCS0026 2021-03	2024-03	4017585	12898976
b	Test gas medium 3 Prüfgas Medium 3	SCS-SCS0026 2021-03	2022-03	4017588	12898982
c	Test gas medium 5 Prüfgas Medium 5	SCS-SCS0026 2021-03	2022-03	4017591	12898984
d	Test gas medium 8 Prüfgas Medium 8	SCS-SCS 2021-07	2022-10	4220471	12898987
e	Test gas medium 7 Prüfgas Medium 7	SCS-SCS0026 2021-03	2022-03	4017596	12898986
f	Test gas medium 11 Prüfgas Medium 11	ISO-ISO 6141 2021-04	2022-04	4017602	14087964
g	Digistant 4420 Digistant 4420	15070-01-01 2021-07	2022-07	E166673	12966901
h	Pneumator Pneumator	15070-01-01 2021-07	2022-07	D53219	12965547

Reference certificates are available at www.primasonline.com Referenzzertifikate sind auf www.primasonline.com abrufbar

Ambient conditions Umgebungsbedingungen

Temperature Temperatur (20...26) °C Humidity Feuchte (20...60) % RH % rF

Measuring procedure Messverfahren

The calibration was carried out by comparison measurement with calibrated test gases, a calibrator of temperature and pressure.
Die Kalibrierung erfolgte durch Vergleichsmessung mit kalibrierten Prüfgasen, einem Temperatur- und Druckkalibrator.

Measuring results Messergebnisse

Channel Kanal ---

Unit Einheit	Reference value Bezugswert	Indicated measured value probe Angezeigter Messwert Kalibriergegenstand	Deviation Abweichung	Allowed deviation[2] Zulässige Abweichung[2]	Measurement uncertainty (k=2) Messunsicherheit (k=2)	Confirmation Bewertung
CO						
ppm	100,1[a]	104	3,9	± 11	3,3	pass
ppm	401,0[b]	404	3,0	± 21	8,5	pass
ppm	700,0[c]	729	29,0	± 36	14,4	pass
NO						
ppm	150,3[a]	151	0,7	± 9	4,0	pass
ppm	300[d]	301	1	± 16	6,9	pass
NO2						
ppm	99,9[e]	102,3	2,4	± 5,1	3,20	pass
SO2						
ppm	100,1[f]	97	-3,1	± 6	3,5	pass
O2						
Vol.-%	0,0[a]	0,04	0,0	± 0,21	0,027	pass
Vol.-%	2,510[c]	2,54	0,030	± 0,21	0,055	pass
Vol.-%	5,000[b]	5,06	0,060	± 0,21	0,102	pass
Temperatur						
°C	100,0[g]	99,1	-0,9	± 1,1	0,24	pass
°C	200,0[g]	199,9	-0,1	± 1,1	0,24	pass
Druck						
hPa	50,0[h]	50,0	0,0	± 0,9	0,52	pass
hPa	100,0[h]	100,0	0,0	± 1,6	0,52	pass

[2] In accordance with the manufacturer gemäß Hersteller

testo

Calibration certificate Kalibrier-Zertifikat

4319339

Special remarks Besondere Bemerkungen

ALS

CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 3 Jul 22
Next Calibration Date : 3 Jan 23

Barometric Pressure (mmHg) : 756
Relative Humidity (%) : 62.0
Temperature (°C) : 31.0

Console Control Meter Data

Calibration No. : C-030722-BKK_FS0507
Dry Gas Meter No. : BKK_FS0507
Serial No. : 1503017
Model No. : XC-572-V

Reference Dry Gas Meter Data

Reference Dry Gas Meter ID.: BKK_FS0629
Serial No. : 1607009
Correction Factor (Yr) : 1.0060
Next Calibration Date : 7 Oct 22

ΔH (mm H2O)	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)	Te (°C)	Avg.Tm (°C)	Dry Gas Meter Correction Factor (Y)	Orifice Calibration Factor ΔHa@
15	11.83	150.00	0.00	150.00	32.0	714127.0	713975.0	152.00	31.0	31.0	31.0	0.9881	43.4668
25	9.23	150.00	0.00	150.00	33.0	714309.2	714157.0	152.20	32.0	32.0	32.0	0.9858	44.2443
50	6.53	150.00	0.00	150.00	34.0	714473.0	714320.0	153.00	32.0	32.0	32.0	0.9751	44.5804
80	5.16	150.00	0.00	150.00	34.0	714655.6	714503.0	152.60	32.0	32.0	35.0	0.9844	44.5387
120	4.18	150.00	0.00	150.00	35.0	714818.6	714666.0	152.60	32.0	32.0	36.0	0.9886	44.1272
											Avg.	0.9828	44.1915

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 5,5 & 7

Calibrated by : (Mr.Prasert Surakhan)
Field Scientist(3)

Approved by : (Mr.Samart Roo-ngan)
Specialist(1)

ALS

Stopwatch Calibration Test Report

Calibration Date : 3 Jul 22
Next Cal. Date : 3 Jan 23
Barometric Pressure (mmHg) : 756
Temperature (°C) : 31.0
Relative Humidity (%) : 62.0

Reference Stopwatch Data

Stopwatch ID No. : E18061
Model : F808
Serial No. : -
Calibration Date : 8 Sep 20
Certificate No. : E-2009018

Console Control Meter Data

Dry Gas Meter No. : BKK_FS0507
Model : XC-572-V
Serial No. : 1503017

Run No.	Time Actual (m:ss:ms)	Time Reading (m:ss)	Diff. (ms)	Diff. (min)
1	5:00:08	5:00	8	0.00013
2	5:00:11	5:00	11	0.00018
3	5:00:10	5:00	10	0.00017
4	5:00:10	5:00	10	0.00017
5	5:00:10	5:00	10	0.00017
6	5:00:10	5:00	10	0.00017
7	5:00:08	5:00	8	0.00013
8	5:00:09	5:00	9	0.00015
9	5:00:11	5:00	11	0.00018
10	5:00:12	5:00	12	0.00020
			Average	0.00017
			SD	0.00002

Calibrate by : Mr.Prasert Surakhan
Field Scientist (3)

Approved by : Mr. Samart Roo-ngan
Specialist (1)

DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date :	3 Jul 22	Ambient Temperature (°C) :	31
Calibration sheet No. :	C-030722-BKK_FS0508	Relative Humidity (%) :	62
Digital Temperature ID	BKK_FS0508	Reference Temperature ID :	BKK_FS0600
Serial No. :	1503017	Serial No. :	7688004
Model :	XC-572-V	Model :	FLUKE 714
		Next Calibrate :	26 Jul 23

Location	Reference Temperature °C	Digital Temperature °C	Error °C	Remark
Stack	0	1	1	
	25	26	1	
	50	51	1	
	100	101	1	
	150	151	1	
	200	201	1	
	250	252	2	
	300	302	2	
	500	503	3	
	1000	1003	3	
	1200	1203	3	
Probe	100	101	1	
	125	126	1	
	150	151	1	
Oven	100	100	0	
	125	125	0	
	150	151	1	
Filter	100	100	0	
	125	125	0	
	150	151	1	
Exit	0	1	1	
	10	11	1	
	20	21	1	
Meter	0	0	0	
	25	25	0	
	50	50	0	
AUX	0	0	0	
	25	25	0	
	50	50	0	

Calibrated by : Prasert S.
(Mr. Prasen Surakhan)
Field Scientist (3)

Approved by : Mr.
(Mr.Samart Roo-ngan)
Specialist (1)

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

Pitot Tube Calibration Data

Pitot Tube Identification Number :	BKK_FS0511	Calibration Date :	3 Jul 22
Lab test duct Number :	258-1-13-01	Standard Pitot ID :	BKK_FS0441
Calibration Sheet No. :	C-030722-BKK_FS0511	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	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
			$\overline{Cp}$	0.842	0.842

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

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

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

Calibrated by : Prasert S.
(Mr. Prasert Surakhan)
Field Scientist (3)

Approved by : Mr.
(Mr.Samart Roo-ngan)
Specialist (1)

FORM NO. F 06-028 REVISION NO. : - ISSUE DATE: 9/10/02

Pitot Tube Calibration Data

Pitot Tube Identification Number :	BKK_FS0512	Calibration Date :	3 Jul 22
Lab test duct Number :	258-1-13-01	Standard Pitot ID :	BKK_FS0441
Calibration Sheet No. :	C-030722-BKK_FS0512	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	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
			$\overline{Cp}$	0.842	0.842

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

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

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

Calibrated by : Prasert S.
(Mr. Prasert Surakhan)
Field Scientist (3)

Approved by : Mr.
(Mr.Samart Roo-ngan)
Specialist (1)

FORM NO. F 06-028 REVISION NO. : - ISSUE DATE: 9/10/02

PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date	3 Jul 22	Nozzle Set ID.:	BKK_FS0513
Calibration Sheet No. :	C-030722-BKK_FS0513	Vernier Caliper ID.:	BKK_FS0626

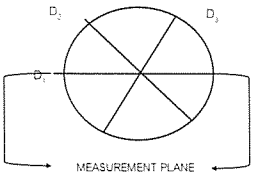
Nozzle ID #	Nozzle Diameter (cm.) D_1	D_2	D_3	Hi - Lo ΔD	$(D_1 + D_2 + D_3) / 3$ D_{avg}
1	0.315	0.315	0.315	0.000	0.315
2	0.475	0.475	0.475	0.000	0.475
3	0.635	0.635	0.635	0.000	0.635
4	0.790	0.790	0.790	0.000	0.790
5	0.950	0.950	0.950	0.000	0.950
6	1.110	1.110	1.110	0.000	1.110
7	1.270	1.270	1.270	0.000	1.270

Where :

D_1, D_2, D_3 = 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 ≤ 0.100 mm.

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



Calibrated by : Prasert S.
(Mr.Prasert Surakhan)
Field Scientist (3)

Approved by : Mr.
Mr.Samart Roo-ngan
Specialist (1)

FORM NO. F 06-029 REVISION NO. : - ISSUE DATE: 9/10/02

CONSOLE CONTROL UNIT CALIBRATION TEST REPORT

Calibration of Date : 3 Jul 22
Next Cal. Date : 3 Jan 23

Barometric Pressure (mm.Hg) : 756
Relative Humidity (%) : 54.0
Temperature : 31.0

Reference Dry Gas Meter Data

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

Console Control Meter Data

Calibration No. : C-030722-BKK_FS1093
Dry Gas Meter No. : BKK_FS1093
Serial No. : 1706090
Model No. : XC-572-V

ΔH (mm.H2O)	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	12.21	150.00	0.00	150.00	29.0	148478.2	148325.0	153.20	30.0	30.0	30.0	0.9966	45.5475
25	9.25	150.00	0.00	150.00	31.0	148646.2	148493.0	153.20	31.0	31.0	31.0	0.9924	44.0016
50	6.55	150.00	0.00	150.00	32.0	148815.2	148662.0	153.20	32.0	32.0	32.0	0.9900	44.2714
80	5.10	150.00	0.00	150.00	32.0	149256.6	149105.0	153.60	33.0	33.0	33.0	0.9878	42.8635
120	4.18	150.00	0.00	150.00	32.0	149424.0	149271.0	153.00	36.0	35.0	35.5	0.9959	42.8593
											Avg.	0.9925	43.8949

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

ΔH@ : Orifice pressure differential that actuates to 21.24 lm of air @ 25 C and 760 mm of mercury , mmH2O : tolerance for individual values ± 5.00 from average .

Procedure; 40 CFR 60,APP A,METH 5,SEC 5.3 & 7

Calibrated by: (Mr. Prasert Surakhan)
Field Scientist(3)

Approved by: (Mr.Samart Roo-ngan)
Specialist (1)

DIGITAL TEMPERATURE CALIBRATION DATA SHEET

Calibration Date : 3 Jul 22
Calibration sheet No. : C-030722-BKK_FS1093
Ambient Temperature (°C) 31
Relative Humidity (%) : 62

Digital Temperature ID : BKK_FS1093
Console Serial No. : 1706090
Console Model : XC-572-V
Reference Temperature ID BKK_FS0809
Serial No. : 7688004
Model : FLUKE714
Last Calibrate : 26 Jul 23

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	501	1	
	1000	1001	1	
	1200	1201	1	
Probe	100	100	0	
	125	126	1	
	150	151	1	
Oven	100	101	1	
	125	125	0	
	150	150	0	
Filter	100	100	0	
	125	125	0	
	150	151	1	
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 : (Mr.Prasert Surakhan)
Field Scientist (3)

Approved by : (Mr.Samart Roo-ngan)
Specialist (1)

Stopwatch Calibration Test Report

Calibration Date : 3 Jul 22
Next Cal. Date : 3 Jan 23
Barometric Pressure (mmHg) : 756
Temperature (°C) : 31.0
Relative Humidity (%) : 62.0

Reference Stopwatch Data

Stopwatch ID No. : E18061
Model : F808
Serial No. : -
Calibration Date : 8 Sep 20
Certificate No. : E-2009018

Console Control Meter Data

Dry Gas Meter No. : BKK_FS1093
Model : XC-572-V
Serial No. : 1706090

Run No.	Time Actual (m:ss:ms)	Time Reading (m:ss)	Diff. (ms)	Diff. (min)
1	5:00:11	5:00	11	0.00018
2	5:00:10	5:00	10	0.00017
3	5:00:11	5:00	11	0.00018
4	5:00:10	5:00	10	0.00017
5	5:00:12	5:00	12	0.00020
6	5:00:12	5:00	12	0.00020
7	5:00:10	5:00	10	0.00017
8	5:00:10	5:00	10	0.00017
9	5:00:08	5:00	8	0.00013
10	5:00:09	5:00	9	0.00015
			Average	0.00017
			SD	0.00002

Calibrate by : Mr.Prasert Surakhan
Field Scientist (3)

Approved by : Mr. Samart Roo-ngan
Specialist (1)

Pitot Tube Calibration Data

Pitot Tube Identification Number : BKK_FS1104
Lab test duct Number : 258-1-13-01
Calibration Sheet No. : C-030722-BKK_FS1104
Calibration Date : 3 Jul 22
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.H2O)	Type s pitot tube (ΔP, mm.H2O)	Cp (s) Leg A	Cp (s) Leg B
Test 1	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
			$\bar{C}p$	0.842	0.842

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

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

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

Calibrated by : Mr.Prasert Surakhan
Field Scientist (3)

Approved by : Mr.Samart Roo-ngan
Specialist (1)

Pitot Tube Calibration Data

Pitot Tube Identification Number :	BKK_FS1105	Calibration Date :	3 Jul 22
Lab test duct Number :	258-1-13-01	Standard Pitot ID :	BKK_FS0441
Calibration Sheet No. :	C-030722-BKK_FS1105	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	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 2	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
Test 3	A	12.00	16.60	0.842	-
	B	12.00	16.60	-	0.842
			$\bar{C}p$	0.842	0.842

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

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

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

Calibrated by : Prasert S.

Mr.Prasen Surakhan

Field Scientist (3)

Approved by : Mr.Samart Roo-ngan

Specialist (1)

PROBE NOZZLE DIAMETER CALIBRATION DATA SHEET

Calibration Date	3 Jul 22	Nozzle Set ID. :	BKK_FS1106
Calibration Sheet No. :	C-030722-BKK_FS1106	Vernier Caliper ID. :	BKK_FS0626

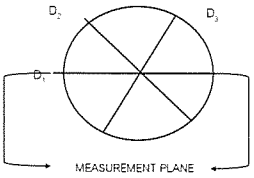
Nozzle ID #	Nozzle Diameter (mm.)			Hi - Lo	$(D_1 + D_2 + D_3) / 3$
	D_1	D_2	D_3	ΔD	D_{avg}
1	0.300	0.300	0.300	0.000	0.300
2	0.450	0.450	0.450	0.000	0.450
3	0.630	0.630	0.630	0.000	0.630
4	0.780	0.780	0.780	0.000	0.780
5	0.950	0.950	0.950	0.000	0.950
6	1.090	1.090	1.090	0.000	1.090
7	1.250	1.250	1.250	0.000	1.250

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 : Prasert S.

Mr.Prasert Surakhan

Field Scientist (3)

Approved by :

Mr.Samart Roo-ngan

Specialist (1)

Calibration certificate Kalibrier-Zertifikat 4321031

Object Gegenstand	Controlunit t350	Measuring Box testo 350
Manufacturer Hersteller	TESTO SE & Co. KGaA	TESTO SE & Co. KGaA
Type description Typ	0632 3511	0632 3510
Serial no. Serien Nr.	03580090	62985022
Inventory no. Inventar Nr.	---	---
Test equipment no. Prüfmittel Nr.	---	---
Equipment no. Equipment Nr.	14672696	14675708
Location Standort	---	---
Customer Auftraggeber	ALS Laboratory Group (Thailand) Co., Ltd 104 Phatthanakan 40, Phatthanakan Rd., TH-10250 Bangkog, Thailand	
Customer ID no. Kunden Nr.	1031994	
Order no. Auftrags Nr.	10842906 / 0520 0055	
Date of calibration Datum der Kalibrierung	10.12.2021	
Date of the recommended re-calibration Datum der empfohlenen Rekalibrierung	10.12.2022	

Hereby we confirm that the performing calibration laboratory is working with a management system according to ISO 9001:2015 and ISO/IEC 17025:2018. Accreditation certificates can be found under www.testolis.de. The measuring installations used for calibration are regularly calibrated and traceable to the national standards of the German Federal Physical Technical Institute (PTB) or other national standards. Should no national standards exist, the measuring procedure corresponds with the technical regulations and norms valid at the time of the measurement. The documents established for this procedure are available for viewing. All the necessary measured data can be found on this calibration certificate.

Hiermit bestätigen wir, dass das durchführende Kalibrierlabor ein Managementsystem nach ISO 9001:2015, sowie ISO/IEC 17025:2018 eingeführt hat. Die Urkunden finden Sie auf www.testolis.de. Die für die Kalibrierung verwendeten Messeinrichtungen werden regelmäßig kalibriert und sind rückführbar auf die nationalen Normale der Physikalisch Technischen Bundesanstalt (PTB) Deutschlands oder auf andere nationale Normale. Wo keine nationalen Normale existieren, entspricht das Messverfahren den derzeit gültigen technischen Regeln und Normen. Die für diesen Vorgang angefertigte Dokumentation kann eingesehen werden. Alle erforderlichen Messdaten sind in diesem Kalibrier-Zertifikat aufgelistet.

Conformity statement Konformitätsaussage

[X] Measured value(s) within the allowable deviation[1]. Messwert(e) innerhalb der zulässigen Abweichung[1].

[ ] Measured value(s) outside of the allowable deviation[1]. Messwert(e) außerhalb der zulässigen Abweichung[1].

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[1] The expanded measurement uncertainty was calculated according to EA-4-02 M:2013 with a coverage probability of approx. 95% and contains the uncertainty of the reference, the method and the uncertainty of the unit under test. The statement of conformity is based on the decision rule "Vertrauensniveau 50" (confidence level 50).

[1] Die erweiterte Messunsicherheit wurde nach EA-4-02 M:2013 mit einer Überdeckungswahrscheinlichkeit von etwa 95% berechnet und enthält die Unsicherheit der Referenz, des Verfahrens sowie die Unsicherheit des Prüflings. Die Konformitätsaussage erfolgt nach der Entscheidungsregel "Vertrauensniveau 50".

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Seal Stempel

Supervisor Fachverantwortlicher: Martin Förderer

Technician Bearbeiter: Samuel Garcia Zlodi

Calibration certificate Kalibrier-Zertifikat 4321031

Measuring equipment Messeinrichtungen

Index	Reference Referenz	Traceability Rückführung	Next cal. Rekal.	Certificate-no. Zertifikat-Nr.	Eq.-no. Eq.-Nr.
a	Test gas medium 1 Prüfgas Medium 1	SCS-SCS0026 2021-03	2024-03	4017585	12898976
b	Test gas medium 3 Prüfgas Medium 3	SCS-SCS0026 2021-03	2022-03	4017588	12898982
c	Test gas medium 5 Prüfgas Medium 5	SCS-SCS0026 2021-03	2022-03	4017591	12898984
d	Test gas medium 8 Prüfgas Medium 8	SCS-SCS 2021-07	2022-10	4220471	12898997
e	Test gas medium 7 Prüfgas Medium 7	SCS-SCS0026 2021-03	2022-03	4017596	12898986
f	Test gas medium 11 Prüfgas Medium 11	ISO-ISO 6141 2021-04	2022-04	4017602	14087964
g	Digistant 4420 Digistant 4420	15070-01-01 2021-07	2022-07	E166673	12966901
h	Pneumator Pneumator	15070-01-01 2021-07	2022-07	D53219	12965547

Reference certificates are available at www.primasonline.com Referenzzertifikate sind auf www.primasonline.com abrufbar

Ambient conditions Umgebungsbedingungen

Temperature Temperatur (20...26) °C Humidity Feuchte (20...60) % RH % rF

Measuring procedure Messverfahren

The calibration was carried out by comparison measurement with calibrated test gases, a calibrator of temperature and pressure.
Die Kalibrierung erfolgte durch Vergleichsmessung mit kalibrierten Prüfgasen, einem Temperatur- und Druckkalibrator.

Measuring results Messergebnisse

Channel Kanal ---

Unit Einheit	Reference value Bezugswert	Indicated measured value probe Angezeigter Messwert Kalibriergegenstand	Deviation Abweichung	Allowed deviation[2] Zulässige Abweichung[2]	Measurement uncertainty (k=2) Messunsicherheit (k=2)	Confirmation Bewertung
CO						
ppm	100.1[a]	103	2,9	± 11	3,3	pass
ppm	401.0[b]	402	1,0	± 21	8,5	pass
ppm	700.0[c]	726	26,0	± 36	14,4	pass
NO						
ppm	150.3[a]	152	1,7	± 9	4,0	pass
ppm	301[d]	304	3	± 16	6,9	pass
NO2						
ppm	99.9[e]	104,1	4,2	± 5,1	3,20	pass
SO2						
ppm	100.1[f]	98	-2,1	± 6	3,5	pass
O2						
Vol.-%	0.0[a]	0,05	0,0	± 0,21	0,027	pass
Vol.-%	2.510[c]	2,55	0,040	± 0,21	0,055	pass
Vol.-%	5.000[g]	5,06	0,060	± 0,21	0,102	pass
Temperatur						
°C	100.0[g]	98,9	-1,1	± 1,1	0,24	pass
°C	200.0[g]	199,9	-0,1	± 1,1	0,24	pass
Druck						
hPa	50.0[h]	49,9	-0,1	± 0,9	0,52	pass
hPa	100.0[h]	99,9	-0,1	± 1,6	0,52	pass

[2] in accordance with the manufacturer gemäß Hersteller

testo

Calibration certificate Kalibrier-Zertifikat 4321031

Special remarks Besondere Bemerkungen

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Dokmai Prawet Bangkok 10250
Tel: +66 (0) 2069-9773
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Certificate of Calibration

NSC-TISI-TIS17025 CALIBRATION 0324

Represent to Certificate of Calibration ,PTC/07/22071

Certificate No.:	PTC/07/22071	Page:	1 of 2
Equipment:	Digital Balance	Condition:	Normal
Manufacturer:	Sartonus	Serial No:	26207042
Model:	MSE224-100-DU	ID No:	BKK_EN0002
Type of Balance:	Single interval		

Customer: ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakarn 40 Phatthanakarn Rd.,
khwaeng Phatthanakarn, Khet Suan Luang, Bangkok 10250.

Environment Condition:

Temperature	21.5 °C	±	0.7 °C
Humidity	61.8 %RH	±	4.7 %RH
Air density	1.19		kg/m³

REVIEW BY Sorasit M.
APPROVED BY
NEXT CAL. DATE 25/02/26

Calibration Place: ALS Laboratory Group (Thailand) Co.,Ltd.
104 Phatthanakarn 40 Phatthanakarn Rd.,
khwaeng Phatthanakarn, Khet Suan Luang, Bangkok 10250.

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

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

Date Received: February 25, 2022

Calibration Date: February 25, 2022

Issued Date: March 01, 2022

Calibration By: Mr. Rungroje Metakul

PENTA CALIBRATION CO.,LTD.

(Mr.Kriangsak Kalasri)
Reviewed by

Approved By :
(Mr. Keattisak Kerdto)
Laboratory Manager

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

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

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Represent to Certificate of Calibration ,PTC/07/22071

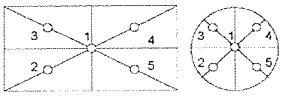
Certificate No.: PTC/07/22071 Page 2 of 2

Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

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



Eccentricity test 100 (g)

Position (g)				
1	2	3	4	5
0.0000	-0.0002	-0.0001	0.0001	-0.0001
Maximum deviation:			0.0002	

Repeatability Test : Weight to be 1/2 ≤ L_1 ≤ Maximum capacity

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

Nominal test value (g)	Standard Deviation
200	0.00005

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

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
0	0.00000	0.0000	0.0000	0.00016	2.52
0.1	0.10000	0.1000	0.0000	0.00017	2.20
0.5	0.50000	0.5000	0.0000	0.00016	2.28
1	1.00001	1.0000	0.0000	0.00016	2.28
2	2.00001	2.0000	0.0000	0.00016	2.28
5	5.00001	5.0000	0.0000	0.00016	2.28
10	10.00002	10.0000	0.0000	0.00016	2.28
20	20.00002	20.0000	0.0000	0.00016	2.23
50	50.00001	50.0000	0.0000	0.00017	2.15
100	100.00002	99.9999	0.0001	0.00020	2.06
120	120.00004	120.0000	0.0000	0.00023	2.03
150	150.00003	150.0000	0.0000	0.00026	2.00
200	200.00003	199.9999	0.0001	0.00030	2.00

Note: Weight of adjust (g)

The End of Certificate

RYG_EN0004

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Certificate of Calibration

NSC-TISI-TIS17025 CALIBRATION 0324

Represent to Certificate of Calibration ,PTC/07/22104

Certificate No.:	PTC/07/22104	Page:	1 of 3
Equipment:	Digital Balance	Condition:	Normal
Manufacturer:	Sartonus	Serial No:	33108993
Model:	MSE125P-100-DU	ID No:	RYG_EN0004
Type of Balance:	Single interval		

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

REVIEW BY Thanitaff.
APPROVED BY
NEXT CAL. DATE 28/00/23.

Environment Condition:

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

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

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

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

Date Received: March 23, 2022

Calibration Date: March 23, 2022

Issued Date: March 25, 2022

Calibration By: Mr. Rungroje Metakul

PENTA CALIBRATION CO.,LTD.

(Mr.Kriangsak Kalasri)
Reviewed by

Approved By :
(Mr. Keattisak Kerdto)
Laboratory Manager

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

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

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Represent to Certificate of Calibration ,PTC/07/22104

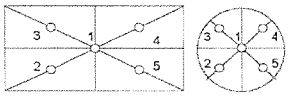
Certificate No.: PTC/07/22104

Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

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



Eccentricity test 50 (g)

Position (g)				
1	2	3	4	5
0.00000	-0.00004	-0.00001	0.00000	0.00001
Maximum deviation:		0.00004		

Repeatability Test : Weight to be 1/2 ≤ L_1 ≤ Maximum capacity

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

Nominal test value (g)	Standard Deviation
50	0.000007

Error of indication : from nominal value., Readability 0.00001 (g)

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
0	0.000000	0.00000	0.00000	0.000020	2.65
0.01	0.010001	0.01000	0.00000	0.000022	2.17
0.05	0.050002	0.04999	0.00001	0.000022	2.17
0.1	0.099999	0.09999	0.00001	0.000022	2.17
0.5	0.500001	0.50001	-0.00001	0.000022	2.17
1	1.000004	0.99999	0.00001	0.000022	2.14
2	1.999999	1.99999	0.00001	0.000022	2.14
5	5.000015	4.99999	0.00002	0.000023	2.14
10	10.000004	10.00000	0.00000	0.000024	2.10
20	20.000029	20.00000	0.00003	0.000032	2.00
50	50.000043	49.99999	0.00005	0.000069	2.00

Note: Weight of adjust - (g)

PENTA CALIBRATION

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

Represent to Certificate of Calibration ,PTC/07/22104

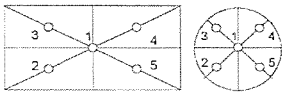
Certificate No.: PTC/07/22104

Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

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



Eccentricity test 50 (g)

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

Repeatability Test : Weight to be 1/2 ≤ L_1 ≤ Maximum capacity

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

Nominal test value (g)	Standard Deviation
100	0.00000

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

Nominal Value (g)	Conventional Mass (g)	Indication (g)	Correction of Balance (g)	Uncertainty (g)	k
65	65.00006	65.0000	0.0001	0.00013	2.00
70	70.00007	70.0000	0.0001	0.00013	2.00
75	75.00009	75.0000	0.0001	0.00014	2.00
80	80.00008	80.0000	0.0001	0.00014	2.00
85	85.00009	85.0000	0.0001	0.00015	2.00
90	90.00010	90.0000	0.0001	0.00015	2.00
95	95.00012	95.0000	0.0001	0.00016	2.00
100	100.00004	100.0000	0.0000	0.00014	2.00
110	110.00004	110.0000	0.0000	0.00015	2.00
120	120.00007	120.0000	0.0001	0.00016	2.00

Note: Weight of adjust - (g)

The End of Certificate

ALS

ROTA METER CALIBRATION RESULT JULY 2022

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R^2)
BKK_FS0577	01 Jul 22	Y = 1.0202x + 0.1976	1.0000
BKK_FS0579	01 Jul 22	Y = 1.0078x + 0.4789	0.9998
BKK_FS0583	01 Jul 22	Y = 1.016x + 0.3922	1.0000
BKK_FS0584	01 Jul 22	Y = 1.0036x + 2.2262	0.9997
BKK_FS0585	01 Jul 22	Y = 1.0189x - 5.6476	0.9997
BKK_FS0586	01 Jul 22	Y = 1.0095x - 1.1524	0.9995
BKK_FS0587	01 Jul 22	Y = 1.013x - 3.6619	0.9996
BKK_FS0588	01 Jul 22	Y = 1.0154x + 4.8357	0.9999
BKK_FS0589	01 Jul 22	Y = 0.9918x + 4.8069	0.9999
BKK_FS0590	01 Jul 22	Y = 1.0038x - 0.4857	0.9996
BKK_FS0591	01 Jul 22	Y = 0.9705x - 52.174	0.9986
BKK_FS0592	01 Jul 22	Y = 0.9646x - 37.642	0.9985
BKK_FS0593	01 Jul 22	Y = 0.9767x - 58.445	0.9988
BKK_FS0594	01 Jul 22	Y = 0.9902x - 62.87	0.9999
BKK_FS0595	01 Jul 22	Y = 1.0249x - 98.162	0.9999
BKK_FS0596	01 Jul 22	Y = 0.9843x - 26.806	0.9991
BKK_FS0597	01 Jul 22	Y = 0.9802x - 61.653	0.9978
BKK_FS1004	01 Jul 22	Y = 0.9696x + 17.69	0.9990
BKK_FS1005	01 Jul 22	Y = 1.0092x + 2.4571	0.9999
BKK_FS1006	01 Jul 22	Y = 1.168x - 5.566	0.9997
BKK_FS1007	01 Jul 22	Y = 0.9917x + 1.6592	1.0000
BKK_FS1008	01 Jul 22	Y = 1.0132x + 0.7207	1.0000
BKK_FS1009	01 Jul 22	Y = 1.0132x + 1.1633	0.9960
BKK_FS1010	01 Jul 22	Y = 1.0033x + 0.5758	0.9999
BKK_FS1011	01 Jul 22	Y = 1.0234x + 0.1759	0.9996
BKK_FS1012	01 Jul 22	Y = 1.0106x - 2.0048	0.9997
BKK_FS1013	01 Jul 22	Y = 0.9677x - 35.851	0.9997
BKK_FS1014	01 Jul 22	Y = 1.0021x + 0.3148	0.9998
BKK_FS1015	01 Jul 22	Y = 0.9994x + 1.786	1.0000
BKK_FS1016	01 Jul 22	Y = 1.0105x - 80.256	0.9998
BKK_FS1017	01 Jul 22	Y = 0.9995x + 0.649	1.0000
BKK_FS1018	01 Jul 22	Y = 1.0011x + 1.1786	1.0000
BKK_FS1019	01 Jul 22	Y = 1.0023x - 68.424	0.9996
BKK_FS1020	01 Jul 22	Y = 1.0547x - 0.666	0.9998
BKK_FS1021	01 Jul 22	Y = 1.018x - 3.3286	0.9998
BKK_FS1022	01 Jul 22	Y = 0.9932x - 57.035	0.9986
BKK_FS1023	01 Jul 22	Y = 1.0094x + 0.0717	0.9999
BKK_FS1024	01 Jul 22	Y =1.0042x + 0.4086	0.9997
BKK_FS1025	01 Jul 22	Y = 1.0132x - 88.507	0.9996

ALS

ROTA METER CALIBRATION RESULT JULY 2022

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R^2)
BKK_FS1026	01 Jul 22	Y = 1.0018x + 1.0776	0.9997
BKK_FS1027	01 Jul 22	Y = 1.0053x + 0.231	0.9995
BKK_FS1028	01 Jul 22	Y = 0.9792x - 60.312	0.9982
BKK_FS1029	01 Jul 22	Y = 0.9935x + 0.8234	1.0000
BKK_FS1030	01 Jul 22	Y = 1.0039x + 0.515	0.9999
BKK_FS1031	01 Jul 22	Y = 1.009x - 79.295	0.9998
BKK_FS1039	01 Jul 22	Y = 0.9879x + 7.3524	0.9996
BKK_FS1040	01 Jul 22	Y = 0.9704x + 88.336	0.9987
BKK_FS1041	01 Jul 22	Y = 1.0645x - 1.7878	0.9999
BKK_FS1042	01 Jul 22	Y = 0.9983x + 3.6262	0.9998
BKK_FS1043	01 Jul 22	Y = 1.0069x - 6.9619	1.0000
BKK_FS1044	01 Jul 22	Y = 1.0355x - 0.6214	0.9997
BKK_FS1161	01 Jul 22	Y = 1.0126x + 0.7738	0.9999
BKK_FS1162	01 Jul 22	Y = 0.9994x + 2.6357	0.9995
BKK_FS1163	01 Jul 22	Y = 0.977x - 55.03	0.9987
BKK_FS1164	01 Jul 22	Y = 0.9914x + 0.8427	0.9997
BKK_FS1165	01 Jul 22	Y = 0.9893x + 6.5919	0.9998
BKK_FS1166	01 Jul 22	Y = 1.0031x - 77.881	0.9996
BKK_FS1200	01 Jul 22	Y = 1.0313x - 0.4602	0.9995
BKK_FS1201	01 Jul 22	Y = 1.0045x + 0.15	0.9996
BKK_FS1202	01 Jul 22	Y = 0.9702x - 44.156	0.9994
RYG_FS0197	01 Jul 22	Y = 1.0039x - 0.179	0.9999
RYG_FS0198	01 Jul 22	Y = 0.9971x + 16.648	0.9999
RYG_FS0199	01 Jul 22	Y = 1.0832x - 2.6367	1.0000

Review By : (Mr. Wichan Choonharat)
Enviro Field Services Manager

Approved By : (Mr.Sarayuth Jittranont)
Assistant General Manager

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Certificate of System Qualification

GC-OQ + GCMS-OQ

REVIEW BY Somrat M.
APPROVED BY
NEXT CAL DATE 1 April 23

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

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Accuracy

Name: 7890

Front MMI

Setpoint Status: Pass

	Setpoint		Actual	
Inlet Pressure:	25.0	psi	24.9	psi

Accuracy: 0.1 psi

Agilent Recommended: <= 1.2

Overall Inlet Pressure Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890

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Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 230.0 230.5 °C

Accuracy: 0.5 °C

Agilent Recommended: >= -1.0 % setpoint in K (-5.0 °C)
<= 1.0 % setpoint in K (5.0 °C)

Setpoint Status: Pass

Zone: Oven

Setpoint/Actual

Temperature: 100.0 101.5 °C

Accuracy: 1.5 °C

Agilent Recommended: >= -1.0 % setpoint in K (-3.7 °C)
<= 1.0 % setpoint in K (3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: 7890

Setpoint Status: Pass

Setpoint/Average

Temperature: 100.0 101.5 °C

Stability: 0.0 °C

Agilent Recommended: <= 0.5

Overall GC Oven Temperature Stability Test Status

Pass

Log Amp

Tested Combination1 Front MMI / External SQ

Name: 5975C Inert XL with TAD

Setpoint Status: Pass

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Overall Log Amp Test Status

Pass

RFPA

Tested Combination1 Front MMI / External SQ

Name: 5975C inert XL with TAD

Setpoint Status: Pass

Amu: 1050 m/z

Drift After Five Minutes: 6 mV

RFPA Voltage: 461 mV

Agilent Recommended: >= -100 and <= 100 <= 1100

Overall RFPA Test Status

Pass

Tune EI

Tested Combination1 Front MMI / External SQ

Name: 5975C inert XL with TAD

Setpoint Status: Pass

Filament: 1

Setpoint Status: Pass

Filament: 2

Overall Tune EI Test Status

Pass

Scouting Run

Tested Combination1 Front MMI / External SQ

Injection Tower

Name: 7693A

Source: EI - Inert

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Setpoint Status: Completed

Injection Volume on Column: 1.0 uL

Overall Scouting Run Status

Completed

Signal to Noise EI

Tested Combination1 Front MMI / External SQ

Name: 5975C Inert XL with TAD

Source: EI - Inert Filament: 1

Setpoint Status: Pass

Signal to Noise: 619

Agilent Recommended: >= 320

Source: EI - Inert Filament: 2

Setpoint Status: Pass

Signal to Noise: 647

Agilent Recommended: >= 320

Overall Signal to Noise EI Test Status

Pass

Injection Precision

Tested Combination1 Front MMI / External SQ

Name: 7693A

Source: EI - Inert

Setpoint Status: Pass

Injection Volume on Column: 1.0 uL

Area RSD: 4.75 %

Agilent Recommended: <= 5.00

Retention Time RSD: 0.02 %

<= 1.00

Overall Injection Precision Test Status

Pass

Mass Ratio Precision

Tested Combination1	Front	MMI	/ External	SQ
	Injection Tower			
Name:	7693A			
Source:	EI - Inert			
Setpoint Status:	Pass			
Injection Volume on Column:	1.0 uL			

	Area Mass 1 Abundance*s	Mass Ratio
RSD:	4.75 %	0.81 %
Agilent Recommended:	<= 5.00	<= 5.00
	Pass	Pass

Overall Mass Ratio Precision Test Status

Pass

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

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

Tested Combination1

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

Sampler 1

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

Sampler 2

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

Mainframe 1

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

Inlet 1

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

Detector 1

Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External

Mass Spectrometer 1

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

MS EI Source 1

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

Electronic Signature

Purpose

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Details

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

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User Name: supasak.nimsongtham
Hostname: SCG1115HKC

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

ALS_GM2 Transaction log :

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

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User Name: supasak.nimsongtham
Hostname: SCG1115HKC

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

ALS_GM2 Transaction log :

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

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User Name: supasak.nimsongtham
Hostname: SCG1115HKC

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

ALS_GM2 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 1, 2021 12:48:38 PM	Start	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
October 1, 2021 12:49:34 PM	Audit	Data	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
October 1, 2021 12:49:36 PM	End	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count : 1
October 1, 2021 12:49:37 PM	Start	Execution	Log Amp - 5975C Inert XL with TAD SQ: - Source: EI - Inert	None
October 1, 2021 12:49:47 PM	End	Execution	Log Amp - 5975C Inert XL with TAD SQ: - Source: EI - Inert	Run Count : 1
October 1, 2021 12:49:48 PM	Start	Execution	RFPA - 5975C Inert XL with TAD SQ: - Source: EI - Inert	None
October 1, 2021 12:50:23 PM	End	Execution	RFPA - 5975C Inert XL with TAD SQ: - Source: EI - Inert	Run Count : 1
October 1, 2021 12:50:25 PM	Start	Execution	Tune EI - 5975C Inert XL with TAD SQ: - Source: - EI - Inert Filament 1 (Qualitative - No setpoints associated)	None
October 1, 2021 12:50:49 PM	End	Execution	Tune EI - 5975C Inert XL with TAD SQ: - Source: - EI - Inert Filament 1 (Qualitative - No setpoints associated)	Run Count : 1
October 1, 2021 12:50:53 PM	Start	Execution	Tune EI - 5975C Inert XL with TAD SQ: - Source: - EI - Inert Filament 2 (Qualitative - No setpoints associated)	None
October 1, 2021 12:50:59 PM	End	Execution	Tune EI - 5975C Inert XL with TAD SQ: - Source: - EI - Inert Filament 2 (Qualitative - No setpoints associated)	Run Count : 1

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User Name: supasak.nimsongtham
Hostname: SCG1115HKC

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

ALS_GM2 Transaction log :

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

User Name: supasak.nimsongtham
Hostname: SCG1115HKC

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

ALS_GM2 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 1, 2021 12:53:59 PM	Start	Execution	Signal to Noise EI - Injection Tower, Front MMI, SQ: - Source: EI - Inert using Filament 2 - L: >= 320	None
October 1, 2021 12:54:04 PM	Audit	Data	Signal to Noise EI - Injection Tower, Front MMI, SQ: - Source: EI - Inert using Filament 2 - L: >= 320	Data files Path : E:\GM2OQ2021\SNF2_001.D \DATA.MS
October 1, 2021 12:54:22 PM	End	Execution	Signal to Noise EI - Injection Tower, Front MMI, SQ: - Source: EI - Inert using Filament 2 - L: >= 320	Run Count : 1
October 1, 2021 12:54:29 PM	Start	Execution	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	None
October 1, 2021 12:54:37 PM	Audit	Data	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM2OQ2021\P_MRP003. D\DATA.MS
October 1, 2021 12:54:37 PM	Audit	Data	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM2OQ2021\P_MRP004. D\DATA.MS
October 1, 2021 12:54:37 PM	Audit	Data	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM2OQ2021\P_MRP005. D\DATA.MS
October 1, 2021 12:54:37 PM	Audit	Data	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM2OQ2021\P_MRP006. D\DATA.MS

User Name: supasak.nimsongtham
Hostname: SCG1115HKC

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

ALS_GM2 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 1, 2021 12:54:37 PM	Audit	Data	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM2OQ2021\P_MRP007. D\DATA.MS
October 1, 2021 12:54:37 PM	Audit	Data	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Data files Path : E:\GM2OQ2021\P_MRP008. D\DATA.MS
October 1, 2021 12:54:52 PM	End	Execution	Injection Precision - Injection Tower, Front MMI, SQ: - Source: - EI - Inert L (Area): <= 5.00% - L (Ret. Time): <= 1.00%	Run Count : 1
October 1, 2021 12:54:55 PM	Start	Execution	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	None
October 1, 2021 12:55:05 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM2OQ2021\P_MRP003. D\DATA.MS
October 1, 2021 12:55:05 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM2OQ2021\P_MRP004. D\DATA.MS
October 1, 2021 12:55:05 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM2OQ2021\P_MRP005. D\DATA.MS
October 1, 2021 12:55:05 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM2OQ2021\P_MRP006. D\DATA.MS

User Name: supasak.nimsongtham
Hostname: SCG1115HKC

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

ALS_GM2 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 1, 2021 12:55:05 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM2OQ2021\P_MRP007. D\DATA.MS
October 1, 2021 12:55:05 PM	Audit	Data	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Data files Path : E:\GM2OQ2021\P_MRP008. D\DATA.MS
October 1, 2021 12:55:10 PM	End	Execution	Mass Ratio Precision - Injection Tower, Front MMI, SQ: - Source: EI - Inert - L (RSD): <= 5.00%	Run Count : 1
October 1, 2021 12:55:13 PM	End	Qualification	Session	OQ
October 1, 2021 12:55:13 PM	Start	Reporting	Session	None
October 1, 2021 1:09:11 PM	Audit	Reporting	Session	Report Generated : Certificate

Lot No. 2293802-1

ANALYZER CALIBRATION DATA

Client : GHECO-ONE Co.,Ltd. Location : ปล่องระบายของ PC Boiler
Date : 19 Aug 22 Test Operator : Anuvat M.

O_2 ANALYZER
Model : TELEDYNE API 200EH Serial No. : 482
Span (%) : 25

	Cylinder Value (%)	Initial Analyzers Calibration Response (%)	Final Analyzers Calibration Response (%)	Difference (Percent of Span)
Zero Gas	0.00	0.00	0.10	0.40
Low-Level Gas	8.02	8.00	7.89	0.44
Span Gas	16.17	16.07	16.00	0.28

NO_X ANALYZER
Model : TELEDYNE API T200H Serial No. : 482
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	0.02	0.01
Low-Level Gas	54.64	55.00	54.00	1.00
Span Gas	81.85	80.78	80.55	0.23

SO2 ANALYZER
Model : TELEDYNE API T100H Serial No. : 324
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	0.00	0.00
Low-Level Gas	54.34	53.88	54.00	0.12
Span Gas	79.92	79.14	80.12	0.98

CO ANALYZER
Model : TELEDYNE API T300M Serial No. : 377
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	54.42	53.89	54.00	0.11
Span Gas	79.73	80.22	80.12	0.10

Calibrated by

Anuvat M

(Mr. Anuvat Moungpair)

Environmental Field Scientist (2)

FORM NO : F 06-062 REVISION NO : 2 ISSUE DATE 3/05/19

ALS Laboratory Group

Lot No. 2293802-1

SYSTEM CALIBRATION BIAS AND DRIFT DATA

Client : GHECO-ONE Co.,Ltd. Location : ปล่องระบายของ PC Boiler
Date : 19 Aug 22 Test Operator : Anuvat M.

O_2 ANALYZER
Cylinder Conc. (%) : 16.17 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	0.00	0.01	0.04	0.02	0.08	0.04
Upscale Gas	16.07	16.00	0.28	16.11	0.16	0.44

NO_X ANALYZER
Cylinder Conc. (ppm) : 81.85 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	0.03	0.04	0.01	0.02
Upscale Gas	80.78	79.88	0.90	80.00	0.78	0.12

SO_2 ANALYZER
Cylinder Conc. (ppm) : 79.92 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	0.03	0.03	0.10	0.10	0.07
Upscale Gas	79.14	78.88	0.26	79.05	0.09	0.17

CO ANALYZER
Cylinder Conc. (ppm) : 79.73 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	0.05	0.03	0.06	0.04	0.01
Upscale Gas	80.22	79.59	0.63	80.00	0.22	0.41

Calibrated by

Anuvat M

(Mr. Anuvat Moungpair)

Environmental Field Scientist (2)

FORM NO F 06-062 REVISION NO 2 ISSUE DATE 3/05/19

ALS Laboratory Group

EMISSION TEST RESULT

		Run #	1
Client	GHECO-ONE Co.,Ltd.	Location	ปล่องระบายของ PC Boiler
Date	19 Aug 22	Test Operator	Anuvat M.
Start Time	11:00	Finish Time	11:20
SO_2 Analyzer Model	TELEDYNE API T100H	Serial No.	324
NO_x/O_2 Analyzer Model	TELEDYNE API T200H	Serial No.	482
CO/CO_2 Analyzer Model	TELEDYNE API T300M	Serial No.	377

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
11:00	5.39	14.87	46.79	6.56	7.27	
11:01	5.39	14.71	47.41	6.72	7.72	
11:02	5.39	14.73	47.65	6.95	6.98	
11:03	5.39	14.68	47.21	9.30	6.05	
11:04	5.36	14.72	46.65	9.25	4.19	
11:05	5.33	14.79	47.13	9.57	5.30	
11:06	5.33	14.76	48.36	9.57	7.11	
11:07	5.32	14.66	48.97	9.38	5.92	
11:08	5.34	14.83	48.54	9.52	4.67	
11:09	5.34	14.81	48.44	9.56	5.84	
11:10	5.30	14.82	48.68	9.53	6.50	
11:11	5.35	14.86	48.20	9.39	5.42	
11:12	5.40	14.70	47.24	9.43	4.14	
11:13	5.38	14.64	46.63	9.55	2.98	
11:14	5.34	14.82	46.63	9.65	6.41	
11:15	5.35	14.90	47.36	9.72	7.77	
11:16	5.35	14.83	47.77	9.65	9.53	
11:17	5.38	14.81	46.85	9.60	10.48	
11:18	5.33	14.98	45.38	9.80	10.90	
11:19	5.29	14.98	45.00	9.92	10.62	
11:20	5.30	14.88	46.23	9.96	14.03	
Average	**5.35**	**14.79**	**47.29**	**9.17**	**7.13**	

Anuvat M

(Mr. Anuvat Moungpair)

Environmental Field Scientist (2)

FORM NO F 06-062 REVISION NO 2 ISSUE DATE 3/05/19

ALS Laboratory Group

EMISSION TEST RESULT

		Run #	2
Client	GHECO-ONE Co.,Ltd.	Location	ปล่องระบายของ PC Boiler
Date	19 Aug 22	Test Operator	Anuvat M.
Start Time	11:21	Finish Time	11:41
SO_2 Analyzer Model	TELEDYNE API T100H	Serial No.	324
NO_x/O_2 Analyzer Model	TELEDYNE API T200H	Serial No.	482
CO/CO_2 Analyzer Model	TELEDYNE API T300M	Serial No.	377

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
11:21	5.35	14.84	46.89	9.99	12.02	
11:22	5.33	14.86	46.66	10.07	7.55	
11:23	5.34	14.91	46.89	10.26	9.60	
11:24	5.31	14.90	47.93	10.51	10.18	
11:25	5.31	14.77	48.98	10.44	10.25	
11:26	5.32	14.90	48.88	10.43	10.66	
11:27	5.30	14.81	48.60	10.43	10.74	
11:28	5.32	14.99	48.70	10.42	11.53	
11:29	5.36	14.95	49.03	10.44	13.23	
11:30	5.34	14.76	49.00	10.56	15.97	
11:31	5.32	14.83	48.34	10.45	10.80	
11:32	5.30	14.87	47.83	10.52	6.87	
11:33	5.30	14.75	48.39	10.60	8.00	
11:34	5.31	14.84	48.98	10.54	7.98	
11:35	5.29	14.67	49.29	10.57	9.91	
11:36	5.32	14.83	49.20	10.59	11.93	
11:37	5.34	14.94	49.00	10.88	10.93	
11:38	5.35	14.93	48.83	10.90	28.30	
11:39	5.34	15.02	49.09	10.88	15.88	
11:40	5.30	14.81	49.24	10.81	12.97	
11:41	5.29	14.85	48.21	10.66	11.17	
Average	**5.32**	**14.85**	**48.47**	**10.52**	**11.74**	

Anuvat M

(Mr. Anuvat Moungpair)

Environmental Field Scientist (2)

FORM NO F 06-062 REVISION NO 2 ISSUE DATE 3/05/19

ALS Laboratory Group

EMISSION TEST RESULT

Client	GHECO-ONE Co.,Ltd.	Run #	3
Date	19 Aug 22	Location	ปล่องหางเครื่อง PC Boiler
Start Time	11:42	Test Operator	Anuvat M.
SO_2 Analyzer Model	TELEDYNE API T100H	Finish Time	12:02
NO_x/O_2 Analyzer Model	TELEDYNE API T200H	Serial No.	324
CO/CO_2 Analyzer Model	TELEDYNE API T300M	Serial No.	482
		Serial No.	377

Time (min)	O_2 (%)	CO_2 (%)	NOx (ppm)	SO_2 (ppm)	CO (ppm)	Remark
11:42	5.34	14.88	47.19	10.86	13.01	
11:43	5.35	14.88	47.10	10.82	10.05	
11:44	5.33	14.82	47.45	10.67	6.56	
11:45	5.31	14.92	48.14	10.69	7.30	
11:46	5.32	14.90	48.84	10.65	12.49	
11:47	5.32	14.98	49.74	10.74	13.52	
11:48	5.35	14.99	49.43	11.38	11.88	
11:49	5.29	14.93	48.94	11.05	10.45	
11:50	5.24	14.85	48.54	10.79	9.84	
11:51	5.29	14.87	47.71	10.71	12.00	
11:52	5.35	14.91	46.44	10.83	11.25	
11:53	5.33	14.83	45.28	10.80	12.31	
11:54	5.32	14.93	45.42	10.72	13.64	
11:55	5.29	14.79	47.01	10.86	9.98	
11:56	5.31	14.85	48.86	10.89	8.30	
11:57	5.33	15.00	49.93	11.13	13.62	
11:58	5.35	14.77	50.22	11.25	11.37	
11:59	5.34	14.73	50.04	11.44	7.02	
12:00	5.32	14.94	49.41	11.38	7.49	
12:01	5.32	14.95	49.26	11.48	6.68	
12:02	5.34	15.08	49.80	11.49	6.06	
Average	5.32	14.89	48.32	10.98	10.23	

Anuvat M

(Mr. Anuvat Moungpair)

Environmental Field Scientist (2)

FORM NO F 05-062 REVISION NO 2 ISSUE DATE 3/06/19

ALS Laboratory Group

PM CEMs Data (@7%O_2)

Client Name	GHECO-ONE CO.,LTD.	Date	15-Nov-22
Plant Name	GHECO-ONE	Location	PC Boiler

Run No.1			Run No.2			Run No.3			Run No.4			Run No.5		
Time	Dust mg/m³	Opacity %	Time	Dust mg/m³	Opacity %	Time	Dust mg/m³	Opacity %	Time	Dust mg/m³	Opacity %	Time	Dust mg/m³	Opacity %
11:25	3.10	1.75	12:30	3.10	1.80	13:30	3.20	2.13	14:30	3.10	1.90	15:30	3.20	2.07
11:26	3.10	1.70	12:31	3.10	1.79	13:31	3.20	2.08	14:31	3.10	1.86	15:31	3.20	2.09
11:27	3.10	1.82	12:32	3.10	1.83	13:32	3.10	2.02	14:32	3.10	1.94	15:32	3.10	2.03
11:28	3.10	1.75	12:33	3.20	1.92	13:33	3.10	1.91	14:33	3.20	2.15	15:33	3.20	2.21
11:29	3.10	1.69	12:34	3.20	1.98	13:34	3.10	1.87	14:34	3.20	2.54	15:34	3.20	2.20
11:30	3.10	1.56	12:35	3.20	1.93	13:35	3.10	1.82	14:35	3.20	2.49	15:35	3.20	2.15
11:31	3.00	1.56	12:36	3.20	1.98	13:36	3.10	2.04	14:36	3.20	2.40	15:36	3.10	2.10
11:32	3.00	1.56	12:37	3.10	1.93	13:37	3.20	2.06	14:37	3.20	2.33	15:37	3.10	2.10
11:33	3.10	1.60	12:38	3.10	1.96	13:38	3.10	1.96	14:38	3.20	2.28	15:38	3.10	2.13
11:34	3.10	1.71	12:39	3.10	1.95	13:39	3.20	1.94	14:39	3.20	2.45	15:39	3.10	2.22
11:35	3.20	1.73	12:40	3.10	1.82	13:40	3.10	1.98	14:40	3.20	2.57	15:40	3.20	2.15
11:36	3.20	1.73	12:41	3.10	1.73	13:41	3.10	1.94	14:41	3.20	2.48	15:41	3.20	2.17
11:37	3.20	1.87	12:42	3.10	1.82	13:42	3.10	1.99	14:42	3.10	2.33	15:42	3.20	2.17
11:38	3.20	1.87	12:43	3.10	1.90	13:43	3.10	1.98	14:43	3.10	2.25	15:43	3.20	2.26
11:39	3.00	1.93	12:44	3.10	1.81	13:44	3.10	1.92	14:44	3.10	2.21	15:44	3.20	2.25
11:40	3.10	1.86	12:45	3.10	2.11	13:45	3.10	1.77	14:45	3.10	2.19	15:45	3.20	2.35
11:41	3.20	1.81	12:46	3.10	2.04	13:46	3.10	1.79	14:46	3.20	2.25	15:46	3.20	2.48
11:42	3.20	1.86	12:47	3.10	1.84	13:47	3.10	1.70	14:47	3.20	2.44	15:47	3.20	2.47
11:43	3.10	1.86	12:48	3.10	1.80	13:48	3.10	1.70	14:48	3.20	2.65	15:48	3.20	2.53
11:44	3.10	2.03	12:49	3.10	1.88	13:49	3.10	1.79	14:49	3.20	2.58	15:49	3.20	2.59
11:45	3.10	2.18	12:50	3.10	1.83	13:50	3.10	1.95	14:50	3.20	2.40	15:50	3.20	2.54
11:46	3.10	2.02	12:51	3.20	1.80	13:51	3.10	1.99	14:51	3.20	2.35	15:51	3.20	2.37
11:47	3.10	2.03	12:52	3.10	1.79	13:52	3.10	1.98	14:52	3.10	2.32	15:52	3.20	2.41
11:48	3.20	2.07	12:53	3.10	1.84	13:53	3.10	2.09	14:53	3.20	2.34	15:53	3.20	2.40
11:49	3.20	1.99	12:54	3.10	1.85	13:54	3.20	2.36	14:54	3.20	2.45	15:54	3.20	2.38
11:50	3.20	2.08	12:55	3.10	1.98	13:55	3.20	2.20	14:55	3.20	2.33	15:55	3.20	2.36
11:51	3.20	2.34	12:56	3.10	2.11	13:56	3.20	2.11	14:56	3.10	2.16	15:56	3.20	2.30
11:52	3.10	2.11	12:57	3.10	1.93	13:57	3.20	2.17	14:57	3.10	2.07	15:57	3.20	2.35
11:53	3.10	1.89	12:58	3.10	2.00	13:58	3.10	2.14	14:58	3.10	2.12	15:58	3.20	2.26
11:54	3.00	1.73	12:59	3.10	1.95	13:59	3.10	2.11	14:59	3.10	2.14	15:59	3.20	2.19
11:55	3.10	1.81	13:00	3.10	1.92	14:00	3.10	2.14	15:00	3.20	2.16	16:00	3.20	2.36
11:56	3.10	1.87	13:01	3.10	1.95	14:01	3.10	2.02	15:01	3.10	2.15	16:01	3.20	2.36
11:57	3.10	1.92	13:02	3.20	2.19	14:02	3.20	2.05	15:02	3.10	2.13	16:02	3.20	2.27
11:58	3.10	1.84	13:03	3.20	2.24	14:03	3.20	2.15	15:03	3.10	2.13	16:03	3.20	2.29
11:59	3.10	1.86	13:04	3.20	2.08	14:04	3.20	2.30	15:04	3.10	2.14	16:04	3.20	2.37
12:00	3.00	1.68	13:05	3.10	2.04	14:05	3.20	2.27	15:05	3.20	2.43	16:05	3.20	2.31
12:01	3.10	1.57	13:06	3.10	1.96	14:06	3.20	2.31	15:06	3.20	2.38	16:06	3.20	2.26
12:02	3.10	2.02	13:07	3.10	1.97	14:07	3.20	2.29	15:07	3.10	2.18	16:07	3.20	2.32
12:03	3.10	2.04	13:08	3.20	1.95	14:08	3.10	2.37	15:08	3.10	2.16	16:08	3.20	2.22
12:04	3.10	2.01	13:09	3.20	2.21	14:09	3.10	2.31	15:09	3.20	2.14	16:09	3.10	2.23
12:05	3.10	1.95	13:10	3.20	2.04	14:10	3.10	2.22	15:10	3.20	2.11	16:10	3.20	2.25
12:06	3.10	1.84	13:11	3.10	1.96	14:11	3.10	2.19	15:11	3.20	2.12	16:11	3.20	2.18
12:07	3.10	1.79	13:12	3.10	1.86	14:12	3.10	2.23	15:12	3.10	2.08	16:12	3.10	2.09
12:08	3.10	1.80	13:13	3.10	1.87	14:13	3.20	2.26	15:13	3.10	1.97	16:13	3.20	2.11
12:09	3.10	1.93	13:14	3.10	1.87	14:14	3.20	2.27	15:14	3.10	2.05	16:14	3.20	2.31
12:10	3.10	2.02	13:15	3.10	1.85	14:15	3.10	2.29	15:15	3.10	1.95	16:15	3.10	2.29
12:11	3.10	1.83	13:16	3.10	1.86	14:16	3.10	2.40	15:16	3.10	1.97	16:16	3.10	2.29
12:12	3.10	1.70	13:17	3.10	1.85	14:17	3.20	2.35	15:17	3.10	1.94	16:17	3.10	2.16
12:13	3.10	1.72	13:18	3.10	1.82	14:18	3.20	2.23	15:18	3.20	1.98	16:18	3.10	2.17
Avg.	3.11	1.85	Avg.	3.12	1.93	Avg.	3.14	2.08	Avg.	3.15	2.23	Avg.	3.18	2.27

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA, LLC
6141 Easton Road
Bldg 1
Plumsteadville, PA 18949
Airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E04NI99E15A0664	Reference Number:	160-401907846-1
Cylinder Number:	EB0136209	Cylinder Volume:	144.4 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
PGVP Number:	A12020	Valve Outlet:	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Oct 06, 2020

Expiration Date: Oct 06, 2028

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.
Do Not Use This Cylinder below 100 psig i.e 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	55.00 PPM	54.64 PPM	G1	+/- 1.3% NIST Traceable	09/29/2020, 10/06/2020
CARBON MONOXIDE	55.00 PPM	54.42 PPM	G1	+/- 0.8% NIST Traceable	09/29/2020
NITRIC OXIDE	55.00 PPM	54.64 PPM	G1	+/- 1.3% NIST Traceable	09/29/2020, 10/06/2020
SULFUR DIOXIDE	55.00 PPM	54.34 PPM	G1	+/- 1.0% NIST Traceable	09/29/2020, 10/06/2020
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	11010130	KAL004536	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	17060226	EB0079109	100.3 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Jul 23, 2023
GMIS	124206889	CC323707	4.026 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	11010416	KAL004802	99.6 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.6%	Jul 28, 2023
NTRM	16010203	KAL003087	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/-0.8%	Dec 23, 2021

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

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet iS50 FTIR AUP2010245 CO	FTIR	Sep 21, 2020
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Sep 14, 2020
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Sep 22, 2020
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Sep 16, 2020

Triad Data Available Upon Request

NOTES:Gross Weight: 27.8 Kg, Net Weight: 4.6 Kg

Approved for Release

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA, LLC
6141 Easton Road
Bldg 2
Plumsteadville, PA 18949
Airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E04NI99E3HA0002	Reference Number:	160-402138465-1
Cylinder Number:	ND11218	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 mole/mole basis unless otherwise noted.
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	80.00 PPM	81.85 PPM	G1	+/- 1.4% NIST Traceable	07/08/2021, 07/15/2021
CARBON MONOXIDE	80.00 PPM	79.73 PPM	G1	+/- 0.5% NIST Traceable	07/08/2021
NITRIC OXIDE	80.00 PPM	81.85 PPM	G1	+/- 1.1% NIST Traceable	07/08/2021, 07/15/2021
SULFUR DIOXIDE	80.00 PPM	79.92 PPM	G1	+/- 0.9% NIST Traceable	07/08/2021, 07/15/2021
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	11010130	KAL004536	97.31 PPM CARBON MONOXIDE/NITROGEN	+/- 0.4%	Oct 04, 2022
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
NTRM	200510-50	CC733428	98.61 PPM NITRIC OXIDE/NITROGEN	+/- 0.9%	Oct 06, 2026
GMIS	124206889	CC323707	4.026 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	16010224	KAL003838	97.69 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Dec 23, 2021

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

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
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 09, 2021

Triad Data Available Upon Request

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

Approved for Release

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA, LLC
6141 Easton Road
Bldg 1
Plumsteadville, PA 18949
Airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E02NI84E15A07B7	Reference Number:	160-401948145-1
Cylinder Number:	CC740041	Cylinder Volume:	145.8 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
PGVP Number:	A12020	Valve Outlet:	590
Gas Code:	O2,BALN	Certification Date:	Nov 11, 2020

Expiration Date: Nov 11, 2028

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

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

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	16.00 %	16.17 %	G1	+/- 0.3% NIST Traceable	11/11/2020
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	16060503	CC109542	23.204 % OXYGEN/NITROGEN	+/- 0.2%	Dec 24, 2021

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS OXYMAT 6 - N1-W5-951 - O2	PARAMAGNETIC	Oct 26, 2020

Triad Data Available Upon Request

NOTES:
Gross Weight: 27.8 Kg
Net Weight: 4.7 Kg

Approved for Release

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA, LLC
6141 Easton Road
Bldg 1
Plumsteadville, PA 18949
Airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	E02NI92E3HA0000	Reference Number:	160-401948144-1
Cylinder Number:	GN0025083	Cylinder Volume:	248.4 CF
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2214 PSIG
PGVP Number:	A12020	Valve Outlet:	590
Gas Code:	O2,BALN	Certification Date:	Nov 11, 2020

Expiration Date: Nov 11, 2028

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

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

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
OXYGEN	8.000 %	8.019 %	G1	+/- 0.3% NIST Traceable	11/11/20
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	10010602	1D38055	9.987 % OXYGEN/NITROGEN	+/- 0.3%	Apr 19, 2022

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS OXYMAT 6 - N1-W5-951 - O2	PARAMAGNETIC	Oct 26, 2020

Triad Data Available Upon Request

NOTES:
Gross Weight: 48.1 Kg
Net Weight: 8.2 Kg

Approved for Release

ALS

ROTA METER CALIBRATION RESULT OCTOBER 2022

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R^2)
BKK_FS0577	01 Oct 22	Y = 1.0202x + 0.1976	1.0000
BKK_FS0579	01 Oct 22	Y = 1.0078x + 0.4789	0.9998
BKK_FS0583	01 Oct 22	Y = 1.016x + 0.3922	1.0000
BKK_FS0584	01 Oct 22	Y = 1.0036x + 2.2262	0.9997
BKK_FS0585	01 Oct 22	Y = 1.0189x - 5.6476	0.9997
BKK_FS0586	01 Oct 22	Y = 1.0095x - 1.1524	0.9995
BKK_FS0587	01 Oct 22	Y = 1.013x - 3.6619	0.9996
BKK_FS0588	01 Oct 22	Y = 1.0154x + 4.8357	0.9999
BKK_FS0589	01 Oct 22	Y = 0.9918x + 4.8069	0.9999
BKK_FS0590	01 Oct 22	Y = 1.0038x - 0.4857	0.9996
BKK_FS0591	01 Oct 22	Y = 0.9705x - 52.174	0.9986
BKK_FS0592	01 Oct 22	Y = 0.9646x - 37.642	0.9985
BKK_FS0593	01 Oct 22	Y = 0.9767x - 58.445	0.9988
BKK_FS0594	01 Oct 22	Y = 0.9902x - 62.87	0.9999
BKK_FS0595	01 Oct 22	Y = 1.0249x - 98.162	0.9999
BKK_FS0596	01 Oct 22	Y = 0.9843x - 26.806	0.9991
BKK_FS0597	01 Oct 22	Y = 0.9802x - 61.653	0.9978
BKK_FS1004	01 Oct 22	Y = 0.9762x + 11.724	0.9998
BKK_FS1005	01 Oct 22	Y = 1.0081x + 1.5143	1.0000
BKK_FS1006	01 Oct 22	Y = 1.098x - 2.9327	0.9999
BKK_FS1007	01 Oct 22	Y = 0.9917x + 1.6592	1.0000
BKK_FS1008	01 Oct 22	Y = 1.0132x + 0.7207	1.0000
BKK_FS1009	01 Oct 22	Y = 1.0132x + 1.1633	0.9960
BKK_FS1010	01 Oct 22	Y = 1.0033x + 0.5758	0.9999
BKK_FS1011	01 Oct 22	Y = 1.0234x + 0.1759	0.9996
BKK_FS1012	01 Oct 22	Y = 1.0106x - 2.0048	0.9997
BKK_FS1013	01 Oct 22	Y = 0.9677x - 35.851	0.9997
BKK_FS1014	01 Oct 22	Y = 1.0021x + 0.3148	0.9998
BKK_FS1015	01 Oct 22	Y = 0.9994x + 1.786	1.0000
BKK_FS1016	01 Oct 22	Y = 1.0105x - 80.256	0.9998
BKK_FS1017	01 Oct 22	Y = 0.9995x + 0.649	1.0000
BKK_FS1018	01 Oct 22	Y = 1.0011x + 1.1786	1.0000
BKK_FS1019	01 Oct 22	Y = 1.0023x - 68.424	0.9996
BKK_FS1020	01 Oct 22	Y = 1.0547x - 0.666	0.9998
BKK_FS1021	01 Oct 22	Y = 1.018x - 3.3286	0.9998
BKK_FS1022	01 Oct 22	Y = 0.9932x - 57.035	0.9986
BKK_FS1023	01 Oct 22	Y = 1.0094x + 0.0717	0.9999
BKK_FS1024	01 Oct 22	Y =1.0042x + 0.4086	0.9997
BKK_FS1025	01 Oct 22	Y = 1.0132x - 88.507	0.9996

ALS

ROTA METER CALIBRATION RESULT OCTOBER 2022

Rotameter ID.	Calibration Date	Regression Result	Coefficient (R^2)
BKK_FS1026	01 Oct 22	Y = 1.0018x + 1.0776	0.9997
BKK_FS1027	01 Oct 22	Y = 1.0053x + 0.231	0.9995
BKK_FS1028	01 Oct 22	Y = 0.9792x - 60.312	0.9982
BKK_FS1029	01 Oct 22	Y = 0.9935x + 0.8234	1.0000
BKK_FS1030	01 Oct 22	Y = 1.0039x + 0.515	0.9999
BKK_FS1031	01 Oct 22	Y = 1.009x - 79.295	0.9998
BKK_FS1039	01 Oct 22	Y = 0.9967x + 4.5048	0.9999
BKK_FS1040	01 Oct 22	Y = 0.9936x + 32.694	0.9998
BKK_FS1041	01 Oct 22	Y = 1.067x - 1.999	1.0000
BKK_FS1042	01 Oct 22	Y = 1.0019x + 2.1571	1.0000
BKK_FS1043	01 Oct 22	Y = 1.1569x - 96.479	0.8412
BKK_FS1044	01 Oct 22	Y = 1.0318x - 0.9374	0.9999
BKK_FS1161	01 Oct 22	Y = 1.0126x + 0.7738	0.9999
BKK_FS1162	01 Oct 22	Y = 0.9994x + 2.6357	0.9995
BKK_FS1163	01 Oct 22	Y = 0.977x - 55.03	0.9987
BKK_FS1164	01 Oct 22	Y = 0.9914x + 0.8427	0.9997
BKK_FS1165	01 Oct 22	Y = 0.9893x + 6.5919	0.9998
BKK_FS1166	01 Oct 22	Y = 1.0031x - 77.881	0.9996
BKK_FS1200	01 Oct 22	Y = 1.0313x - 0.4602	0.9995
BKK_FS1201	01 Oct 22	Y = 1.0045x + 0.15	0.9996
BKK_FS1202	01 Oct 22	Y = 0.9702x - 44.156	0.9994
RYG_FS0197	01 Oct 22	Y = 1.0039x - 0.179	0.9999
RYG_FS0198	01 Oct 22	Y = 0.9964x + 21.757	1.0000
RYG_FS0199	01 Oct 22	Y = 1.0577x - 1.7486	1.0000

Review By : (Mr. Wichan Choonharat)
Enviro Field Services Manager

Approved By : (Mr.Sarayuth Jittranont)
Assistant General Manager

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 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 Nanthorn P.
APPROVED BY
NEXT CAL. DATE 26/4/23

Received Date : 22 APRIL 2022
Calibration Date : 26 APRIL 2022
Date of Issue : 29 APRIL 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-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	94.11	0.11	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1003.1	0.3	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
2.02	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

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00734220 / 145272 / 34370
ID No.: RYG_FS0026

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 Nanthorn P.
APPROVED BY
NEXT CAL. DATE 21/1/23

Received Date : 14 JANUARY 2022
Calibration Date : 21-24 JANUARY 2022
Date of Issue : 25 JANUARY 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-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

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 indicatinn	✓	-	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 (93.96)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.6

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	17.8
Flat	23.7

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	-1.6	-1.5	-1.5	±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	0.0	±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	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	33.9	-0.1	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.0	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	134.1	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	135.2	-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		
89.6	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 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.: 01073608 / 172153 / 85748
ID No.: RYG_FS0387

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
APPROVED BY
NEXT CAL DATE 13/9/22

Received Date : 01 SEPTEMBER 2021
Calibration Date : 13-15 SEPTEMBER 2021
Date of Issue : 16 SEPTEMBER 2021

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-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

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	✓	-	0.1	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 (93.96)	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	17.7
Flat	23.3

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	0.7	0.7	0.7	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-2.9	-2.8	-2.8	±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	-0.1	±1.5
250	0.0	-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	0.0	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	94.1	0.0	-
C - weight	94.0	0.0	± 0.2
Flat	94.1	0.0	± 0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.1	0.0	-
Slow	94.0	0.0	± 0.1
Leq	94.1	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	130.9	-0.1	± 1.1
129.0	128.9	-0.1	± 1.1
124.0	123.9	-0.1	± 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	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	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	98.9	-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		
89.5	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 level 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. : ACC22024
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-74
Serial No.: 34178124
ID No.: RYG_FS0216

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 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 : (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).

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	94.21	0.21	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1001.3	0.1	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
1.95	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

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

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NSC-TISI-TIS 17025 CALIBRATION 0394

Cert. No. : ACL22025
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00734221 / 145286 / 34371
ID No.: RYG_FS0027

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 10/1/23

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

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-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

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 (93.96)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
16.2

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	18.0
Flat	23.9

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	0.5	0.5	0.6	± 1.5
1000	0.0	0.0	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	0.0	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	94.1	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	104.0	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	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, 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	89.6	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.
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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.: 00734218 / 146937 / 34368
ID No.: RYG_FS0031

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) %

REVIEWED BY Nathakom P.
APPROVED BY
NEXT CAL DATE 20/6/23

Received Date : 17 JUNE 2022
Calibration Date : 20-22 JUNE 2022
Date of Issue : 27 JUNE 2022

Calibrated by : Nathakom 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).

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. Pitak.

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)
20.1

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	17.4
Flat	23.1

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	0.5	0.5	0.5	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-1.5	-1.5	-1.4	±5.0

T. Pitak.

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	0.0	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	0.1	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

T. Pitak.

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	130.9	-0.1	± 1.1
129.0	128.9	-0.1	± 1.1
124.0	123.9	-0.1	± 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	29.9	-0.1	± 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	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

T. Pitak.

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	135.7	-0.7	±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	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 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

Cert. No. : ACC22001
Pages : 1 of 3

Calibration Certificate

Equipment : SOUND CALIBRATOR
Manufacturer : RION
Model : NC-75
Serial No.: 35002736
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 Nathakom P.
APPROVED BY
NEXT CAL. DATE 10/1/23

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

Calibrated by : Nathakom 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-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-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	33461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22
Audio Analyzer	AVR-3360A	V744B6069	EF-0010-21	10-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

Result of calibration :

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit (dB)
94	93.99	-0.01	0.14	0.40

2. Frequency

Specified Frequency (Hz)	Measured value (Hz)	Deviated value (%)	Uncertainty (%)	Tolerance limit (%)
1000	1000.0	0.0	0.1	1.0

3. Total distortion

Measured value (%)	Uncertainty (%)	Tolerance limit (%)
0.28	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
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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.: 01222723 / 143841 / 22770
ID No.: RYG_FS0022

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 Monkom P.
APPROVED BY
NEXT CAL. DATE 21/1/23

Received Date : 14 JANUARY 2022
Calibration Date : 21-24 JANUARY 2022
Date of Issue : 25 JANUARY 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	EI-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

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 (93.96)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	12.0
C - weight	18.0
Flat	24.1

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	0.4	0.4	0.4	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-0.4	-0.3	-0.3	±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	-0.1	0.0	-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

T. Petch.

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	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

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	134.0	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	135.8	-0.6	±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		
89.6	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

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.: 00734223 / 157777 / 22653
ID No.: RYG_FS0029

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 Nonlon P.
APPROVED BY
NEXT CAL DATE 24/5/23

Received Date : 17 MAY 2022
Calibration Date : 24-27 MAY 2022
Date of Issue : 30 MAY 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. 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).

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)
18.0

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

Frequency Weighting	Measured value (dB)
A - weight	13.8
C - weight	20.3
Flat	25.8

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	0.7	0.7	0.7	± 1.5
1000	0.1	0.1	0.1	± 1.0
8000	-1.5	-1.5	-1.5	±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	-0.1	-0.2	-0.1	±2.0
125	-0.1	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	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

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	135.0	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	130.9	-0.1	± 1.1
129.0	128.9	-0.1	± 1.1
124.0	123.9	-0.1	± 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	29.9	-0.1	± 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	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

T. Rotch.

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	135.8	-0.6	±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. Rotch.

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

T. Petch

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY
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Tel.0-2433-8800 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.: 00734225 / 169439 / 72460
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) %

REVIEW BY Nongkhon P.
APPROVED BY
NEXT CAL DATE 21/1/23

Received Date : 14 JANUARY 2022
Calibration Date : 21-24 JANUARY 2022
Date of Issue : 25 JANUARY 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-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

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	✓	-	0.4	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

T. Petch

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.2

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

Frequency Weighting	Measured value (dB)
A - weight	10.8
C - weight	17.2
Flat	23.0

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	0.4	0.5	0.5	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-1.6	-1.5	-1.5	±5.0

T. Ritch.

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	-0.1	±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

T. Ritch.

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	130.9	-0.1	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

T. Ritch.

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	135.8	-0.6	±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. Ritch.

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

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.: 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 Nathakorn 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. 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).

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)
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

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

12. High level stability

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

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

End of Calibration Certificate

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.: 00233183 / 144835 / 23230
ID No.: RYG_FS0024

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 Thanakorn P.
APPROVED BY
NEXT CAL. DATE 4/10/22

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

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-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

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	✓	-	0.4	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

T. Petch.

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
22.9

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

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

3. Acoustical signal tests of frequency weightings

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

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

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	0.0	0.0	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

T. Petch.

7. Level linearity on the reference level range

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

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	136.2	-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	89.5	-0.1	±1.5

12. High level stability

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

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

End of Calibration Certificate

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.: 00233184 / 144837 / 23232
ID No.: RYG_FS0025

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 21/1/23

Received Date : 14 JANUARY 2022
Calibration Date : 21-24 JANUARY 2022
Date of Issue : 25 JANUARY 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petchurai
(Thanakul Petchurai)

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Calibration Procedure : CP-AC-01

Calibration Method :
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1. Reference Standard Instruments :

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Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

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	✓	-	0.4	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

T. Petch.

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.2

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

Frequency Weighting	Measured value (dB)
A - weight	10.8
C - weight	17.0
Flat	22.8

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	0.2	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-0.9	-0.8	-0.8	±5.0

T. Pitaka.

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	0.0	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

T. Pitaka.

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	131.9	-0.1	± 1.1
131.0	130.9	-0.1	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	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

T. Pitaka.

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	136.4	0.0	±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	135.2	-0.2	±2.0

T. Pitaka.

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

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.: 00472126 / 180410 / 88180
ID No.: RYG_FS0301

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 Nitiphorn P.
APPROVED BY
NEXT CAL. DATE 13/9/22

Received Date : 01 SEPTEMBER 2021
Calibration Date : 13-15 SEPTEMBER 2021
Date of Issue : 16 SEPTEMBER 2021

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-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

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 (93.96)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
26.1

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	18.4
Flat	23.9

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	-1.6	-1.6	-1.6	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.4	0.5	0.5	±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	-0.2	-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	0.1	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	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.1	0.1	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.1	0.1	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.1	0.1	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.1	0.1	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.1	0.1	± 1.1
29.0	29.1	0.1	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.2	0.2	± 1.1
26.0	26.2	0.2	± 1.1
25.0	25.2	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	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	135.8	-0.6	±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 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.: 00472127 / 169440 / 72461
ID No.: RYG_FS0302

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 11/7/23

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

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. 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).

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)
17.3

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	18.1
Flat	23.9

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	0.1	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	0.4	0.4	0.5	±5.0

T. Rotth.

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	-0.1	±2.0
125	0.0	0.1	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

T. Rotth.

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	48.9	-0.1	± 1.1
44.0	43.9	-0.1	± 1.1
39.0	38.9	-0.1	± 1.1
34.0	33.9	-0.1	± 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. Rotth.

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	136.0	-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

T. Rotth.

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
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.: 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 Nathakorn 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. 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).

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, Lcpeak (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

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00572561 / 170398 / 72899
ID No.: RYG_FS0300

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 :
(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)
16.2

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	18.3
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	0.4	0.4	0.4	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.4	0.5	0.5	±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 includiog 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.: 00296518 / 179118 / 87525
ID No.: RYG_FS0431

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 Nanakon P.
APPROVED BY
NEXT CAL DATE 31/1/25

Received Date : 14 JANUARY 2022
Calibration Date : 21-24 JANUARY 2022
Date of Issue : 25 JANUARY 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-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

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 (93.96)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.6

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	17.6
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	0.1	0.1	0.1	± 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	0.0	±2.0
125	0.0	0.0	-0.1	±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	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.0	0.0	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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	136.1	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	129.0	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	98.9	-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	135.8	-0.6	±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		
89.7	89.7	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 0354

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 01173609 / 172170 / 74021
ID No.: RYG_FS0388

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 Manakan P.
APPROVED BY
NEXT CAL. DATE 13/9/22

Received Date : 01 SEPTEMBER 2021
Calibration Date : 13-15 SEPTEMBER 2021
Date of Issue : 16 SEPTEMBER 2021

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-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	8846A	1997025	EEL.BP. 06/0264	05-Feb-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

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 (93.96)	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	18.1
Flat	23.9

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	0.4	0.4	0.4	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-0.7	-0.6	-0.6	±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	-0.1	±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	0.1	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	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	28.1	0.1	± 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	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	135.2	-0.2	±2.0

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

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.: 00873109 / 171842 / 73485
ID No.: RYG_FS0384

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 24/8/23

Received Date : 22 AUGUST 2022
Calibration Date : 26-31 AUGUST 2022
Date of Issue : 02 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).

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)
16.5

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

Frequency Weighting	Measured value (dB)
A - weight	11.2
C - weight	17.6
Flat	23.3

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	0.4	0.5	0.5	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-2.4	-2.4	-2.4	±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	-0.1	±1.5
250	-0.1	-0.1	-0.1	±1.5
500	-0.1	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.0	0.0	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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	29.9	-0.1	± 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	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	98.9	-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		
89.6	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 cunfidence 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.: 00597167 / 157778 / 34375
ID No.: RYG_FS0437

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 1/2/23

Received Date : 06 SEPTEMBER 2022
Calibration Date : 07-09 SEPTEMBER 2022
Date of Issue : 14 SEPTEMBER 2022

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. 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

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)
18.3

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

Frequency Weighting	Measured value (dB)
A - weight	15.1
C - weight	21.4
Flat	27.0

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	0.3	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	-0.6	-0.6	-0.6	±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	-0.1	-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	0.0	±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

T. Petch.

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	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.1	0.1	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 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	26.0	0.0	± 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	134.0	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	136.3	-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		
89.6	89.6	0.0	±1.5

12. High level stability

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

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

End of Calibration Certificate

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-TLS 17025 CALIBRATION 0394

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00472126 / 176915 / 88180
ID No.: RYG_FS0301

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 18/10/23

Received Date : 03 OCTOBER 2022
Calibration Date : 18-19 OCTOBER 2022
Date of Issue : 20 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).

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)
14.6

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	16.7
Flat	22.5

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	-7.6	-7.6	-7.3	± 1.5
1000	0.5	0.5	0.5	± 1.0
8000	-5.1	-5.1	-5.1	±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	-0.1	-0.1	-0.1	±2.0
125	0.0	0.0	-0.1	±1.5
250	0.0	-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	0.0	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

T. Petch.

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	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	29.0	0.0	± 1.1
28.0	28.0	0.0	± 1.1
27.0	27.0	0.0	± 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	134.0	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	136.4	0.0	±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		
89.6	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

T. Petchu.

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.: 00709746 / 187332 / 01297
ID No.: RYG_FS0491

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 Nonlom P.
APPROVED BY
NEXT CAL. DATE 10/1/23

Received Date : 05 JANUARY 2022
Calibration Date : 10-12 JANUARY 2022
Date of Issue : 13 JANUARY 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-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

T. Petchu.

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. Petchu.

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
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	13.4
C - weight	19.8
Flat	25.2

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	0.1	0.1	0.1	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	1.1	1.2	1.2	±5.0

T. Rtch.

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	-0.1	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	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

T. Rtch.

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.0	0.0	± 1.1
30.0	30.0	0.0	± 1.1
29.0	29.0	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

T. Rtch.

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	135.5	-0.9	±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. Rtch.

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	136.9	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

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-ISO 17025 CALIBRATION 0394

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00900071 / 188464 / 01733
ID No.: RYG_FS0492

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 10/1/23

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

Calibrated by : Nathakorn Pisutpaisan

Approved by : T. Petchurai
(Thanakul Petchurai)

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Calibration Procedure : CP-AC-01

Calibration Method :
This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :
1. Reference Standard Instruments :

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

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

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 (93.96)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.8
Flat	23.6

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

T. Petch.

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	33.9	-0.1	± 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	26.8	-0.2	± 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	128.0	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	136.2	-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	89.5	-0.1	±1.5

12. High level stability

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

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

End of Calibration Certificate

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.: 00900072 / 188465 / 01734
ID No.: RYG_FS0493

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 10/1/23

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Approved by : T. Petchurai.
(Thanakul Petchurai)

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Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
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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 :
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T. Petch.

Summary of Measurement Result :

Parameter	Pass	Fail	Uncertainty (dB)	Maximum-permitted uncertainty of measurement (dB)
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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 (93.96)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

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

3. Acoustical signal tests of frequency weightings

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

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

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	-0.1	-0.1	-0.1	±2.0
125	0.0	0.0	-0.1	±1.5
250	0.0	0.0	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.0	0.0	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

T. Petch-

7. Level linearity on the reference level range

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

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	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	136.0	-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

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	137.0	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.: 00900073 / 188466 / 01735
ID No.: RYG_FS0494

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 Nathakom P.
APPROVED BY
NEXT CAL. DATE 10/1/23

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

Calibrated by : Nathakom 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-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 National Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

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 (93.96)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.8

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.8
Flat	23.5

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	0.1	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.0	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	-0.1	-0.1	-0.1	±2.0
125	0.0	0.0	-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	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.0	0.0	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

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	136.1	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	129.0	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	28.1	0.1	± 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	136.4	0.0	±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	89.7	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 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. : ACL22029
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00900074 / 188467 / 01736
ID No.: RYG_FS0495

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 10/1/23

Received Date : 05 JANUARY 2022
Calibration Date : 10-12 JANUARY 2022
Date of Issue : 13 JANUARY 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-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	EF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY53220104	EEL.BP. 05/0264	10-Feb-22
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

2. This result of calibration was found accurate as shown on date and place of calibration for this calibrated item only.
3. This certificate is traceable to the international system of unit maintained at :
   3.1 Natinnal Institute of Metrology (Thailand).
   3.2 Thailand Institute of Scientific and Technological Research (TISTR).

T. Pet

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. Pet

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.2

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

Frequency Weighting	Measured value (dB)
A - weight	10.8
C - weight	17.4
Flat	23.3

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	-0.8	-0.7	-0.7	±5.0

T. Ptah.

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	0.0	±2.0
125	-0.1	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	0.1	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

T. Ptah.

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	84.1	0.1	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 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	28.0	0.0	± 1.1
27.0	27.0	0.0	± 1.1
26.0	25.9	-0.1	± 1.1
25.0	24.9	-0.1	± 1.1

T. Ptah.

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	135.8	-0.6	±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. Ptah.

11. Overload indication

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

12. High level stability

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

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$ or any value following calculation,providing a 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@sithiporn.com http://www.sithiporn.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.: 00873057 / 171591 / 73333
ID No.: RYG_FS0381

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 Nirakon P.
APPROVED BY
NEXT CAL. DATE 26/8/23

Received Date : 22 AUGUST 2022
Calibration Date : 26-31 AUGUST 2022
Date of Issue : 02 SEPTEMBER 2022

Calibrated by : Nathakom 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 prinr 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	✓	-	0.4	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

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)
15.4

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	18.3
Flat	24.0

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	0.2	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	-0.1	±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	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	137.1	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	124.1	0.1	± 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	99.0	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	28.0	0.0	± 1.1
27.0	26.9	-0.1	± 1.1
26.0	25.9	-0.1	± 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	136.1	-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

SITHIPORN associates

SITHIPORN ASSOCIATES CO.,LTD.
CALIBRATION LABORATORY

Continuation of Calibration Certificate

Cert. No. : ACL22181
Job No. : VC65AC0077
Pages : 8 of 8

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 level of confidence of approximately 95 %

End of Calibration Certificate

QF-TS12-04-04-020664

CERTIFICATE OF CALIBRATION

ISSUED BY Cirrus Research plc

DATE OF ISSUE 07/09/21 CERTIFICATE NUMBER 162335

REVIEW BY Nanakorn P.
APPROVED BY
NEXT CAL. DATE 7/9/22

Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 1
Test engineer:
Nigel Smith
Electronically signed:

doseBadge Reader

Instrument

Manufacturer: Cirrus Research plc
Serial Number: 89107
Model Number: RC:110A
Notes:

Calibration Procedure

The tests were carried out in accordance with the requirements of IEC 60942:2003 where applicable.

Date of Calibration: 07 September 2021

Functionality Results

Function	Result
Keypad	Pass
Battery Power	Pass
Display	Pass
Communication	Pass
Trap Mode	Pass
Clock	Pass

Calibration Results

	Level (dB)	Frequency (Hz)	Distortion (% THD + Noise)
Initial	113.90	1000.2	0.20
Adjusted	114.00	1000.2	0.20
Uncertainty	± 0.11	± 0.14	± 0.10
Tolerances	± 0.60	± 2.00	± 4.00

Environmental Conditions

Pressure: 101.40 kPa
Temperature: 22.4 °C
Humidity: 60.2 %

Notes

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

CERTIFICATE OF CALIBRATION

ISSUED BY Cirrus Research plc

DATE OF ISSUE 07/09/21 CERTIFICATE NUMBER 162333

REVIEW BY Nanakorn P.
APPROVED BY
NEXT CAL. DATE 7/9/22

Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 1
Test engineer:
Nigel Smith
Electronically signed:

doseBadge Reader

Instrument

Manufacturer: Cirrus Research plc
Serial Number: 73729
Model Number: RC:110A
Notes:

Calibration Procedure

The tests were carried out in accordance with the requirements of IEC 60942:2003 where applicable.

Date of Calibration: 07 September 2021

Functionality Results

Function	Result
Keypad	Pass
Battery Power	Pass
Display	Pass
Communication	Pass
Trap Mode	Pass
Clock	Pass

Calibration Results

	Level (dB)	Frequency (Hz)	Distortion (% THD + Noise)
Initial	113.90	998.2	0.46
Adjusted	114.00	998.2	0.46
Uncertainty	± 0.11	± 0.14	± 0.10
Tolerances	± 0.60	± 2.00	± 4.00

Environmental Conditions

Pressure: 101.40 kPa
Temperature: 22.3 °C
Humidity: 59.4 %

Notes

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%.

JNAC

63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Watthapra, Bangkokyai, Bangkok 10600 Thailand.
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NSC - TISI - TIS 17025 CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CL-134.65
Page 1 of 2

Equipment Name: Heat Stress Monitor
Manufacturer.: DeltaOHM
Model: HD32.2
Serial No: 15020735
ID No: RYG_FS0231

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: 27 Jul 2022
Calibration date: 3 Aug 2022
Issue date: 8 Aug 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: 04 June 2022

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-0032-21

REVIEW BY Nanakorn P.
APPROVED BY
NEXT CAL. DATE 3/8/23

Calibrated by
☐ Mr. Sorawit Thachalad
☑ Miss Jittraporn Lertsomphol

Approved Signatory:
Mr. Panya Booncharoen
Calibration Department Manager

JNAC (JIRANATEE ASSOCIATES CO.,LTD.)

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

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Watthapra, Banghokyai, Banghok 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:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 15035050.
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
30	20.043	20.1	0.1	0.099
30	25.037	25.1	0.0	0.14
30	30.027	30.0	0.0	0.14
30	35.021	35.0	0.0	0.099
30	40.012	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15033221.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.043	20.1	0.1	0.099
70	25.037	24.9	-0.1	0.099
70	30.028	29.7	-0.3	0.099
70	35.021	34.5	-0.5	0.099
70	40.011	39.5	-0.5	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 17023218.
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.043	20.1	0.1	0.099
110	25.037	25.1	0.1	0.099
110	30.028	30.1	0.1	0.099
110	35.021	35.1	0.1	0.099
110	40.012	40.1	0.1	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.

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Watthapra, Banghokyai, Banghok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

CERTIFICATE OF CALIBRATION

Equipment Name: Heat Stress Monitor
Manufacturer.: DeltaOHM
Model: HD32.2
Serial No: 15020736
ID No: RYG_FS0232

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: 27 Jul 2022
Calibration date: 3 Aug 2022
Issue date: 8 Aug 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: 04 June 2022

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-0032-21

REVIEW BY Nmakorn P.
APPROVED BY
NEXT CAL. DATE 3/8/23

Calibrated by
☐ Mr. Sorawit Thachalad
☑ Miss Jittraporn Lertsomphol

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, Banghokyai, Banghok 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:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 15027737.
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
30	20.043	20.1	0.1	0.099
30	25.037	25.2	0.1	0.16
30	30.028	30.1	0.1	0.099
30	35.021	35.1	0.1	0.099
30	40.012	40.1	0.1	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 15015503.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.044	20.1	0.1	0.099
70	25.037	24.9	0.1	0.099
70	30.027	29.8	0.2	0.099
70	35.021	34.6	-0.4	0.099
70	40.012	39.5	-0.5	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 15031164
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.043	20.1	0.1	0.099
110	25.037	25.1	0.1	0.099
110	30.027	30.1	0.1	0.099
110	35.021	35.1	0.1	0.099
110	40.013	40.1	0.1	0.099

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

☆ End of Certificate ☆

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Watthapra, Banghokyai, Banghok 10600 Thailand.
Tel.: (66) 02-8680812#13 Fax.: (66) 02-8680860 www.jiranatee.com

CERTIFICATE OF CALIBRATION

Equipment Name: Heat Stress Monitor with Sensor
Manufacturer.: DeltaOHM
Model: HD32.2
Serial No: 18018311
ID No: RYG_FS0356

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: 10 JAN 2022
Calibration date: 16 FEB 2022
Issue date: 17 FEB 2022

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

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-0036-21, Certificate number: ER-0032-21

REVIEW BY Nmakorn P.
APPROVED BY
NEXT CAL. DATE 16/2/23

Calibrated by
☑ Mr. Sorawit Thachalad
☐ Miss Orathai Wiwatwittaya

Approved Signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

JIRANATE ASSOCIATES CO.,LTD.

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

NAC
63/14-15,67/35-36, Soi Petchkasem7,7/1, Petchkasem Rd,
Wathapra, 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:

Table 1: This equipment was connected with wet bulb probe Model: HP3201.2 S/N: 18021466.
Dimension: Diameter 14 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
30	20.054	20.0	-0.1	0.099
30	25.043	25.0	0.0	0.099
30	30.036	30.0	0.0	0.099
30	35.026	35.0	0.0	0.099
30	40.027	40.0	0.0	0.099

Table 2: This equipment was connected with temperature probe Model: TP3207.2 S/N: 18021258.
Dimension: Diameter 14 mm. Length 150 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
70	20.051	20.1	0.0	0.099
70	24.990	25.1	0.1	0.099
70	29.917	29.9	0.0	0.099
70	34.873	34.7	0.2	0.099
70	39.864	39.6	0.3	0.099

Table 3: This equipment was connected with Globe thermometer probe Model: TP3276.2 S/N: 18020493.
Dimension: Diameter 8 mm. Length 170 mm.

Immersion Depth (mm)	Standard Reading (°C)	UUC Reading (°C)	Error (°C)	Uncertainty (°C)
110	20.054	20.1	0.0	0.099
110	25.044	25.1	0.1	0.099
110	30.036	30.1	0.1	0.099
110	35.029	35.1	0.1	0.099
110	40.029	40.1	0.1	0.099

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

☆ End of Certificate ☆

NAC 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. : 22PH188
Page : 1 of 2

Equipment : Lux Meter
Manufacturer: Tenmars
Model : TM-201L
Serial No.: 190702490
ID No.: RYG_FS0471
Condition As-Received: Used Item
Received Date: 07 April 2022
Calibration Date: 08 April 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: 2204-0185WSC
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) Photometry & Encorder	LMguide 9.6 m	120RC003	61-140006-1	30 Apr 2022
2) Luminous intensity standard lamp	OL FEL-U	F-1543	TP-1020-21	02 May 2022

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 : 16221394).
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
APPROVED BY
NEXT CAL. DATE 8/4/23

Calibrated by : Nivat Nitas
Issue Date : 20 April 2022

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

B 0285815

Cert. No.: 22PH188
Page.: 2 of 2

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

Function : Illuminance Measurement **Range :** 200 lx

Standard Value (lx)	UUC* Reading (lx)	Error (lx)	Uncertainty (± lx)
0	0.0	0.0	0.060
20	20.0	0.0	0.26
50	50.0	0.0	0.65
100	100.0	0.0	1.3
150	150.0	0.0	2.0
190	190.0	0.0	2.5

Function : Illuminance Measurement **Range :** 2000 lx

Standard Value (lx)	UUC* Reading (lx)	Error (lx)	Uncertainty (± lx)
200	200	0	2.6
500	500	0	6.5
1000	1000	0	13
1500	1500	0	20
1900	1900	0	25

Function : Illuminance Measurement **Range :** 20000 lx

Standard Value (lx)	UUC* Reading (lx)	Error (lx)	Uncertainty (± lx)
2000	1990	-10	26
3000	2990	-10	39
4000	3990	-10	52
5000	4980	-20	65

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 1104092

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.: 22CH405
Page.: 1 of 3

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Mettler Toledo
Model : Seven Compact S220
Serial No. : C104059460
ID No. : RYG_EN0183
Condition As-Received: Used Item
Received Date : 16 March 2022
Calibration Date : 17 March 2022
Reference : 2203-0611DSC-4

REVIEW BY
APPROVED BY
NEXT CAL. DATE 17/3/23

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

Issue Date : 22 March 2022

The Uncertainties are for a confidence probability of approximately 95%

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A 0037307

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
2) Ref. Standard Thermometer	4982054	110RC044	21I1201	26 Oct 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	788995	01 Jan 2024
pH 6.982	CPA chem	761017	02 Aug 2022
pH 10.015	CPA chem	766824	04 Sep 2022

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	177.4	4.000	0.058	2.00
S/N.: C104059460	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 1100955

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	4.010	177.7	0.0046	2.00
S/N.: 1453404	6.982	6.988	3.6	0.0084	2.00
	10.015	10.010	-172.9	0.0073	2.05

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;
- Model : InLab Expert Pro-ISM
- Serial No. : 1453404

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	25.002	24.9	-0.102	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 %.

-o0o-

Malu.

a 1100954

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484

NSC-TISI-TIS17025 CALIBRATION 0228

Certificate of Calibration

Certificate No. : 22E986
Page : 1 of 2

Equipment : pH Meter
Manufacturer: Mettler Toledo
Model : SevenCompact S220
Serial No.: C104059460
ID No.: RYG_EN0183
Condition As-Received: Used Item
Received Date: 16 March 2022
Calibration Date: 21 March 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: 2203-0811DSC
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	6440007	21E1444	07 May 2022

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)

REVIEW BY N.Bonbit
APPROVED BY
NEXT CAL. DATE 21/3/23

Calibrated by : Pongsagorn Boonyapom
Issue Date : 22 March 2022

Approved Signatory :
[*] Phalinee Prabpaipat
[ ] Nuntawat Khamchai
[ ] Pornthippa Tameyakul

B 0284414

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

Function: DC voltage measurement **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	200.0	0.0	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.**

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a 1101070

Certificate of Calibration

Equipment:	SPECTROPHOTOMETER	Certificate No.:	C06210159
Model:	OR6000	Issued Date:	01 April 2021
Serial No. (or ID.):	1627845 (RYG_EN0037)	Job No.:	KSPR2104738
Manufacturer:	HACH	Page:	1 of 3
Condition:	In Condition		

REVIEW BY Mr.Banjit
APPROVED BY
NEXT CAL. DATE 01/10/22

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

Environment Condition:

Temperature	25.1	°C	±	0.4	°C
Humidity	48.8	%RH	±	3.7	%RH

Calibration Place: ALS Laboratory Group (Thailand) Co.,Ltd. (Rayong Branch) (Wet Chemistry Lab)
616/10 Moo 5 T.Maenam Khu,
A.Pluakdaeng, Rayong 21140, Thailand.

Calibration By: Mr. Chattuphon Foithong

Calibration Date: 01 April 2021

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

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

The standard for Wavelength Certificate No. 87146 and 87152
The standard for Photometric Certificate No. 87220 and 87139
The standard for Stray light Certificate No. 87163 and 87161
The standard for Spectral resolution Certificate No. 87173

(Mr. Chattuphon Foithong)
Person in charge

บริษัท เอสพีซี อาร์ที จำกัด
SPC RT Co., Ltd

(Mr. Dumrong Boonsopon)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of SPC RT Co., Ltd.

Calibration Results:
Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 2 nm and UUC at 2 nm

Standard Wavelength	Unit Under Calibration	Correction	Uncertainty
418.61	418.4	0.21	0.13
536.66	536.7	-0.04	0.13
637.98	638.3	-0.32	0.14
748.48	748.7	-0.22	0.14
807.03	807.4	-0.37	0.14

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5890	0.590	-0.0010	0.0045
	0.7616	0.762	-0.0004	0.0045
	1.0263	1.027	-0.0007	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.5787	0.579	-0.0003	0.0045
	0.7442	0.744	0.0002	0.0045
	1.0039	1.004	-0.0001	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.5292	0.530	-0.0008	0.0045
	0.6865	0.687	-0.0005	0.0045
	0.9534	0.954	-0.0006	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5468	0.546	0.0008	0.0045
	0.6957	0.695	0.0007	0.0045
	0.9991	0.998	0.0011	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5851	0.584	0.0011	0.0045
	0.7238	0.723	0.0008	0.0045
	1.0957	1.094	0.0017	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.5692	0.568	0.0012	0.0045
	0.6914	0.691	0.0004	0.0045
	1.0881	1.087	0.0011	0.0045

Calibration Results:
Without Adjustment

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
235 nm	0.0000	0.000	0.0000	0.0080
	0.7307	0.730	0.0007	0.0080
257 nm	0.0000	0.000	0.0000	0.0080
	0.8516	0.850	0.0016	0.0080
313 nm	0.0000	0.000	0.0000	0.0080
	0.2836	0.285	-0.0014	0.0080
350 nm	0.0000	0.000	0.0000	0.0080
	0.6319	0.629	0.0029	0.0080

Stray light *

Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%T)	Absorbance (A)
260.57 +/- 0.11 nm	260.6	1.5	1.824
392.03 +/- 0.11 nm	392.0	1.5	1.824

The stray light transmission reference is less than 1.0 T(%) and absorbance is greater than 2.0 (A)

Spectral Resolution *

Nominal Concentration 0.02 % v/v	Peak	Trough	Ratio	SBW
Standard Wavelength (nm)	268.72	266.76	1.39	2.00
UUC: Wavelength (nm)	268.2	266.1		
Std Absorbance (A)	0.4616	0.2797		
Absorbance (A)	0.416	0.300		

* Calibration Marked " Not TISI Accredited " in this Certificate have been included for completeness.

The End of Certificate

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2104738

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR6000 หมายเลขเครื่อง: 1627845

ตรวจสอบ (รับ) 01 Apr 2021 ปกติ	ตรวจสอบ (รับ) 01 Apr 2021 ไม่ปกติ	รายการตรวจเช็ค	ตรวจสอบ (ส่ง) 01 Apr 2021 ปกติ	ตรวจสอบ (ส่ง) 01 Apr 2021 ไม่ปกติ	หมายเหตุ
		General			
☑	☐	1. ความสมบูรณ์เครื่อง	☑	☐	
☑	☐	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	☑	☐	
☑	☐	3. สวิทช์ ปิด – เปิด เครื่อง (On-Off Swicth)	☑	☐	
☑	☐	4. ปุ่มกด (Keypad)	☑	☐	
☑	☐	5. หน้าจอ (Display, Screen Contrast)	☑	☐	
		Spectrophotometer			
☐	☐	6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC	☐	☐	
☐	☐	7. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control)	☐	☐	
☑	☐	8. ความยาวคลื่น (Wavelength Check)	☑	☐	656.1=656.1 nm
☑	☐	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	☑	☐	
☑	☐	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	☑	☐	
☑	☐	11. ช่องวัดหลายตัวอย่าง (Carousel Module)	☑	☐	
		pH Meter and Conductivity Meter			
☐	☐	12. อิเล็คโทรด (Electrode and Connection Cable)	☐	☐	
☐	☐	13. ระดับสารละลายใน Electrode (Level KCl)	☐	☐	
☐	☐	14. ฝาปิดกันปลาย Electrode (Dust Protection Hood)	☐	☐	
☐	☐	15. ขาจับอิเล็คโทรด (Stand)	☐	☐	
		Turbidimeter			
☐	☐	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	☐	☐	
☐	☐	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่เกิน 3.0)	☐	☐	
		Automatic titrator			
☐	☐	18. สภาพ Piston Burettes	☐	☐	
☐	☐	19. Function Rinsing and Dosing	☐	☐	
☐	☐	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	☐	☐	

เพิ่มเติม/ข้อแนะนำ :

Mr. Chattuphon Foithong
Service Engineer

DKSH

Certificate of Calibration

Equipment:	SPECTROPHOTOMETER	Certificate No.:	C06220464
Model:	DR6000	Issued Date:	27 September 2022
Serial No. (or ID.):	1627845 (RYG_EN0037)	Job No.:	KSPR2212224
Manufacturer:	HACH	Page:	1 of 3
Condition:	In Condition		

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

REVIEW BY N.Banjat
APPROVED BY D.
NEXT CAL. DATE 27/3/24

Environment Condition: Temperature 23.1 °C ± 3.2 %RH
Humidity 65.4 %RH ± 3.2 %RH

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

Calibration By: Mr. Chattuphon Foithong
Calibration Date: 27 September 2022
The Method used: In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04
Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Stama Scientific Limited.
The standard for Wavelength Certificate No. 91418 and 91435
The standard for Photometric Certificate No. 91441 and 101088
The standard for Stray light Certificate No. 101041 and 101040
The standard for Spectral resolution Certificate No. 101037

(Mr. Chattuphon Foithong)
Person in charge

(Mr. Thalamgkeat Poungngam)
Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor (k=2) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).
These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of DKSH Technology Limited.

บริษัท ดีเคเซ็ท เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงพัฒนา เขตพระโขนง กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2029 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

DKSH

Calibration Results:

Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 2 nm and UUC at 2 nm

Standard Wavelength	Unit Under Calibration	Correction	Uncertainty
418.61	418.4	0.21	0.14
536.66	536.7	-0.04	0.14
637.98	638.3	-0.32	0.14
740.48	740.8	-0.32	0.14
807.03	807.4	-0.37	0.13

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5805	0.583	-0.0025	0.0045
	0.7334	0.737	-0.0036	0.0045
	1.0534	1.057	-0.0036	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.5503	0.553	-0.0027	0.0045
	0.7179	0.720	-0.0021	0.0045
	1.0312	1.034	-0.0028	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.5024	0.506	-0.0036	0.0045
	0.6693	0.672	-0.0027	0.0045
	0.9604	0.964	-0.0035	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5168	0.519	-0.0022	0.0045
	0.6903	0.691	-0.0007	0.0045
	0.9904	0.992	-0.0016	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5525	0.554	-0.0015	0.0045
	0.7175	0.718	-0.0005	0.0045
	1.0301	1.031	-0.0009	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.5367	0.538	-0.0013	0.0045
	0.6847	0.685	-0.0003	0.0045
	0.9823	0.983	-0.0007	0.0045

บริษัท ดีเคเซ็ท เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงพัฒนา เขตพระโขนง กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2029 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

DKSH

Calibration Results:

Without Adjustment

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
235 nm	0.0000	0.000	0.0000	0.0060
	0.7423	0.744	-0.0017	0.0083
257 nm	0.0000	0.000	0.0000	0.0060
	0.8609	0.861	-0.0001	0.0084
313 nm	0.0000	0.000	0.0000	0.0060
	0.2895	0.292	-0.0025	0.0080
350 nm	0.0000	0.000	0.0000	0.0060
	0.6381	0.639	0.0001	0.0080

Stray light *

Standard: cut-off	UUC: Wavelength (nm)	UUC: Transmission (%T)	Absorbance (A)
260.67 +/- 0.11 nm	260.7	2.1	1.678
391.94 +/- 0.11 nm	391.9	1.7	1.770

Spectral Resolution *

Nominal Concentration 0.02 % v/v	Peak	Trough	Ratio	SBW
Standard Wavelength (nm)	266.60	266.63	1.39	2.00
UUC: Wavelength (nm)	266.2	266.1		
Std Absorbance (A)	0.4810	0.3176		
Absorbance (A)	0.373	0.268		

* Calibration Marked * Not TISI Accredited * in this Certificate have been included for completeness.

The End of Certificate

บริษัท ดีเคเซ็ท เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงพัฒนา เขตพระโขนง กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2029 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

DKSH

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2212224

ชนิดเครื่องมือ: SPECTROPHOTOMETER รุ่น: DR6000 หมายเลขเครื่อง: 1627845

ตรวจสอบ (รับ) 27 Sep 2022 ปกติ	ตรวจสอบ (รับ) 27 Sep 2022 ไม่ปกติ	รายการตรวจเช็ค	ตรวจสอบ (ส่ง) 27 Sep 2022 ปกติ	ตรวจสอบ (ส่ง) 27 Sep 2022 ไม่ปกติ	หมายเหตุ
		General			
☑	☐	1. ความสมบูรณ์เครื่อง	☑	☐	
☑	☐	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	☑	☐	
☑	☐	3. สวิทซ์ ปิด – เปิด เครื่อง (On-Off Swicth)	☑	☐	
☑	☐	4. ปุ่มกด (Keypad)	☑	☐	
☑	☐	5. หน้าจอ (Display, Screen Contrast)	☑	☐	
		Spectrophotometer			
☐	☐	6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC	☐	☐	
☐	☐	7. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control)	☐	☐	
☑	☐	8. ความยาวคลื่น (Wavelength Check)	☑	☐	656.1 ได้ 656.1 nm
☑	☐	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	☑	☐	
☑	☐	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	☑	☐	
☑	☐	11. ช่องวัดหลายตัวอย่าง (Carousel Module)	☑	☐	
		pH Meter and Conductivity Meter			
☐	☐	12. ขั้วเลิดโทรด (Electrode and Connection Cable)	☐	☐	
☐	☐	13. ระดับสารละลายใน Electrode (Level KCl)	☐	☐	
☐	☐	14. ฝาปิดกันเปลาย Electrode (Dust Protection Hood)	☐	☐	
☐	☐	15. ขาจับขั้วเลิดโทรด (Stand)	☐	☐	
		Turbidimeter			
☐	☐	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	☐	☐	
☐	☐	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่เกิน 3.0)	☐	☐	
		Automatic titrator			
☐	☐	18. สภาพ Piston Burettes	☐	☐	
☐	☐	19. Function Rinsing and Dosing	☐	☐	
☐	☐	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	☐	☐	

เพิ่มเติมข้อแนะนำ :

Mr. Chattuphon Foithong
Service Engineer

บริษัท ดีเคเซ็ท เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงพัฒนา เขตพระโขนง กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2029 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

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 0244

Certificate No.T220384I01 "Substitute for Calibration Certificate Number T220384" Page 1 of 4

Certificate of Calibration

Equipment	:	Chamber (Cold 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	:	18 February 2022
Calibrated By	:	Boonchai Suriyawong (Site Calibration Manager)
Approved By	:	_____/ Sujjar Naknakred (Site Calibration Manager)
Date of Issue	:	10 MAR 2022

REVIEW BY Thanitak
APPROVED BY
NEXT CAL. DATE 22 Feb 2023

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, Thailand.
NSC-TISI-TIS 17025 CALIBRATION 0244

Certificate No. T220384I01 Page 2 of 4

Calibration Report

Equipment	:	Chamber (Cold Room)
Date of Calibration	:	22 February 2022
Environment	:	Temperature : 23.2-24.3 °C
		Line Voltage : 221.8-227.2 V
		Relative Humidity : 55 - 65 %RH

Condition of this results of calibration :

1. Thisequipment 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	T210743	21 April 2022
TC	TYPE T	TN151-TN160	T210743	21 April 2022
DATA LOGGER	34970A	T150	T210743	21 April 2022

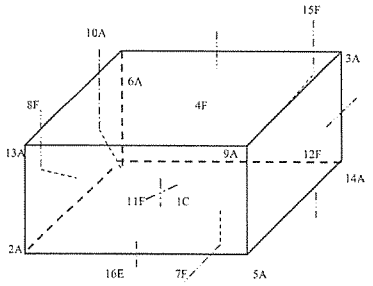
3. This certificate is traceable to :
   National Institute of Metrology (Thailand) through Metrological Center (NSC-TISI-TIS 17025 CALIBRATION 0244.)
4. Condition of calibrated item : good
   Equipment Description :
   Time Constant - Hour 40 Minute At 3 °C
   Fresh Air Damper ☐ Open ☐ Min ☐ Medium ☐ Max
   ☐ Close
   ☒ Not Available
5. Adjustment :
   (X) without adjustment ( ) after adjustment

Approved By_____

Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.
NSC-TISI-TIS 17025 CALIBRATION 0244

Certificate No. T220384I01 Page 3 of 4

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_____

Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.
NSC-TISI-TIS 17025 CALIBRATION 0244

Certificate No. T220384I01 Page 4 of 4

Calibration Report

Measurement Results

Calibration Point	Average Standard Reading at each position (°C)									
	TN141	TN142	TN143	TN144	TN145	TN146	TN147	TN148	TN149	TN150
3.0	2.80	2.96	2.98	2.97	3.16	3.29	2.95	3.14	3.10	3.45
	TN151	TN152	TN153	TN154	TN155	TN156				
	3.04	3.19	3.03	3.34	3.21	3.11				

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	2.7 , 4.1	3.5	3.11	1.30	1.30	2.00	2.05

* The Acuoted 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_____

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 FAX. 0-2719-9484

Certificate of Testing

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 :	Approved Signatory

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

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

Issue Date : 18 February 2022

B 0281285

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-

a 1094744

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

NSC-TS5-TIS17025 CALIBRATION 0048

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 :	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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Approval of the head of Corporate Services 3 - Equipment Calibration and Testing Services

A 0030008

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

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	2111273	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 %.

-o0o-

a 1095714

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-8000-27 FAX. 0-2719-9484

NSC-TISI-TIS17025 CALIBRATION 0006

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
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

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

Approved by : Approved Signatory

( ) Pornthippa Tameyakul
(✓) Maleo 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

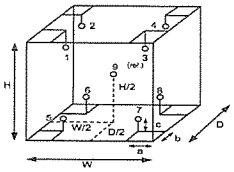
1. Reference standard instrument:-

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	m³

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 1106486

RYG_EN0002

PENTA CALIBRATION

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

Certificate of Calibration

Represent to Certificate of Calibration ,PTC/07/22103

NSC-TISI-TIS17025 CALIBRATION 0324

Certificate No.:	PTC/07/22103	Page:	1 of 2
Equipment:	Digital Balance	Condition:	Normal
Manufacturer:	Sartorius	Serial No:	26207038
Model:	MSE224S-100-DU	ID No:	RYG_EN0002
Type of Balance:	Single interval		

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

REVIEW BY Thanitah.
APPROVED BY D.
NEXT CAL. DATE 23/03/23

Environment Condition:

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

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

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

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

Date Received:	March 23, 2022
Calibration Date:	March 23, 2022
Issued Date:	March 25, 2022
Calibration By:	Mr. Rungroje Metakul

PENTA CALIBRATION CO.,LTD.

(Mr. Kitrongsak Kalasri)
Reviewed by

Approved By :
(Mr. Keattisak Kerdto)
Laboratory Manager

This calibration is provided in units of measurement according to the International System of Units (SI). It provides traceability of measurements to international national standard or other recognised national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor k= 2 to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM). The effect that the results relate only to the items calibrated.
This calibration certificate shall not be reproduced except in full only, without written approval from penta calibration co., ltd.

PTC TMC-01 02 2 Feb 2020

PENTA CALIBRATION

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

Represent to Certificate of Calibration ,PTC/07/22103

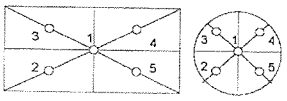
Certificate No.: PTC/07/22103 Page: 2 of 2

Measurement Results:

Without Adjustment :

Function Calibration: Non Adjustment

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



Eccentricity test 100 (g)

Position (g)				
1	2	3	4	5
0.0000	0.0000	-0.0002	0.0002	0.0002
Maximum deviation:			0.0002	

Repeatability Test : Weight to be 1/2 ≤ L, ≤ Maximum capacity

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

Nominal test value (g)	Standard Daviation
200	0.00003

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

Nominal Value (g)	Conventional Mass (g)	indication (g)	Correction of Balance (g)	Uncertainty (g)	k
0	0.00000	0.0000	0.0000	0.000086	2.16
0.01	0.01000	0.0100	0.0000	0.00010	2.06
0.1	0.10000	0.1000	0.0000	0.00010	2.06
1	1.00000	1.0000	0.0000	0.00010	2.06
2	2.00000	1.9999	0.0001	0.00010	2.06
5	5.00001	5.0000	0.0000	0.00010	2.06
10	10.00000	10.0000	0.0000	0.00010	2.06
20	20.00003	19.9999	0.0001	0.00011	2.05
50	50.00004	49.9999	0.0001	0.00012	2.00
100	100.00004	100.0001	-0.0001	0.00017	2.00
200	200.00011	200.0000	0.0001	0.00027	2.00

Note: Weight of adjust - (g)

The End of Certificate

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NSC-TISI-TIS17025 CALIBRATION 0008

Cert. No.: 21TM827
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 : 5 May 2021
Calibration Date : 5 May 2021
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Khit Ruttanaprapachai

REVIEW BY Thanitall.
APPROVED BY D.
NEXT CAL. DATE 2/11/22

Approved by :
Approved Signatory

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

Issue Date : 14 May 2021

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the Head of Corporate Services 3 Equipment Calibration and Testing Services

A 0028099

Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2105-0005OC-4

Cert. No.: 21TM827
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	MY57013823	21LM3	26 Feb 2022

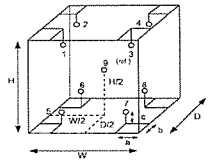
2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

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. (%)	59	56
AC Supply (Volt)	220	221



Position :	Ref. Std. ID No.: @ Calibration Point (104) °C	(180) °C
1	21-17RTD-01	19-17TC-01
2	21-17RTD-02	19-17TC-02
3	17RTD-03	19-17TC-03
4	17RTD-04	19-17TC-04
5	17RTD-05	19-17TC-05
6	17RTD-06	19-17TC-06
7	17RTD-07	19-17TC-07
8	17RTD-08	19-17TC-08
9 (ref.)	17RTD-09	19-17TC-09

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

Malee

a 1054287

Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2105-0005OC-4

Cert. No.: 21TM827
Page.: 3 of 3

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

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	0.063	0.54	0.70	0.42	2
180.0	180.0	180.0	0.15	0.89	1.3	1.1	2

Calibration Point (°C)	Measured Temperature (°C) Position 1	2	3	4	5	6	7	8	9 (ref.)
104.0	104.243	103.732	103.760	103.742	103.863	103.743	104.311	103.689	103.815
180.0	180.101	180.481	179.401	179.692	179.980	179.943	180.127	179.915	179.709

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 coverago factor *k*, providing a level of confidence of approximately 95 %.

-o0o-

Malee

a 1054286

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 : Malu.
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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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services.

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

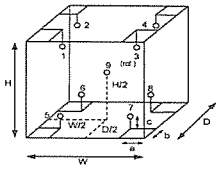
1. Reference standard instrument:-

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



Ref. Std. ID No.: @ Calibration Point		
Position :	(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

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

Malu.

a 1132466

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

Cert. No.: 22TM1517
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
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 (°C)	Measured Temperature (°C) Position 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 %.

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Malu.

a 1132465

RYG_EN0029

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NSC-TISI-TIS17025 CALIBRATION 0008

Cert.No.: 22CH283
Page.: 1 of 2

Certificate of Calibration

Equipment :	Conductivity Meter
Manufacturer :	Mettler Toledo
Model :	S230
Serial No. :	B241407147
ID No. :	RYG_EN0029
Condition As-Received:	Used Item
Received Date :	22 February 2022
Calibration Date :	23 February 2022
Reference :	2202-0732DSC-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-CH6 : based on direct measurement by using certified reference material (CRM)
Calibrated by :	Walalak Sinthean

REVIEW BY Thanitall.
APPROVED BY
NEXT CAL. DATE 24/8/23

Approved by : Malu.
Approved Signatory

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

Issue Date : 25 February 2022

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services

A 0038145

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NSC-TISI-TIS17025 CALIBRATION 8008

Cert. No.: 21TM829
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 :	5 May 2021
Calibration Date :	5 - 6 May 2021
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %
Calibrated by :	Khit Ruttanaprapachai
Approved by :	Approved Signatory
Issue Date :	14 May 2021

REVIEW BY Thanatall.
APPROVED BY D.
NEXT CAL DATE 3/11/22

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

The Uncertainties are for a confidence probability of approximately 95%

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A 0028096

Cert.No.: 22CH283
Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Certificate No.	Due date
1) Thermometer	9549224	130RC003	21I451	15 Apr 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 :-
- Conductivity calibration solution, CPA chem Ltd., The measurement results are traceable to SI through CPA chem Ltd., ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Conductivity Solution	Manufacturer	Lot No.	Exp. date
84.000 µS/cm	CPA Chem	754034	28 June 2022
1413.0 µS/cm	CPA Chem	766815	04 Sep 2022
12.880 mS/cm	CPA Chem	761022	02 Aug 2022

- Control Conductivity calibration solution temperature by Water bath (25±0.1) °C

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

Calibration results

Function : Conductivity Measurement
(*) After Adjustment at 1413.0 µS/cm
Conductivity Electrode Serial No.: 5821441030

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (±)	Coverage factor k
84.000 µS/cm	82.4 µS/cm	84.4 µS/cm	0.62 µS/cm	2.00
1413.0 µS/cm	1375 µS/cm	1413 µS/cm	9.2 µS/cm	2.00
12.880 mS/cm	12.54 mS/cm	12.81 mS/cm	0.086 mS/cm	2.00

Remark - UUC* = Unit Under Calibration
- Cell constant = 0.555236 cm^{-1}

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 1090534

Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2105-0005OC-1
Cert. No.: 21TM829
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

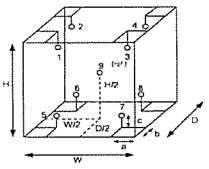
1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY57013823	21LM3	26 Feb 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)	29	30
REL.Humid. (%)	56	58
AC Supply (Volt)	221	222



Position :	Ref. Std. ID No.:
1	21-17RTD-01
2	21-17RTD-02
3	17RTD-03
4	17RTD-04
5	17RTD-05
6	17RTD-06
7	17RTD-07
8	17RTD-08
9 (ref.)	17RTD-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 m^3

a 1054310

Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2105-0005OC-1
Cert. No.: 21TM829
Page.: 3 of 3

Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

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	0.21	1.8	2.0	0.55	2

Calibration Point (°C)	Measured Temperature (°C) Position 1	2	3	4	5	6	7	8	9 (ref.)
70.0	70.404	70.277	70.607	70.307	68.789	69.257	68.846	69.331	70.495

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 %.

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a 1054309

RYG_EN0006

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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

REVIEW BY Tranitsil
APPROVED BY
NEXT CAL. DATE 20/oct/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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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services

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

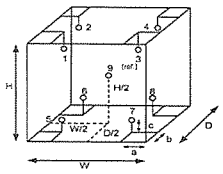
1. Reference standard instrument:-

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

Cert. No.: 22TM1492
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
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.: 21TM673
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 :	5 May 2021
Calibration Date :	5 May 2021
Ambient Temperature :	(26 ± 10) °C
Relative Humidity :	(50 ± 30) %
Calibrated by :	Tawatchai Pama

REVIEW BY Tranitsil
APPROVED BY
NEXT CAL. DATE 3/may

Approved by : Approved Signatory

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

Issue Date : 14 May 2021

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 : Equipment Calibration and Testing Services

A 0028098

Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2105-0005OC-3

Cert. No.: 21TM673
Page.: 2 of 3

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

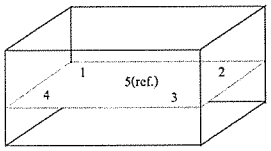
1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34970A	MY44060450	21LM4	06 Mar 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	22	68	230
Finished of Calibration	20	64	231



Front

Position :	Ref. Std. S/N.:
1	4803988-001
2	4803988-002
3	4803988-003
4	4803988-004
5(ref.)	4803988-005

a 1054289

Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2105-0005OC-3

Cert. No.: 21TM673
Page.: 3 of 3

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	84.891	84.893	84.880	84.892	84.917

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Uncertainty (± °C)	Coverage Factor *k*
85.0	0.089	0.052	0.22	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 1054288

RYG_EN0061

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

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

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 0046906

Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2210-0376OC-4

Cert. No.: 22TM1491
Page : 2 of 3

Procedure Used :-

Calibration were conducted using in-house calibretion 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

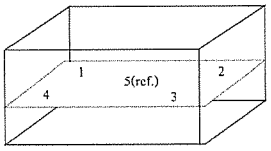
1. Reference standard instrument:-

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
Condition As-Received : Used Item
Reference : 2210-0376OC-4
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 22TM1491
Page : 3 of 3

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 %.

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a 1132470

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. : 22T13
Page : 1 of 2

Equipment : Digital Thermometer With Sensor
Manufacturer: Fluke
Model : 50S
Serial No.: 76950190
ID No.: RYG_EN0065
Condition As-Received: Used Item
Received Date: 22 December 2021
Calibration Date: 04 January 2022 to 07 January 2022
Reference: 2112-0636DSC
Ambient Temperature: (25 ± 3) °C
Relative Humidity: (50 ± 20) %

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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-T01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into liquid bath temperature controller. The temperature scale used was based on ITS-90.

Condition of this result of calibration

1.Reference standards instuments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Digital Thermometer	1529	A7A609	2111126	14 Oct 2022
2) Industrial Platinum Resistance Thermometer	5627-12	571975	2111126	14 Oct 2022
3) Digital Thermometer	1529	A66176	2111248	16 Nov 2022
4) Industrial Platinum Resistance Thermometer	5627	739435	2111248	16 Nov 2022

2.The 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 maintained at:-
-National Institute of Metrology Thailand (NIMT)

REVIEW BY Thanitta U.
APPROVED BY D. [signature]
NEXT CAL. DATE 05/07/23

Calibrated by : Thatchanan Chankong
Issue Date : 12 January 2022
Approved Signatory :
[ ] Phalinee Prabpalpal
[✓] Chatchawan Khunpiluek
[ ] Wanlop Larpkurn

B 0278021

Cert. No.: 22T13
Page.: 2 of 2

Result of Calibration:- Before Adjustment
Function: Temperature measurement
This equipment was connected with Thermocouple Type K ID No. 76950190/T

Immersion Depth (mm.)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
150	3.0037	3.7	0.6963	0.36
150	60.0061	59.4	-0.6061	0.38
150	104.0031	103.0	-1.0031	0.49
150	180.0031	177.5	-2.5031	0.72

Result of Calibration:- After Adjustment

Immersion Depth (mm.)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
150	3.0026	4.6	1.5974	0.36
150	20.0035	21.2	1.1965	0.36
150	60.0019	60.3	0.2981	0.38
150	70.0021	70.2	0.1979	0.40
150	85.0050	85.2	0.1950	0.44
150	104.0028	104.0	-0.0028	0.49
150	150.0049	149.4	-0.6049	0.62
150	180.0015	178.5	-1.5015	0.72

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

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a 1089050

REVIEW BY Nart Sok
APPROVED BY KL Al
NEXT CAL. DATE 21/12/23

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Agilent CrossLab Compliance Services

Certificate of System Qualification

GC-OQ + GCMS-OQ

System ID: GM-7
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Patthanakarn 40, Patthanakarn rd., Khwang Suan Luang, Khet Suan Luang, Bangkok 10250

Date: June 21, 2022 2:04:12 PM
EOP Name: AgilentRecommended , AgilentRecommended
EOP Revision: GC.02.50, GCMS.02.50
Overall Qualification Status: Pass

System Inspection and Basic Safety and Operation

Name: 7890
Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status
Pass

Inlet Pressure Accuracy

Name: 7890
Front SSL
Setpoint Status: Pass

	Setpoint		Actual	
Inlet Pressure:	25.0	psi	25.0	psi
Accuracy:			0.0	psi
Agilent Recommendad:			<= 1.2	

Overall Inlet Pressure Accuracy Test Status
Pass

GC Oven Temperature Accuracy

Name: 7890

Date: June 21, 2022 2:04:12 PM
System ID: GM-7

Setpoint Status: Pass
Zone: Oven

	Setpoint	Actual	
Temperature:	230.0	230.0	°C
Accuracy:		0.0	°C

Agilent Recommended: >= -1.0 % setpoint in K (-5.0 °C)
<= 1.0 % setpoint in K (5.0 °C)

Setpoint Status: Pass
Zone: Oven

	Setpoint	Actual	
Temperature:	100.0	100.4	°C
Accuracy:		0.4	°C

Agilent Recommended: >= -1.0 % setpoint in K (-3.7 °C)
<= 1.0 % setpoint in K (3.7 °C)

Overall GC Oven Temperature Accuracy Test Status
Pass

GC Oven Temperature Stability

Name: 7890
Setpoint Status: Pass

	Setpoint	Average	
Temperature:	100.0	100.0333	°C
Stability:		0.1	°C

Agilent Recommended: <= 0.5

Overall GC Oven Temperature Stability Test Status
Pass

Log Amp

Tested Combination1 Front SSL / External SQ
Name: 5977A
Setpoint Status: Pass

Overall Log Amp Test Status
Pass

RFPA

Tested Combination1 Front SSL / External SQ
Name: 5977A
Setpoint Status: Pass

Amu: 1050 m/z
Drift After Five Minutes: 22 mV
RFPA Voltage: 568 mV
Agilent Recommended: >= -100 and <= 100 <= 1100

Overall RFPA Test Status
Pass

Tune EI

Tested Combination1 Front SSL / External SQ
Name: 5977A
Setpoint Status: Pass
Filament: 1
Setpoint Status: Pass
Filament: 2

Overall Tune EI Test Status
Pass

Signal to Noise EI

Tested Combination1 Front SSL / External SQ
Name: 5977A

Source: EI - Extractor Filament: 1
Setpoint Status: Pass
Signal to Noise: 51283
Agilent Recommended: >= 1200

Source: EI - Extractor Filament: 2
Setpoint Status: Pass
Signal to Noise: 7088
Agilent Recommended: >= 1200

This test's 0 comment(s) and 1 deviation(s) are available in the Attachments section.

Overall Signal to Noise EI Test Status
Pass

Instrument Details

Purpose
This section describes the as found system configuration.

Details

System

System ID	GM-7
Manufacturer	Agilent Technologies
Name	7890

Tested Combination1

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

Sampler 1

Manufacturer	Agilent Technologies
Type	Manual Injection
Usage	Sample Injection
Syringe Volume (µL)	10

Mainframe 1

Manufacturer	Agilent Technologies
Name	7890
Model Number	G3442B
Serial Number	CN14133181
Firmware Revision	B.02.03
Oven Type	Standard

Inlet 1

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

Detector 1

Manufacturer	Agilent Technologies
Name	Mass Spectrometer
Type	Mass Spectrometer
Location	External

Mass Spectrometer 1

Manufacturer	Agilent Technologies
Type	SQ
Name	5977A
Serial Number	US1415M209
Firmware Revision	5977 6.00.21
High Vacuum System	Turbo Pump
Scouting Run Standard	OFN Std

MS EI Source 1

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

Electronic Signature

Purpose

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Details

Full Name of Signer:	Supasak Nimsongtham
Logged On User Name:	supasak.nimsongtham@agilent.com
Signature Creation Date:	June 21, 2022
Reason for Signature:	Executed protocol and published this original version of document

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User Name: supasak.nimsongtham
Hostname: SCG1115HKC

System Id: GM-7
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 10:25:05 AM	Audit	SessionCreated	Session	None
June 21, 2022 10:25:05 AM	Start	Configuration	Session	None
June 21, 2022 10:25:05 AM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
June 21, 2022 10:25:26 AM	Audit	EqpLoaded	Session	EQP details for primary technique [Gc] - File path: [PhotocalPacks/Gc/Configurations/02.50/Gc.02.50.acq], EQP File Name: [Gc.02.50.acq], EQP Name: [AgilentRecommended] EQP details for hyphenated technique [GcMs] - File path: [PhotocalPacks/GcMs/Configurations/02.50/GcMs.02.50.acq], EQP File Name: [GcMs.02.50.acq], EQP Name: [AgilentRecommended]
June 21, 2022 10:25:39 AM	End	Configuration	Session	None
June 21, 2022 10:25:43 AM	Start	Qualification	Session	QO
June 21, 2022 10:25:43 AM	Start	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	None
June 21, 2022 10:25:54 AM	End	Execution	System Inspection and Basic Safety and Operation - 7890: - Qualitative Test - No setpoints associated	Run Count : 1

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User Name: supasak.nimsongtham
Hostname: SCG1115HKC

System Id: GM-7
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 10:25:50 AM	Start	Execution	Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
June 21, 2022 10:26:10 AM	End	Execution	Inlet Pressure Accuracy - Front SSL: - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count : 1
June 21, 2022 10:26:12 AM	Start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
June 21, 2022 10:34:09 AM	Audit	Data	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
June 21, 2022 10:34:10 AM	End	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count : 1
June 21, 2022 10:34:11 AM	Start	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
June 21, 2022 10:38:42 AM	Audit	Data	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
June 21, 2022 10:38:44 AM	End	Execution	GC Oven Temperature Accuracy - 7890: - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count : 1
June 21, 2022 10:38:45 AM	Start	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None

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User Name: supasak.nimsongtham
Hostname: SCG1115HKC

System Id: GM-7
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 11:01:00 AM	Audit	AceClosed	Session	None
June 21, 2022 11:01:47 AM	Audit	AceRestarted	Session	None
June 21, 2022 11:01:48 AM	Audit	SessionReloaded	Session	None
June 21, 2022 11:01:51 AM	Start	Qualification	Session	OQ
June 21, 2022 11:01:51 AM	Start	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
June 21, 2022 11:03:14 AM	Audit	Data	DataManager	DataManager was in a data verification state but the user chose to start over.
June 21, 2022 11:04:19 AM	Audit	Data	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
June 21, 2022 11:04:22 AM	End	Execution	GC Oven Temperature Stability - 7890: - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count : 1
June 21, 2022 11:04:24 AM	Start	Execution	Log Amp - 5977A SQ: - Source: EI - Extractor	None
June 21, 2022 11:04:34 AM	End	Execution	Log Amp - 5977A SQ: - Source: EI - Extractor	Run Count : 1
June 21, 2022 11:04:37 AM	Start	Execution	RFPA - 5977A SQ: - Source: EI - Extractor	None
June 21, 2022 11:07:49 AM	End	Execution	RFPA - 5977A SQ: - Source: EI - Extractor	Run Count : 1
June 21, 2022 11:07:52 AM	Start	Execution	Tune EI - 5977A SQ: - Source: - EI - Extractor Filament 1 (Qualitative - No setpoints associated)	None

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User Name: supasak.nimsongtham
Hostname: SCG1115HKC

System Id: GM-7
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 11:08:33 AM	End	Execution	Tune EI - 5977A SQ: - Source: - EI - Extractor Filament 1 (Qualitative - No setpoints associated)	Run Count : 1
June 21, 2022 11:14:59 AM	Start	Execution	Tune EI - 5977A SQ: - Source: - EI - Extractor Filament 2 (Qualitative - No setpoints associated)	None
June 21, 2022 11:16:48 AM	End	Execution	Tune EI - 5977A SQ: - Source: - EI - Extractor Filament 2 (Qualitative - No setpoints associated)	Run Count : 1
June 21, 2022 11:16:49 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
June 21, 2022 11:17:05 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
June 21, 2022 11:17:10 AM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
June 21, 2022 11:26:09 AM	Audit	AceClosed	Session	None
June 21, 2022 12:35:20 PM	Audit	AceRestarted	Session	None
June 21, 2022 12:36:22 PM	Audit	SessionReloaded	Session	None
June 21, 2022 12:36:26 PM	Start	Qualification	Session	OQ
June 21, 2022 12:36:26 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None

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User Name: supasak.nimsongtham
Hostname: SCG1115HKC

System Id: GM-7
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 12:37:07 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
June 21, 2022 12:37:08 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None
June 21, 2022 12:38:54 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : H:\ALSGM7_2022\SNF1_001 .D
June 21, 2022 12:39:24 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : H:\ALSGM7_2022\SNF1_001 .D
June 21, 2022 12:40:09 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : H:\ALSGM7_2022\SNF1_001 .D
June 21, 2022 12:42:04 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : H:\ALSGM7_2022\SNF1_001 .D
June 21, 2022 12:42:17 PM	Audit	AceClosed	Session	None
June 21, 2022 12:33:31 PM	Audit	AceRestarted	Session	None
June 21, 2022 12:33:33 PM	Audit	SessionReloaded	Session	None
June 21, 2022 12:33:37 PM	Start	Qualification	Session	OQ
June 21, 2022 12:33:37 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	None

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User Name: supasak.nimsongtham
Hostname: SCG1115HKC

System Id: GM-7
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 12:34:44 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF1_001 .D
June 21, 2022 12:35:26 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 1 - L: >= 1200	Run Count : 1
June 21, 2022 12:37:11 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
June 21, 2022 12:38:15 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001 .D
June 21, 2022 12:38:30 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001 .D
June 21, 2022 12:38:45 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001 .D
June 21, 2022 12:39:00 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001 .D
June 21, 2022 12:39:14 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001 .D

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User Name: supasak.nimsongtham
Hostname: SCG1115HKC

System Id: GM-7
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 12:39:45 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001 .D
June 21, 2022 12:40:16 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001 .D
June 21, 2022 12:40:40 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001 .D
June 21, 2022 12:41:09 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001 .D
June 21, 2022 12:41:29 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Run Count : 1
June 21, 2022 12:42:30 PM	Audit	TestUnlocked	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Deviation filed for Run Count : 1
June 21, 2022 12:42:30 PM	Start	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	None
June 21, 2022 12:42:35 PM	Audit	Data	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Data files Path : E:\ALSGM7_2022\SNF2_001 .D

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User Name: supasak.nimsongtham
Hostname: SCG1115HKC

System Id: GM-7
Print Date: June 21, 2022 2:04:17 PM

ALS-GM7-2022 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
June 21, 2022 12:42:45 PM	End	Execution	Signal to Noise EI - Liquid Injection, Front SSL, SQ: - Source: EI - Extractor using Filament 2 - L: >= 1200	Run Count : 2
June 21, 2022 12:42:50 PM	End	Qualification	Session	OQ
June 21, 2022 12:42:50 PM	Start	Reporting	Session	None
June 21, 2022 12:45:17 PM	Audit	AppClosed	Session	None
June 21, 2022 1:57:47 PM	Audit	AppRestarted	Session	None
June 21, 2022 1:57:50 PM	Audit	SessionReloaded	Session	None
June 21, 2022 1:57:56 PM	Start	Qualification	Session	OQ
June 21, 2022 2:02:42 PM	Audit	Reporting	Session	Report Generated : Certificate

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Certificate of System Qualification

GC-OQ

REVIEW BY Sawat P.
APPROVED BY
NEXT CAL DATE 20 Apr 23

System ID: GC-5
Organization Name: ALS Laboratory Group (Thailand) Co., Ltd.
Organization Location: 104 Phattanakan 40, Phattanakan Rd., Suan Luang, Bangkok 10250

Date: October 20, 2021 10:15:57 AM
EQP Name: AgilentRecommended
EQP Revision: GC.02.50
Overall Qualification Status: Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: **Pass**

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Decay

Name: 7890
Front SSL

Setpoint Status: Pass
Pressure: 25.0 psi

Pressure Change: 0.3 psi /5 minutes
Agilent Recommended: >= -2.0 and <= 0.5

Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7890
Front SSL

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Setpoint Status: Pass

	Setpoint		Actual	
Inlet Pressure:	25.0	psi	24.9	psi

Accuracy: 0.1 psi
Agilent Recommended: <= 1.2

Overall Inlet Pressure Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890
Front FID

Setpoint Status: Pass

Flow Type: Fuel
Setpoint: 30.0 mL/min Measured Flow: 30.0 mL/min

Accuracy: 0.0 mL/min
Agilent Recommended: <= 10.0 % setpoint (3.0 ml/min)
Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Setpoint Status: Pass

Flow Type: Oxidizer
Setpoint: 400.0 mL/min Measured Flow: 390.3 mL/min

Accuracy: 9.7 mL/min
Agilent Recommended: <= 10.0 % setpoint (40.0 ml/min)
Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Setpoint Status: Pass

Flow Type: Makeup
Setpoint: 25.0 mL/min Measured Flow: 24.5 mL/min

Accuracy: 0.5 mL/min
Agilent Recommended: <= 10.0 % setpoint (2.5 ml/min)
Limit is percentage of setpoint or 0.5 ml/minute, whichever is largest.

Overall Detector Flow Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name:	7890						
Setpoint Status:	**Pass**						
Zone:	Oven						
	Setpoint/Actual						
Temperature:	230.0	231.2	°C				
Accuracy:		1.2	°C				
Agilent Recommended:	>=	-1.0	% setpoint in K	(	-5.0	°C	)
	<=	1.0	% setpoint in K	(	5.0	°C	)
Setpoint Status:	**Pass**						
Zone:	Oven						
	Setpoint/Actual						
Temperature:	100.0	100.4	°C				
Accuracy:		0.4	°C				
Agilent Recommended:	>=	-1.0	% setpoint in K	(	-3.7	°C	)
	<=	1.0	% setpoint in K	(	3.7	°C	)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name:	7890		
Setpoint Status:	**Pass**		
	Setpoint/Average		
Temperature:	100.0	100.4	°C
Stability:		0.0	°C
Agilent Recommended:	<=	0.5	

Overall GC Oven Temperature Stability Test Status

Pass

Scouting Run

Tested Combination1	Front	SSL	/ Front	FID
	Injection Tower			
Name:	7683B			
Setpoint Status:	**Completed**			
Injection Volume on Column:	1.0	uL		

Overall Scouting Run Status

Completed

Noise and Drift

Tested Combination1	Front	SSL	/ Front	FID
Name:	7890			
Setpoint Status:	**Pass**			
Base Signal:	20.2	pA		

		ASTM Noise		Drift
		pA		pA/Hr
		0.05		0.50
Agilent Recommended:	<=	0.10	<=	2.50
Status:	Pass		Pass	

Overall Noise and Drift Test Status

Pass

Injection Precision

Tested Combination1	Front	SSL	/ Front	FID
Name	7683B			

Setpoint Status:	**Pass**			
Injection Volume on Column:	1.0	uL		
Area RSD:	0.52	%	Retention Time RSD:	0.22 %
Agilent Recommended:	<= 3.00			<= 1.00

Overall Injection Precision Test Status

Pass

Signal to Noise

Tested Combination1	Front	SSL	/ Front	FID
	Injection Tower			
Name:	7890			
Setpoint Status:	**Pass**			
Signal to Noise:	1258310			
Agilent Recommended:	>= 300000			

Overall Signal to Noise Test Status

Pass

Instrument Details

Purpose

This section describes the as found system configuration.

Details

System	
System ID	GC-5
Manufacturer	Agilent Technologies
Name	7890
Flow Data Input	Manual Data
Temperature Data Input	Manual Data or Other Data Logging
Tested Combination1	
Injection Technique	Injection Tower
Inlet	Front
Detector	Front
LTM Included?	No
Sampler 1	
Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7683B
Model Number	G2913A
Serial Number	CN00259643
Firmware Revision	A.11.03
Usage	Sample Injection
Location	Front
Syringe Volume (µL)	10
Sampler 2	
Manufacturer	Agilent Technologies
Type	Tray
Name	7683A
Model Number	G2614A
Serial Number	CN81347892
Firmware Revision	A.02.01

Mainframe 1

Manufacturer	Agilent Technologies
Name	7890
Model Number	G3440A
Serial Number	US10813027
Firmware Revision	A.01.12.1
Component ID/Asset No.	GC-5
Oven Type	Standard

Inlet 1

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

Detector 1

Manufacturer	Agilent Technologies
Name	7890
Type	FID
Adapter	Capillary
Control Type	Electronic Pressure Control (EPC)
Location	Front
Makeup Gas	Nitrogen

Electronic Signature

Purpose

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

Details

Full Name of Signer:	Suriya Thongkaew
Logged On User Name:	suriya.thongkaew@non.agilent.com
Signature Creation Date:	October 20, 2021
Reason for Signature:	Executed protocol and published this original version of document

Regulatory Disclaimer

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

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User Name: suriya.thongkaew System Id: GC-5
Hostname: ASDKKW7029 Print Date: October 20, 2021 10:16:00 AM

OQ GC ALS US10813027 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 19, 2021 10:37:29 AM	Audit	SessionCreated	Session	None
October 19, 2021 10:37:29 AM	Start	Configuration	Session	None
October 19, 2021 10:37:30 AM	Audit	Entitlement	Licensing	Session identifier generated. 0000-0002-0000-1YGP-0M4G
October 19, 2021 10:45:44 AM	Audit	Entitlement	Licensing	Successfully unlocked session identified by 0000-0002-0000-1YGP-0M4G with unlock code CZR6-QXE5-0GOD-6681-683G
October 19, 2021 10:57:00 AM	Audit	EcpLoaded	Session	EQP details for primary technique: [Gc] - File path: [ProtocolPacks/Gc/Configurations/Eqp.51/Gc.02.51.eqp]. EQP File Name: [Gc.02.51.eqp]. EQP Name: [AgilentRecommended].
October 19, 2021 10:58:11 AM	End	Configuration	Session	None
October 19, 2021 10:58:14 AM	Start	Qualification	Session	OQ
October 19, 2021 10:59:14 AM	Start	Execution	System Inspection and Basic Safety and Operation - 7890 - Qualitative Test - No setpoints associated	None
October 19, 2021 10:59:07 AM	End	Execution	System Inspection and Basic Safety and Operation - 7890 - Qualitative Test - No setpoints associated	Run Count: 1

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User Name: suriya.thongkaew System Id: GC-5
Hostname: ASDKKW7029 Print Date: October 20, 2021 10:16:00 AM

OQ GC ALS US10813027 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 19, 2021 11:11:55 AM	Start	Execution	Inlet Pressure Decay - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi	None
October 19, 2021 11:28:02 AM	End	Execution	Inlet Pressure Decay - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: >= -2.0 psi and <= 0.5 psi	Run Count: 1
October 19, 2021 11:28:06 AM	Start	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
October 19, 2021 11:28:15 AM	End	Execution	Inlet Pressure Accuracy - Front SSL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	Run Count: 1
October 19, 2021 11:28:17 AM	Start	Execution	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	None
October 19, 2021 11:45:30 AM	Audit	Data	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 19, 2021 11:45:36 AM	End	Execution	Detector Flow Accuracy - Front FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
October 19, 2021 11:45:38 AM	Start	Execution	Detector Flow Accuracy - Front FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	None
October 19, 2021 11:52:52 AM	Audit	Data	Detector Flow Accuracy - Front FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 19, 2021 11:52:54 AM	End	Execution	Detector Flow Accuracy - Front FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint	Run Count: 1

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User Name: suriya.thongkaew
Hostname: ASDKKW7029

System Id: GC-5
Print Date: October 20, 2021 10:16:00 AM

OQ GC ALS US10813027 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 19, 2021 11:52:55 AM	Start	Execution	Detector Flow Accuracy - Front FID - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	None
October 19, 2021 12:03:38 PM	Audit	Data	Detector Flow Accuracy - Front FID - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
October 19, 2021 12:03:39 PM	End	Execution	Detector Flow Accuracy - Front FID - Type : Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Run Count : 1
October 19, 2021 12:03:42 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
October 19, 2021 12:23:23 PM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
October 19, 2021 12:23:24 PM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count : 1
October 19, 2021 12:23:28 PM	Start	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	None
October 19, 2021 12:33:48 PM	Audit	Data	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Manual Data Entry
October 19, 2021 12:33:50 PM	End	Execution	GC Oven Temperature Accuracy - 7890 - Temperature : Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K	Run Count : 1

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User Name: suriya.thongkaew
Hostname: ASDKKW7029

System Id: GC-5
Print Date: October 20, 2021 10:16:00 AM

OQ GC ALS US10813027 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 19, 2021 12:33:53 PM	Start	Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	None
October 19, 2021 12:34:48 PM	Audit	Data	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Manual Data Entry
October 19, 2021 12:34:49 PM	End	Execution	GC Oven Temperature Stability - 7890 - Temperature : Oven - S: 100.0°C - L: <= 0.5°C	Run Count : 1
October 19, 2021 12:34:52 PM	Start	Execution	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	None
October 19, 2021 4:48:49 PM	Audit	AceClosed	Session	None
October 20, 2021 9:34:06 AM	Audit	AceRestarted	Session	None
October 20, 2021 9:34:08 AM	Audit	SessionReloaded	Session	None
October 20, 2021 9:34:12 AM	Start	Qualification	Session	OQ
October 20, 2021 9:34:12 AM	Start	Execution	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	None
October 20, 2021 9:35:51 AM	Audit	Data	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	Data files Path: C:\Chem32\1\DATA\OQPV2021\OQPV2021 2021-10-19 17-23-14\SCOUTING001.D\FID1A.ch

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User Name: suriya.thongkaew
Hostname: ASDKKW7029

System Id: GC-5
Print Date: October 20, 2021 10:16:00 AM

OQ GC ALS US10813027 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 20, 2021 9:36:24 AM	End	Execution	GC Scouting Run - Injection Tower, Front SSL, Front FID - Part of System Preparation - No limits associated	Run Count : 1
October 20, 2021 9:36:27 AM	Start	Execution	Noise and Drift - Front FID - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour	None
October 20, 2021 9:37:19 AM	Audit	Data	Noise and Drift - Front FID - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour	Data files Path: C:\Chem32\1\DATA\OQPV2021\OQPV2021 2021-10-19 17-23-14\NSDRFC001.D\FID1A.ch
October 20, 2021 9:37:30 AM	End	Execution	Noise and Drift - Front FID - Detector FID - L (Noise): <= 0.10 pA - L (Drift): <= 2.50 pA/hour	Run Count : 1
October 20, 2021 9:37:32 AM	Start	Execution	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%	None
October 20, 2021 9:37:53 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%	Data files Path: C:\Chem32\1\DATA\OQPV2021\OQPV2021 2021-10-19 17-23-14\INJPREC002.D\FID1A.ch
October 20, 2021 9:37:53 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%	Data files Path: C:\Chem32\1\DATA\OQPV2021\OQPV2021 2021-10-19 17-23-14\INJPREC003.D\FID1A.ch

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User Name: suriya.thongkaew
Hostname: ASDKKW7029

System Id: GC-5
Print Date: October 20, 2021 10:16:00 AM

OQ GC ALS US10813027 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 20, 2021 9:37:53 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%	Data files Path: C:\Chem32\1\DATA\OQPV2021\OQPV2021 2021-10-19 17-23-14\INJPREC004.D\FID1A.ch
October 20, 2021 9:37:53 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%	Data files Path: C:\Chem32\1\DATA\OQPV2021\OQPV2021 2021-10-19 17-23-14\INJPREC005.D\FID1A.ch
October 20, 2021 9:37:53 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%	Data files Path: C:\Chem32\1\DATA\OQPV2021\OQPV2021 2021-10-19 17-23-14\INJPREC006.D\FID1A.ch
October 20, 2021 9:37:53 AM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%	Data files Path: C:\Chem32\1\DATA\OQPV2021\OQPV2021 2021-10-19 17-23-14\INJPREC007.D\FID1A.ch
October 20, 2021 9:38:21 AM	End	Execution	Injection Precision - Injection Tower, Front SSL, Front FID - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%	Run Count : 1
October 20, 2021 9:38:28 AM	Start	Execution	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L: >= 300000	None
October 20, 2021 9:38:42 AM	Audit	Data	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L: >= 300000	Data files Path: C:\Chem32\1\DATA\OQPV2021\OQPV2021 2021-10-19 17-23-14\SIGTONS001.D\FID1A.ch
October 20, 2021 9:38:50 AM	End	Execution	Signal to Noise - Injection Tower, Front SSL, Front FID - Detector FID - L: >= 300000	Run Count : 1

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User Name: suriya.thongkaew
Hostname: ASBKKW7029

System Id: GC-5
Print Date: October 28, 2021 10:15:00 AM

OQ GC ALS US10813027 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
October 20, 2021 9:38:54 AM	End	Qualification	Session	OQ
October 20, 2021 9:38:54 AM	Start	Reporting	Session	None
October 20, 2021 10:15:14 AM	Audit	Reporting	Session	Report Generated Certificate

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Agilent Technologies
Agilent CrossLab

EQUIPMENT QUALIFICATION REPORT (EQR)

Agilent CrossLab Compliance

Qualification Type:	ICPMS-OQ
System ID:	JP15471169
EQP Name:	AgilentRecommended
EQP Revision:	ICPMS.02.50
EQP Publish Date:	March 2020
Date:	September 30, 2021 4:07:18 PM
Report Type:	Report
Org. Name:	ALS Laboratory Group (Thailand) Co.,Ltd.
Org. Location:	104 Phattanakarn 40, Suan Luang, Bangkok 10250.

REVIEW BY Sophon M.
APPROVED BY Somtri N.
NEXT CAL. DATE 29 March 2023

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Test Summary

Purpose

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

Details

Test	Status	Runs
Autosampler Check : SPS4	Pass	1
Integrated Sample Introduction System (ISIS) Check : ISIS3	Pass	1
Autotune : G8403A	Pass	1
Background (No Gas Mode) : G8403A	Pass	1
Background (Gas Modes) : G8403A	Pass	1
20-Minute Stability (No Gas Mode) : G8403A	Pass	1

Overall Qualification Status

Pass

Service Details

Purpose

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

General Details

Service Order No./Request:	6004837154
EQP Name:	AgilentRecommended
EQP Revision:	ICPMS.02.50
Report Type:	Report

Organization Details

Name:	ALS Laboratory Group (Thailand) Co.,Ltd.
Location:	104 Phattanakarn 40, Suan Luang, Bangkok 10250.

Local Contact Details

Name:	Chatchanai Komarakul.
Job Title:	Manager
Qualification Location:	Laboratory

Operator Details

Name:	Panthep Kurasathoin
Job Title:	Field Service Engineer.

Data Acquisition Details

Acquisition Software Name:	MassHunter
Acquisition Software Revision:	C.01.04
Customer Data System (CDS):	IcpMs: MassHunter

Instrument Details

Purpose

This section describes the as found system configuration.

Details

ICP-MS 1

Manufacturer	Agilent Technologies
Name	7900
Model Number	G8403A
Installed Options	#100H: Standard Package with Hydrogen option
Detector Type	SQ
Nebulizer	Mira Mist (G3161)
Spray Chamber	Quartz
Torch	Quartz
Sampling Cone	Ni
Skimmer Cone	Ni
Serial Number	JP15471169
Firmware Revision	C.01.04

ISIS 1

Manufacturer	Agilent Technologies
Name	ISIS3
Model Number	G8411A
Type	Peristaltic pump system
Serial Number	JP15510227

Autosampler 1

Manufacturer	Agilent Technologies
Name	SPS4
Model Number	G8410A
Serial Number	AU15430722

Chiller 1

Manufacturer	Agilent Technologies
Name	Chiller
Model Number	G3292A
Serial Number	3U1610713

Calculation Formulas

Purpose

This section includes calculation formulas for all available tests. Depending upon which tests are scheduled, all or some apply to your qualification.

For a description of calculations for ICP-MS tests performed by the MassHunter software, refer to the MassHunter application and documentation.

Protocol Details

Purpose

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

Test Revision	Test
ICPMS.02.50	20-Minute Stability (No Gas Mode)
ICPMS.02.50	Autosampler Check
ICPMS.02.50	Autotune
ICPMS.02.50	Background (Gas Modes)
ICPMS.02.50	Background (No Gas Mode)
ICPMS.02.50	Integrated Sample Introduction System (ISIS) Check

Autosampler Check

Purpose

This test demonstrates that the autosampler module is correctly installed and connected. It does not test module performance.

Setpoint

Results

Criteria	Observed Result	Expected Result	Status
After the self test, is probe in the home position?	Yes	Yes	Pass
As commanded, is the probe positioned at vial 2?	Yes	Yes	Pass

Setpoint Status: Pass Runs: 1

Overall Autosampler Check Test Status

Pass

Integrated Sample Introduction System (ISIS) Check

Purpose

This test demonstrates that the ISIS module is correctly installed and connected. It does not test module performance.

Setpoint

Results

Criteria	Observed Result	Expected Result	Status
As commanded, does the pump rotate?	Yes	Yes	Pass
As commanded, do the valves load and inject?	Yes	Yes	Pass

Setpoint Status: Pass Runs: 1

Overall Integrated Sample Introduction System (ISIS) Check Test Status

Pass

Autotune

Purpose

This test uses traceable checkout standards to run a software-executed autotune in all modes. The tune report provides values for peak width, mass axis, sensitivity, oxide species, and doubly-charged species tests.

Setpoint

Results

Peakwidth Mass 7		0.719	AMU
Agilent Recommended:	>=	0.65	
	<=	0.80	
Status:	Pass		
Peakwidth Mass 89		0.750	AMU
Agilent Recommended:	>=	0.65	
	<=	0.80	
Status:	Pass		
Peakwidth Mass 205		0.713	AMU
Agilent Recommended:	>=	0.65	
	<=	0.80	
Status:	Pass		
Mass Axis 7		7.05	AMU
Agilent Recommended:	>=	6.9	
	<=	7.1	
Status:	Pass		
Mass Axis 89		88.95	AMU
Agilent Recommended:	>=	88.9	
	<=	89.1	
Status:	Pass		
Mass Axis 205		205.00	AMU
Agilent Recommended:	>=	204.9	
	<=	205.1	
Status:	Pass		

Mass 7 Sensitivity No Gas		94.28	Mcps/ppm
Agilent Recommended:	>=	25.5	
Status:	Pass		
Mass 89 Sensitivity No Gas		307.15	Mcps/ppm
Agilent Recommended:	>=	127.5	
Status:	Pass		
Mass 205 Sensitivity No Gas		203.77	Mcps/ppm
Agilent Recommended:	>=	76.5	
Status:	Pass		
Mass 59 Sensitivity He		28.38	Mcps/ppm
Agilent Recommended:	>=	23.8	
Status:	Pass		
Mass 89 Sensitivity H2		129.27	Mcps/ppm
Agilent Recommended:	>=	.68	
Status:	Pass		
Oxide Ratio 156/140		1.047	%
Agilent Recommended:	<=	1.38	
Status:	Pass		
Doubly Charged Species Ratio 70/140		1.482	%
Agilent Recommended:	<=	2.3	
Status:	Pass		

Setpoint Status: Pass Runs: 1

Overall Autotune Test Status

Pass

Background (No Gas Mode)

Purpose

This test examines the background of the ICP-MS in no gas mode by monitoring ions during a blank run.

Setpoint

Conditions

Masses:	7	AMU
	89	AMU
	205	AMU

Measurements and Results

Masses (AMU):	7	89	205	
Measured Value:	3.200	3.300	9.900	cps
Agilent Recommended:	<= 6.9	<= 4.6	<= 11.5	
Status:	Pass	Pass	Pass	

Setpoint Status: Pass Runs: 1

Overall Background (No Gas Mode) Test Status

Pass

Background (Gas Mode)

Purpose

This test examines the background of the ICP-MS in the various gas modes by monitoring ions during a blank run.

Setpoint Gas Mode: Helium

Conditions

Mass:	78	AMU
Integration Time:	1.0	sec
Cycles:	20	

Measurements and Results

Mass (AMU):		78	
Measured Value:		42.8500	cps
Agilent Recommended:	<=	115	
Status:		Pass	

Setpoint Status: Pass Runs: 1

Setpoint Gas Mode: Hydrogen

Conditions

Mass:	78	AMU
Integration Time:	1.0	sec
Cycles:	20	

Measurements and Results

Mass (AMU):		78	
Measured Value:		2.1500	cps
Agilent Recommended:	<=	4.6	
Status:		Pass	

Setpoint Status: Pass Runs: 1

Overall Background (Gas Mode) Test Status

Pass

20-Minute Stability (No Gas Mode)

Purpose

This test monitors the abundance of ions present in the checkout standard over a 20-minute period to verify that the signal is stable. The %RSD of the abundance of given ions is calculated internally by the software and compared to the limit.

Setpoint

Conditions

Mode:	Spectrum	
Masses:	7, 9, 59, 89, 140, 205	
Integration Time:	9.99	sec
Peak Pattern:	3	points/peak
Repetitions:	20	
Sweeps/Replicates:	100	

Measurements and Results

Masses (AMU):	7	89	205	
Stability RSD:	0.98400	0.51495	0.73011	%
Agilent Recommended:	<= 2.3	<= 2.3	<= 2.3	
Status:	Pass	Pass	Pass	

Setpoint Status: Pass Runs: 1

Overall 20-Minute Stability (No Gas Mode) Test Status

Pass

Declaration of Change Control

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

Attachments

Training requirements note: The delivery engineer attaches an ACE technique-specific training certificate to the Equipment Qualification Report (EQR). Obtaining ACE technique-specific certification includes pre-requisite trainings for Data Integrity, General Compliance topics (GMP, GLP, ALCOA, etc.), instrument hardware and software components, and the ACE technique itself. The one certificate encompasses all pre-requisite trainings as documented in the Agilent Learning Management System called Success Factors.

Location	Category	Document Name	Page
EQR	General	Certificate of System Qualification	18
EQR	General	Operator's training certificate and qualifications	19
EQR	General	Certificate of Qualification for ACE	20
EQR	General	Certificate of Qualification for ACE	21
EQR	General	Tune reports	22
EQR	General	Test Report	25
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EQR	General	Test Report	29

General

Document Name: Certificate of System Qualification

Agilent Technologies

Agilent Compliance Engine Self Qualification

Date: September 14, 2021 4:59:16 PM
Drive Serial #: ACA025C9 Platform Revision: ACE 3.11

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

Technique Type	Tests Completed	Result
Atomic Absorption	7	Conforms
Capillary Electrophoresis	10	Conforms
Dissolution	6	Conforms
Emission Spectroscopy	3	Conforms
Gas Chromatography - GCMS	17	Conforms
Gas Chromatography	29	Conforms
Gel Permeation Chromatography	9	Conforms
ICP-MS	6	Conforms
Infrared Spectroscopy	7	Conforms
Liquid Chromatography	17	Conforms
Liquid Chromatography - LCMS	6	Conforms
Microfluidics	18	Conforms
Sample Preparation - Gas Chromatography	9	Conforms
Sample Preparation - Liquid Chromatography	8	Conforms
Supercritical Fluid Chromatography	15	Conforms
Software	6	Conforms
UV-Vis Spectrophotometer	13	Conforms

Overall Qualification Status
Conforms

General

Document Name: Operator's training certificate and qualifications

Agilent Technologies

Certificate of Completion

Learner Name: Panthep Kumsathain

Title Of Course: AN-CE-ICPMS-2-038-A:Agilent 7900 ICPMS ISE update training

Completion Date: June 7, 2014

Certified By Company: Learning at Agilent

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

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

General

Document Name: Certificate of Qualification for ACE

Agilent Technologies

Certificate of Completion

Learner Name: Panthep Kurasathain

Title Of Course: AN-CE-SS-II-030-A: ACE 3.X User Update Training

Completion Date: July 7, 2020

Certified By Company: Learning at Agilent

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

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

General

Document Name: Certificate of Qualification for ACE

Agilent Technologies

Certificate of Completion

Learner Name: Panthep Kurasathain

Title Of Course: AN-CE-ICPMS-2-035-B: CrossLab Compliance Hardware Specific Delivery for Agilent ICP-MS Systems

Completion Date: October 31, 2020

Certified By Company: Learning at Agilent

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

A certificate for Service and Support training is only valid while employed by Agilent Technologies or while working as an Agilent-authorized service provider, through which the service employee has ongoing access to Agilent's: Safety Alerts, Service Notes, internal technical updates, update training, current documentation, technical support, current parts, and parts updates. Completion of training alone, without being employed by Agilent Technologies, does not qualify an individual to safely install, service or maintain Agilent products.

General

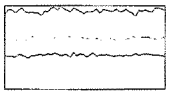
Document Name: Tune reports

Tune Report

Operator Name	Supakwan Mak
Acq/Data Batch	C:\Agilent\ICPMH\1\User\Tune_2\K3.b
Acq. Date-Time	2021-09-30 14:44:08
Report Comment	OG 30 Sep 2021
Instrument Name	G8403A JP15471169

[No Gas]

Sensitivity



Mass	Range	Count	RSD%	Background
7	10000	9428	2.620	3.206
89	50000	30718	1.625	3.308
205	50000	26377	3.315	5.500

Sampling Period [sec] 0.311
Integration Time [sec] 0.1

Oxide/Doubly Charged Ratio

Oxide	156 / 140	1.047 %
Doubly Charged	70 / 140	1.482 %

Resolution/Axis

Mass	Peak Height	Axis	W-50%	W-10%
7	9474.49	7.00	0.53	0.918
89	58118.43	89.00	0.63	0.750
205	25016.12	205.00	0.52	0.913

Integration Time [sec] 0.1
Acquisition Time [sec] 22.74
Y Axis Linear

Tune Parameters

Plasma Parameters

Plasma Mode	—	Nebulizer Gas	1.00 L/min	Makeup Gas	0.10 L/min
RF Power	1550 W	Option Gas	—	Auxiliary Gas	0.90 L/min
RF Matching	1.10 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	9.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	9.1 V	Deflect	13.6 V
Extract 2	-205.0 V	Cell Entrance	-30 V	Plate Bias	-35 V
Omega Bias	-90 V	Cell Exit	-50 V		

Cell Parameters

Use Gas	No	3rd Gas Flow	—	Energy Discrimination 5.0 V	
He Flow	0.0 mL/min	OctP Bias	-8.0 V		

1 of 3 2021-09-30 2:44 PM

Document Name: Tune reports

Tune Report

H2 Flow	0.0 mL/min	OctP RF	190 V		

OP Parameters

Mass Gain	124	Axis Gain	0.9990	OP Bias	-3.0 V
Mass Offset	125	Axis Offset	0.01		

Hardware Settings

Torch

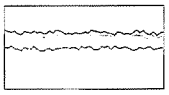
Torch H	-0.3 mm	Torch V	0.1 mm

EM

Discriminator	4.0 mV	Analog HV	2247 V	Pulse HV	1318 V

[H2]

Sensitivity



Mass	Range	Count	RSD%	Background
89	1000	2453	3.423	0.400
89	50000	12537	2.823	0.303
205	20000	13835	2.445	0.701

Sampling Period [sec] 0.31
Integration Time [sec] 0.1

Oxide/Doubly Charged Ratio

Oxide	156 / 140	0.624 %
Doubly Charged	70 / 140	1.020 %

Tune Parameters

Plasma Parameters

Plasma Mode	—	Nebulizer Gas	1.00 L/min	Makeup Gas	0.10 L/min
RF Power	1550 W	Option Gas	—	Auxiliary Gas	0.90 L/min
RF Matching	1.10 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	9.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	9.0 V	Deflect	6.0 V
Extract 2	-210.0 V	Cell Entrance	-30 V	Plate Bias	-100 V
Omega Bias	-105 V	Cell Exit	-60 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	—	Energy Discrimination 3.5 V	
He Flow	0.0 mL/min	OctP Bias	-22.0 V		
H2 Flow	5.0 mL/min	OctP RF	200 V		

OP Parameters

Mass Gain	124	Axis Gain	0.9993	OP Bias	-18.5 V
Mass Offset	125	Axis Offset	0.01		

Hardware Settings

Torch

Torch H	-0.3 mm	Torch V	0.1 mm

2 of 3 2021-09-30 2:44 PM

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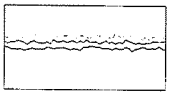
Document Name: Tune reports

Tune Report

EM
Discriminator 4.0 mV Analog HV 2247 V Pulse HV 1318 V

[Hz]

Sensitivity



Mass	Range	Count	RSD %	Background
59	9000	2938	2.502	6.000
89	9000	3149	3.556	5.300
205	20000	9437	2.885	4.291

Sampling Period [sec] 0.31
Integration Time [sec] 0.1

Doble/Doubly Charged Ratio
Doble 156 / 140 0.438 %
Doubly Charged 70 / 140 0.785 %

Tune Parameters

Plasma Parameters

Plasma Mode	--	Nebulizer Gas	1.00 L/min	Makeup Gas	0.10 L/min
RF Power	1550 W	Optical Gas	--	Auxiliary Gas	0.90 L/min
RF Matching	1.10 V	Nebulizer Pump	0.10 rps	Plasma Gas	15.0 L/min
Sample Depth	9.0 mm	S/C Temp	2 °C		

Lens Parameters

Extract 1	0.0 V	Omega Lens	9.2 V	Deflect	12.4 V
Extract 2	-255.0 V	Cell Entrance	-20 V	Plate Bias	-100 V
Omega Bias	-105 V	Cell Exit	-50 V		

Cell Parameters

Use Gas	Yes	3rd Gas Flow	--	Energy Discrimination	3.5 V
He Flow	3.8 mL/min	OctP Bias	-8.0 V		
H2 Flow	0.0 mL/min	OctP RF	200 V		

QP Parameters

Mass Gain	124	Axis Gain	0.9993	QP Bias	-4.5 V
Mass Offset	125	Axis Offset	0.01		

Hardware Settings

Torch

Torch H	-0.3 mm	Torch V	0.1 mm

EM
Discriminator 4.0 mV Analog HV 2247 V Pulse HV 1318 V

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General

Document Name: Test Report

Batch Summary Report

Batch Folder: D:\Batch\2021\0\5G He.b\
Analysis File: 5G He.batch.b\n
Tune Step: #1 He

	Rpt	Acq. Date-Time	Data File	Sample Name	Type	Level	Dilution
1		2021-09-30 14:21:47	5G He.d	5G He	Sample		1.0000

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Document Name: Test Report

Batch Summary Report

Analyte Table

		78 [He]
	Sample Name	CPS
1	5G He	42.8500

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General

Document Name: Test Report

Batch Summary Report

Batch Folder: D:\Agilent Service\DO 30 Sep 2021\5G H2 new.b\
Analysis File: 5G H2 new.batch.b\n
Tune Step: #1 H2

	Rpt	Acq. Date-Time	Data File	Sample Name	Type	Level	Dilution
1		2021-09-30 15:08:58	5G H2.d	5G H2	Sample		1.0000

Page 1 / 2 2021-09-30 15:10:31

Document Name: Test Report

Batch Summary Report

Analyte Table

		78 : M2 :
	Sample Name	CPS
1	BG H2	2.1500

Page 2 / 2 2021-09-30 15:10:31

General

Document Name: Test Report

Batch Summary Report

Batch Folder: D:\Agilent Service\DQ 30 Sep 2021\20 Min\
Analysis File: 20 Min batch.bin
Tune Step: #1 No Gas

	Rpt	Acq. Date-Time	Data File	Sample Name	Type	Level	Dilution
1		2021-09-30 15:17:44	20 Min.d	20 Min	Sample		1.0000

Page 1 / 2 2021-09-30 15:46:42

Document Name: Test Report

Batch Summary Report

Analyte Table

		7 : No Gas 1	9 : No Gas 1	59 : No Gas 1	89 : No Gas 1	140 : No Gas 1	205 : No Gas 1
	Sample Name	CPS RSD	CPS RSD	CPS RSD	CPS RSD	CPS RSD	CPS RSD
1	20 Min	0.56400	7.02464	0.45957	0.51405	0.61214	0.73011

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Electronic Signature

Purpose

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

Details

Full Name of Signer:	Panthep Kurasathain
Logged On User Name:	panthep_kurasathain@agilent.com
Signature Creation Date:	September 30, 2021
Reason for Signature:	Executed protocol and published this original version of document

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User Name: panthep_kurasathain
Hostname: ASDKKWX315

System Id: JP15471169
Print Date: September 30, 2021 4:07:22 PM

ALS OQHW 7900 30Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 30, 2021 3:50:07 PM	Audit	SessionCreated	Session	None
September 30, 2021 3:50:07 PM	Start	Configuration	Session	None
September 30, 2021 3:50:07 PM	Audit	Entitlement	Licensing	User is FieldEngineer and does not require an unlock code
September 30, 2021 3:52:52 PM	Audit	EcpLoaded	Session	EQP details for primary technique [icpMs] - File path: [Protocol Packs/cpMs/Configurations/02.50/icpMs.02.50.ecp]. EQP File Name: [icpMs.02.50.ecp]. EQP Name: [AgilentRecommended]
September 30, 2021 3:52:54 PM	End	Configuration	Session	None
September 30, 2021 3:52:57 PM	Start	Qualification	Session	OQ
September 30, 2021 3:52:57 PM	Start	Execution	Autosampler Check : SPS4: Autosampler Check	None
September 30, 2021 3:53:03 PM	End	Execution	Autosampler Check : SPS4: Autosampler Check	Run Count : 1
September 30, 2021 3:53:04 PM	Start	Execution	Integrated Sample Introduction System (ISIS) Check : ISIS3: Integrated Sample Introduction System (ISIS) Check	None
September 30, 2021 3:53:06 PM	End	Execution	Integrated Sample Introduction System (ISIS) Check : ISIS3: Integrated Sample Introduction System (ISIS) Check	Run Count : 1

Page 1 / 3

User Name: panthep_kurasathain
Hostname: ASDKKWX315

System Id: JP15471169
Print Date: September 30, 2021 4:07:22 PM

ALS OQHW 7900 30Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 30, 2021 3:53:10 PM	Start	Execution	Autotune : G8403A: Autotune 1	None
September 30, 2021 3:55:08 PM	End	Execution	Autotune : G8403A: Autotune 1	Run Count : 1
September 30, 2021 3:55:12 PM	Start	Execution	Background (No Gas Mode) : G8403A: No Gas Mode Background 1	None
September 30, 2021 3:55:40 PM	End	Execution	Background (No Gas Mode) : G8403A: No Gas Mode Background 1	Run Count : 1
September 30, 2021 3:55:43 PM	Start	Execution	Background (Gas Modes) : G8403A: Gas Mode Background :Helium	None
September 30, 2021 3:56:17 PM	End	Execution	Background (Gas Modes) : G8403A: Gas Mode Background :Helium	Run Count : 1
September 30, 2021 3:56:19 PM	Start	Execution	Background (Gas Modes) : G8403A: Gas Mode Background :Hydrogen	None
September 30, 2021 3:56:39 PM	End	Execution	Background (Gas Modes) : G8403A: Gas Mode Background :Hydrogen	Run Count : 1
September 30, 2021 3:56:41 PM	Start	Execution	20-Minute Stability (No Gas Mode) : G8403A: 20-Minute Stability (No Gas Mode) 1	None
September 30, 2021 3:57:22 PM	End	Execution	20-Minute Stability (No Gas Mode) : G8403A: 20-Minute Stability (No Gas Mode) 1	Run Count : 1
September 30, 2021 3:57:24 PM	End	Qualification	Session	OQ
September 30, 2021 3:57:24 PM	Start	Reporting	Session	None

Page 2 / 3

User Name: panthep_kurasathain
Hostname: ASDKKWX315

System Id: JP15471169
Print Date: September 30, 2021 4:07:22 PM

ALS OQHW 7900 30Sep21 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
September 30, 2021 4:03:07 PM	Audit	Reporting	Session	Report Generated : Certificate
September 30, 2021 4:03:17 PM	Audit	Reporting	Session	Report Generated : Report
September 30, 2021 4:03:59 PM	Start	Qualification	Session	OQ
September 30, 2021 4:04:08 PM	End	Qualification	Session	OQ
September 30, 2021 4:04:08 PM	Start	Reporting	Session	None
September 30, 2021 4:04:26 PM	Audit	Reporting	Session	Report Generated : Certificate
September 30, 2021 4:04:36 PM	Audit	Reporting	Session	Report Generated : Report

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Metrological Center
SCI ECO Services Company Limited
SCG CEMENT-BUILDING MATERIALS
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
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

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
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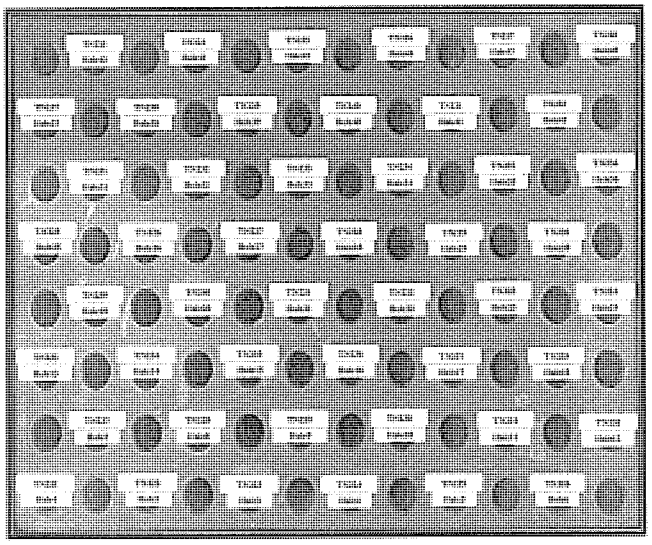
Calibration Report



FRONT CONTROL

Approved By.

Metrological Center
SCI ECO Services Company Limited
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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	95.34	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.

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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.

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Calibration Report

Measurement Results:

HEATING BLOCK			Temperature Distribution	
Setting (°C)	Reading (°C)		Stability (±°C)	Uncertainty (±°C)
	Min , Max	Average		
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.

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Bangkok Tel : +668 9205 6851 , +669 8247 2360
Website : www.scieco.co.th E-Mail : calibrate@scg.co.th
NSC-TISI-TIS 17025 CALIBRATION 0244

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%.

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Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.
NSC-TISI-TIS 17025 CALIBRATION 0244

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 :

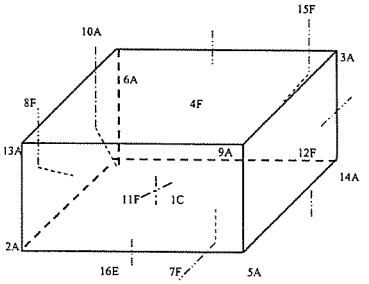
Instrument	Model	Instrument No.	Certificate No.	Due Date
TC	TYPE T	TN161-TN170	T210009	30 July 2022
TC	TYPE T	TN171-TN180	T210009	30 July 2022
DATA LOGGER	34970A	T149	T210009	30 July 2022

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.

Metrological Center
SCI ECO Services Company Limited
33/2 Moo 3, T.Banpa, A.Kaengkhoi, Saraburi 18110, Thailand.
NSC-TISI-TIS 17025 CALIBRATION 0244

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.